APPENDIX Q

NAVAL BASE CORONADO BIRD/ANIMAL AIRCRAFT STRIKE HAZARD PLAN

DEPARTMENT OF THE NAVY
NAVAL BASE CORONADO
BOX 357033
SAN DIEGO, CALIFORNIA 92135-7033

IN REPLY REFER TO:
NBCINST 3750.4A
N3
SEP 26 2012

NAVAL BASE CORONADO INSTRUCTION 3750.4A

Subj: BIRD/ANIMAL AIRCRAFT STRIKE HAZARD (BASH) PROGRAM

Ref: (a) OPNAVINST 3750.6
(b) OPNAVINST 3710.7
(c) OPNAVINST 5090.1
(d) CNICINST 3700
(e) CNIC BASH Program Manual
(f) NBCINST 3710.7 (Series)
(g) NBC BASH Plan
(h) NALFSCIINST 3710.7
(i) BASH Support for NBC (USDA Wildlife Services/Navy Agreement)
(j) DoD Flight Information Publication (En route) Flight Information Handbook
(k) NAVFAC P-73, Vol. II
(l) Integrated Natural Resources Management Plan for NBC

1. Purpose. To establish policy and procedures for a Bird/Animal Aircraft Strike Hazard (BASH) program per references (a) through (l).

2. Cancellation. NBCINST 3750.4

3. Background. The goals of the guidance contained in this instruction are to increase the reporting and identification of strike events and to reduce BASH incidences at Naval Air Station North Island (NASNI), Naval Outlying Landing Field Imperial Beach (NOLF IB), Naval Auxiliary Landing Field San Clemente Island (NALF SCI), and Naval Amphibious Base Coronado (NAB) Turner Field helicopter pad. These goals can be accomplished by reducing the quality and attractiveness of those airfields as habitats for identified problem wildlife, managing wildlife populations to minimize the potential for aircraft strikes, and coordination between tenant commands and air operations personnel to improve the reporting and communications on both wildlife management and aircraft strikes.

4. Policy

a. Commander, Navy Installations Command (CNIC) is the Executive Agent, Budget Submitting Office, Program Manager, and Single Process Integrator for executing, monitoring and sustaining the BASH program at all CNIC installations that conduct or support air operations.

b. This instruction is applicable to all NBC tenant commands.

c. All Navy flying units that are tenants of Naval Base Coronado (NBC) shall report bird/wildlife strikes of known origin (e.g., bird remains found on an aircraft, bird remains found on the runway and correlated to a specific aircraft) in accordance with reference (a) and collect/forward remains in accordance with Appendix 1 of reference (d).

5. Responsibilities

a. The NBC Commanding Officer (CO) is overall responsible for execution and oversight of the NBC BASH program.

b. The Air Operations Officer is the BASH program manager.

c. The Public Works Officer (PWO) is responsible for ensuring the BASH program is supported by routine facility support services, maintenance, and management.

d. The Environmental Program Director (EPD) is responsible for ensuring the BASH program is compliant with all applicable state and federal environmental laws and regulations, and all applicable Department of Defense (DoD), Department of the Navy (DON), and U.S. Navy environmental policies, directives, and instructions.

e. Natural Resource Managers (NRM) are responsible for ensuring BASH programs are addressed in the installation Integrated Natural Resources Management Plan (INRMP) and compliant with all applicable state and federal natural resource laws and regulations as well as all applicable DoD, DON, and U.S. Navy environmental policies, directives, and instructions related to natural resources.

6. Action

a. NBC Air Operations Officer shall:

(1) Organize and chair all quarterly Bird Hazard Working Group (BHWG) meetings and schedule additional BHWG meetings as necessary to address emergent BASH issues that may threaten daily flight operations.

(2) Be responsible for execution oversight of BASH plan and serve as central point of contact for coordination and planning with other departments, tenants, and the local community.

(3) Oversee BASH related issues at NASNI, NOLF IB, NALF SCI, and NAB Turner Field.

(4) Establish a Web Enabled Safety System (WESS) account for the mandatory reporting of all BASH incidents and assist aircraft reporting custodians in their efforts to report strikes and forward remains.

(5) Conduct periodic reviews of the BASH program using the self-inspection checklist per reference (e) appendix 9.

(6) Maintain the following databases: All bird/animal aircraft strikes, locations of hazardous bird/animal activity, monthly bird/animal numbers including runway crossings and locations.

(7) Distribute BASH data to members of BHWG, wings, squadrons, field operation personnel and others working in the airfield environment in order to analyze data for development of future BASH reduction management strategies.

(8) Recommend aircraft operational and maintenance changes to avoid areas and times of known hazardous bird concentrations.

(9) Ensure the BASH program is discussed at Aviation Safety Council meetings, considered during the planning of aerial activities held at NAS North Island (air shows), and is part of the safety review conducted by the Naval Safety Center.

(10) Keep current on present and emerging BASH issues and management technologies by attending BASH conferences, workshops or symposiums and be familiar with BASH resources, such as the BASH points of contact for the Navy BASH program, BASH related documents, and sources of supply for BASH management devices.

(11) Provide local oversight of the United States Department of Agriculture (USDA) Wildlife Biologist and ensure regular coordination of efforts and strike identification with Natural Resource Office (NRO).

(12) Monitor bird attractant vegetation, grass height, foliage growth, drainage ditches, persistent standing water, etc., and report problems to the Public Works Department and Environmental Department.

(13) Request and maintain funding in support of the BASH plan and personnel assigned to conduct BASH program activities.

b. NBC Public Works Officer shall:

(1) Designate a representative to the Bird Hazard Working Group (BHWG) and participate in on-site technical reviews of installation BASH program during periodic Naval Safety Center Surveys.

(2) Ensure the implementation of BHWG proposed projects approved by the CO to reduce wildlife and bird hazardous conditions on and around the airfield.

(3) Maintain the lateral and approach zones of the runway complexes of NASNI, NOLF IB, and NOLF SCI in a manner that is least attractive to birds (e.g. mowing, vegetation, and landscape management), based upon recommendations from the BHWG.

(4) Manufacture and place signs in appropriate locations around the airfield that inform and educate the public to the potential hazards of wildlife, specifically birds, to aircraft operations.

(5) Ensure all trash, road-kill, and other bird/animal attractants found on base are policed.

(6) Ensure all trash receptacles near the PSA are kept covered and are emptied regularly to prevent overflow and be less attractive to birds/animals.

(7) Keep current on present and emerging BASH issues through BASH training programs.

(8) Ensure BASH projects that exceed local approval authority are submitted to CNIC.

c. Commander Navy Region Southwest Environmental Department shall:

(1) NBC Environmental Program Director (EPD)

(a) Participate in on-site technical reviews of NBC BASH program during periodic Naval Safety Center reviews.

(b) Ensure BASH program is in compliance with all applicable environmental laws and policies.

(c) Initiate necessary environmental documentation for implementation of BASH management practices.

(2) NBC Natural Resources Manager (NRM)

(a) Ensure BASH program is planned in compliance with the NBC Integrated Natural Resources Management Plan (INRMP) and all applicable state and federal natural resources laws and regulations. Coordinate INRMP updates with air operations department.

(b) Participate in on-site technical reviews of NBC BASH program during periodic Naval Safety Center reviews.

(c) If requested, participate as co-chair of the BHWG.

(d) Oversee and conduct ongoing avian/airfield surveys and provide data and analysis to the BHWG.

(e) Develop the following NBC databases for Naval Base Coronado: all bird/animal aircraft strikes, locations of hazardous bird/animal activity, and monthly bird/animal numbers including runway crossings and locations.

(f) Coordinate and manage all applicable natural resources consultations and permits to support the BASH program.

(g) Develop and coordinate studies, as necessary, to document wildlife hazards and evaluate the effects of BASH management activities and its impacts on bird populations on and around the airfield.

(h) Support the NBC Wildlife Hazard Assessment (WHA) and ensure data collected is able to be reproduced for annual monitoring and reporting requirements.

(i) Communicate BASH related information with operational personnel conducting BASH management activities.

(j) Disseminate pertinent information monthly to air operations on current and forecasted bird hazards, BASH monitoring and management activity, and other BASH related issues.

(k) Oversee and manage BASH related issues at NASNI, NOLF IB, NALF SCI, and NAB Turner Field.

(l) Ensure BASH program elements consider sustainable land management practices, adaptive management, and scientifically sound monitoring techniques.

(m) Coordinate with the air operations-funded USDA wildlife biologist.

(n) Assist with strike identifications.

(o) Maintain BASH expertise by keeping current with present and emerging BASH issues and management technologies by attending BASH conferences, workshops or symposiums and familiarity with BASH resources, such as the BASH points of contact for the Navy BASH program, BASH related documents, and sources of supply for BASH management devices.

d. Air Traffic Control (ATC) Division shall:

(1) Designate a representative to the BHWG.

(2) Declare Bird Watch Conditions (BWC) based on reported sightings or criteria per reference (j). ATC Supervisor will have the responsibility of downgrading a BWC of SEVERE once updated information is available.

(3) Alert BASH contractor and/or Airfield Operations personnel of bird or animal watch conditions that require dispersal procedures.

(4) Allow BASH contractor priority movement on the airfield to investigate or disperse birds or animals on or around the airfield.

(5) Include BWC and bird advisory information in Automated Terminal Information Service (ATIS) broadcasts, update as necessary.

(6) Establish a training program covering BASH for all ATC personnel (document and review training annually).

(7) Keep current of BASH issues through BASH training programs.

e. Morale, Welfare and Recreation Department shall:

(1) Designate a representative to the BHWG.

(2) Report wildlife, specifically bird activity, on Morale, Welfare and Recreation (MWR) facilities, i.e. golf course, softball fields, etc., to the Air Operations Officer that could be hazardous to aircraft operations.

(3) Ensure implementation of BHWG proposed projects approved by the CO to reduce bird and animal watch conditions at MWR facilities near the airfield.

(4) Keep current of present and emerging BASH issues through BASH training programs.

(5) Manage habitats on golf course to reduce wildlife, specifically bird activity that might pose a hazard to aircraft.

f. USDA - Wildlife Services, Wildlife Biologist shall:

(1) Provide a representative to the BHWG.

(2) Through CNIC headquarters funding, provide at least one full-time person operating on a flexible work schedule of 80 hours/pay period (every two weeks) to conduct BASH activities on NASNI, NOLFIB, NALF SCI, and NAB Turner Field. Generally, daily activities will be conducted during daylight hours on weekdays for approximately six to ten hours/day, however night and weekend activities may be necessary should hazardous conditions occur during aircraft operations within the PSA.

(3) Conduct daily surveys of wildlife, specifically bird activity, on and around the airfield and maintain a daily log/database of these surveys.

(4) Conduct BASH management operations for the purpose of identifying and managing wildlife (birds and animals) that are hazardous to aircraft operations.

(5) Make the BWC reports to the tower and recommend changes that occur in the watch when the BASH contractor is patrolling the airfield.

(6) Use an Integrated Wildlife Damage Management (IWDM) approach to managing wildlife, specifically birds which pose a BASH hazard to aircraft operations.

(7) Communicate frequently (daily or weekly) with Air Operations, NRO and airfield operational personnel regarding BASH management activities or issues.

(8) Report all bird strikes to the Air Operations Officer/ASO and NRO.

(9) Ensure that wildlife remains found are collected, location noted, bagged, and stored in a centralized BASH freezer at the NASNI Air terminal.

(10) Keep current of BASH management technologies by attending BASH conferences, workshops or symposiums and maintain familiarity with BASH resources, such as the BASH point of contact for the Navy BASH program, BASH related documents, and sources of supply for BASH management devices.

7. Bird Hazard Working Group (BHWG). The NBC BHWG was formed to better communicate information about the BASH program and coordinate BASH related issues. This group was created to share pertinent information that can be used to recommend actions and changes in operations to reduce the BASH within the NBC complex. The BHWG is organized to implement and monitor the BASH program and will meet quarterly or more often as necessary. The Commanding Officer is the approval authority for all BHWG recommendations. The group shall have a representative assigned from the following specialties:

a. NBC Air Operations Officer (Chairperson)

b. Commander, Navy Region Southwest, Environment Department

c. NASNI Airfield Manager

d. NASNI Air Traffic Control Division

e. NOLF IB Airfield Manager

f. NOLF IB Air Traffic Division

g. NALF SCI Airfield Operations Department

h. Public Works Department

i. Morale, Welfare and Recreation Department

j. BASH Program Personnel - USDA, Wildlife Services

k. NBC Community Plans and Liaison Officer (CPLO)

l. NBC Public Affairs Officer (PAO)

m. Tenant Wing or Squadron ASO's

8. Tenant Command Responsibilities

a. Ensure Squadron Safety Officers attend NBC quarterly Aviation Safety Council meetings.

b. Ensure training is conducted on BWCs, flight avoidance procedures, and seasonal hazards discussed at the NBC quarterly Aviation Safety Council meetings.

c. Issue specific guidance to aircrew and maintenance personnel for reporting all discovered bird strikes on aircraft to the Squadron Safety Officer.

d. Issue procedures for the preservation of bird remains if discovered on an aircraft.

e. Ensure that all trash receptacles have covers, remain closed, and are emptied on a timely basis to prevent overflowing since trash is a bird attractant.

9. <u>BASH recommendation for aircrew</u>

a. Check FLIP AP1 and NOTAMs for information about permanent and seasonal bird problems at both departure and destination airports.

b. Brief all crewmembers on potential bird problems and strong lookout doctrine.

c. Note ATIS BWC and ask Tower for specific bird locations or additional information.

d. If birds are observed in a location likely to present a danger to aircraft, notify tower so that other aircrews can be advised of the bird hazard.

e. Be advised that birds on the ground face into the wind and may not see or hear you coming. They may take flight just prior to you reaching them.

f. Formation or section departures should be conducted either joined or by increasing the interval between departures to 30 seconds during condition moderate. The lead aircraft in flight can cause birds to lift and circle behind causing a strike to the wingman.

g. Use landing lights during take-off, climb, descent, approach and landing. Although there is no conclusive evidence that birds see and avoid aircraft lights, the lights will make the aircraft more visible.

h. Travel as much as possible above the bird layer. More than 50% of all strikes occur below 100 feet and 88% of all strikes occur below 2000 feet.

i. If you see birds ahead, attempt to pass above them. Birds usually fly downward when threatened.

j. If dense bird concentrations are expected, avoid high-speed descents and approaches. Reducing speed can significantly reduce impact energy. The force of impact is roughly proportional to the square of the aircraft's speed.

k. If flocks are encountered during approach, a wave off is recommended.

l. When able, descend and climb in a straight line. This makes it easier for the birds to anticipate your flight path and get out of your way.

m. Be aware of the increased hazard one hour before and after dawn and dusk.

n. When practical, reduce low-level flight time. Ninety-nine percent of all bird strikes occur below 2300 feet AGL.

o. Reduced airspeeds will allow birds to be seen sooner and lessen damage in the event of a strike.

p. Avoid areas with known raptor concentrations during summer, especially during 1000-1700 due to increased thermals.

q. Report all bird strikes and near misses to ATC.

10. Bird Watch Conditions (BWC). The BWC is a bird hazard alert system used to warn aircrew and support personnel of the current bird activity. These codes are identical to the U.S. Air Force codes in reference (j) and are based on the bird strike potential vice the potential for the occurrence of damage. Bird locations should be given with the condition code.

a. Severe. Bird activity on or immediately above the active duty runway or other specific locations representing high potential for strikes. Supervisors and aircrews must thoroughly evaluate mission needs before conducting operations in areas under BWC Severe.

b. Moderate. Bird activity in locations representing an increased potential for strikes. BWC moderate requires increased vigilance by all agencies and supervisors and caution by aircrews.

c. Low. Bird activity on and around the airfield representing low potential for strikes.

11. BWC Severe Recommendations. If condition severe is set, the following actions are recommended (normally the hazard can be removed within five minutes):

a. Fuel and weather permitting, inbound aircraft will hold until natural movements or runway/taxiway dispersal actions have lowered the hazard condition.

b. Departing aircraft will hold on deck until dispersal actions or natural movements have lowered the hazard condition.

c. Wind and weather permitting, request a runway change from ATC if that runway's BWC is lower.

12. Bird dispersal, trapping, and removal procedures. For bird dispersal, tower will contact the Operation Duty Officer (ODO). The ODO will contact Transient Line personnel to dispatch a vehicle to perform a clearing sweep of the area. If the bird hazard continues to present a problem and vehicle sweeps are ineffective, the ODO will contact NRO and USDA Wildlife Services personnel to assist with more effective hazing methods. These procedures will only be employed by U.S. Wildlife Services, or other qualified personnel, in accordance with reference (e). Prior to initiation of dispersal actions, U.S. Wildlife Services personnel performing these duties will notify tower as appropriate.

13. Bird remains and identification. The single most important element of data in the development of the BASH program is identification of specific wildlife species that are creating the greatest strike hazard for aircraft operating at NBC airfields. Analysis of submitted bird strike reports, as documented in the Naval Safety Center WESS, is the best immediate source of data to determine the species posing the greatest risk at the installation. The following steps should be taken if bird remains are discovered either on an aircraft or on the NOLF IB/NASNI airfield:

a. Collect the remains by placing them (even if just feathers) in a sealable plastic bag. Bird strike collection kits can be obtained from NASNI Air Operations. If only blood is left on the aircraft, wipe it off using an alcohol swab or paper towel moistened with 70% alcohol. Do not use water, as it will cause mold and break down the DNA.

b. Label the bag with the date, aircraft type, and unit point of contact. Deliver the remains to the BASH freezer located in building 702, adjacent to the NASNI Air Terminal. Notify the BASH biologist at (619) 250-9847 once the remains have been placed in the freezer.

c. For remains that are recovered at San Clemente Island, report the incident to Air Traffic Control Division or Airfield Services. Collect the remains with a BASH strike collection kit, available at the Air Terminal and place them in the freezer at the Air Terminal. The remains will be collected and transferred to NASNI at the earliest possible opportunity.

14. Bird strike reporting. All BASH incidents shall be reported in accordance with reference (a). Submit a BASH report, preferably via WESS, for all instances of bird-aircraft strikes where the damage or injuries is below the mishap threshold. If damage or injuries exceed Class "C" severity, do not submit a BASH report. Instead submit a Mishap Data Report and the appropriate safety investigation report.

G. A. MAYES

Distribution:
All Aviation Tenant Commands

BIRD/ANIMAL AIRCRAFT STRIKE HAZARD (BASH) PLAN

NAVAL BASE CORONADO
SAN DIEGO, CALIFORNIA

May 2008

U.S. Navy, Natural Resources Office,
Commander Navy Region Southwest

Bird/Animal Aircraft Strike Hazard (BASH) Plan

Naval Base Coronado: Naval Air Station North Island, Naval Outlying Landing Field Imperial Beach and Naval Auxiliary Landing Field San Clemente Island San Diego, California

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SIGNATURE PAGE

The Bird/Animal Aircraft Strike Hazard (BASH) Plan has been reviewed and updated per OPNAVINST 3750.6R. Bird Hazard Working Group (BHWG) members including the Aviation Safety Officer, Air Field Operations Departments, Air Traffic Control, and Public Works were provided with copies of the BASH Plan, and were briefed on May 29, 2008. Their comments and edits were solicited and incorporated into the plan and accompanying instruction where provided. The Commanding Officer of Naval Base Coronado was briefed on June 18, 2008. The signature below represents his review and approval of the BASH Plan.

Naval Base Coronado Commanding Officer Date

ACRONYMS & ABBREVIATIONS

AGL	Above Ground Level
APZ	Accidental Potential Zones
ASO	Aviation Safety Officer
ATC	Air Traffic Control
ATIS	Automated Terminal Information Service
BASH	Bird/Animal Aircraft Strike Hazard
BGEPA	Bald and Golden Eagle Protection Act
BHWG	Bird Hazard Working Group
BIRDRAD	Bird detecting radar system
BWC	Bird Watch Condition
CNRSW ED	Commander Navy Region Southwest, Environmental Department
COMPACFLT	Commander Pacific Fleet
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FCLP	Field Carrier Landing Practice
FLIP	Flight Information Publication
FIFRA	Federal Insecticide, Fungicide and Rodenticide Act
FOD	Foreign Object Debris / Damage
IB	Imperial Beach
INRMP	Integrated Natural Resources Management Plan

IWDM	Integrated Wildlife Damage Management
MBTA	Migratory Bird Treaty Act
MOU	Memorandum of Understanding
MWR	Morale, Welfare and Recreation Department
NALF	Naval Auxiliary Landing Facility
NAS	Naval Air Station
NASP	Naval Aviation Safety Program
NAVFAC	Naval Facilities Engineering Command
NAVFACINST	Naval Facilities Instruction
NBC	Naval Base Coronado
NEPA	National Environmental Policy Act
NOLF	Naval Outlying Field
NOTAMS	Notices to Airmen
NRO	Natural Resources Office
NSC	Naval Safety Center
NRMO	Natural Resources Management Office
OPNAVINST	Chief of Naval Operations Instruction
PSA	Primary Surface Area
PW	Public Works
RDT&E	Research, Development, Test, and Evaluation
SCI	San Clemente Island
SCIRC	San Clemente Island Range Complex
SHOBA	Shore Bombardment Area

USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
WHA	Wildlife Hazard Assessment
WHM	Wildlife Hazard Monitoring
WMA	Wildlife Monitoring Assessment
WS	Wildlife Services

GLOSSARY OF TERMS

Airfield – An area of land or other hard surface, excluding water, that is used or intended to be used for the landing and takeoff of aircraft and includes its buildings and facilities.

Approach or departure airspace – The airspace, within five statute miles of an airport through which aircraft move during landing or takeoff.

Bald and Golden Eagle Protection Act, 16 U.S.C. 1531 – Federal criminal statute which makes it a misdemeanor to kill, take, or possess Bald and Golden Eagles.

Bird avoidance – Techniques (including radar detection, warning, and use of bird data) that reduce potential for bird strikes by allowing air crews to schedule or maneuver bird concentrations.

Bird control – Any biological, chemical, or physical procedure that discourages the presence of birds. These procedures include repellents, toxicants, harassment, grounds maintenance, and habitat modification.

Bird data – Information about the ecology, anatomy, physiology, behavior, size, movement, and distribution of birds that may be helpful in bird control, bird avoidance, and aircraft design.

Bird hazard reduction plan – A written document that addresses bird strike hazards and designates organizations responsible for implementing solutions.

Bird hazard warning system – A set of procedures, using standard bird watch condition codes, for immediate exchange of information between ground and airborne personnel concerning the existence and locations of birds posing a hazard to flight.

Bird species – A group of interbreeding birds with common characteristics such as size, shape, voice, and behavior.

Bird/animal strike – Any collision between a bird/other wildlife and an aircraft.

Bird watch condition codes – The following terminology is established for rapid communication of bird activity. When communicating, avoid color coded conditions to eliminate any confusion with color codes used during exercises, contingencies, and emergencies (i.e., disaster preparedness exercises). Also, give bird locations with the condition code:

- Bird Watch Condition **SEVERE**. High bird population on or immediately above the active runway or other specific location that represents a high potential for strike. Bird activity for this condition is 15+ large birds or 30+ small birds. Supervisors and aircrews must thoroughly evaluate mission need before conducting operations in areas under condition SEVERE.
- Bird Watch Condition **MODERATE**. Increased bird population in location which represents an increased potential for strike. Bird activity for this condition is five to 15 large birds or 15-30 small birds. This condition requires increased vigilance by all agencies and supervisors and caution by aircrews.
- Bird Watch Condition **LOW**. Normal bird activity on and above the airfield with a low probability of hazard. Bird activity for this condition is less than five large birds or 15 small birds or sparse bird activity.

Carrying capacity – The maximum number of animals of a given species which a habitat is capable of supporting on a sustained basis. The goal of wildlife management programs at airports is to eliminate or minimize the carrying capacity of habitat for species hazardous to aviation.

Cover – Vegetation covering a ground surface and serving as shelter for wildlife that are roosting, resting, nesting, or feeding.

Cover types – A descriptive term characterizing vegetative composition and physical characteristics of a plant community.

Damaging bird/animal strike – Any bird/animal strike that causes reportable damage.

Edge – The border where two cover types meet. These transition zones usually provide more diverse vegetation and physical habitat characteristics which may contribute to increased wildlife species diversity and numbers.

Endangered Species Act, 16 U.S.C. 1531 – Federal environmental statute which makes it a felony to "take" an endangered species. Criminal liability under the Act can be imposed for indirect taking resulting from the destruction of an endangered species habitat.

Habitat – The total environmental elements of food, water, shelter, nesting sites, and space that must be present for wildlife species to survive.

Hazardous wildlife – Species of wildlife (birds, mammals, reptiles), including feral animals and domesticated animals not under control, that are associated with aircraft strike problems, are capable of causing structural damage to airport facilities, or act as attractants to other wildlife that pose a strike hazard.

Landfill – An area of land or an excavation in which wastes are placed for permanent disposal and which is not a land application unit, surface impoundment, injection well, or waste pile.

Migratory bird – "[A] migratory bird [is] … any bird whatever its origin and whether or not raised in captivity, which belongs to a species listed in Section 10.13 [of 50 CFR] or which is a mutation or a hybrid of any such species, including any part, nest, or egg of any such bird, or any product, whether or not manufactured, which consists, or is composed in whole or part, of any such bird, or any part, nest, or egg there of." This list includes almost all native bird species in the United States, with the exception of non-migratory game birds such as pheasants, turkeys and grouse. Exotic and feral species such as mute swans, graylag geese, muscovy ducks, European starlings, house (English) sparrows, and rock pigeons also are not listed in 50 CFR Section 10.13 and are therefore not protected by federal law.

Migration – The periodic movement of a wildlife species from one geographic area to another, usually in correlation with seasonal changes in weather.

Migratory Bird Treaty Act (16 U.S.C. 703-715) – Federal criminal statute which makes it a felony to kill, take or possess migratory birds without a permit.

Movement area – The runways, taxiways, and other areas of an airport which are used for taxiing or hover taxiing, air taxiing, takeoff, and landing of aircraft, exclusive of loading ramps and aircraft parking areas.

Non-damaging bird/animal strike – Any bird/animal strike that does not damage the aircraft or cause damage to the aircraft IAWAFI 91-204.

Propane/cannon exploder – A hollow cylinder that produces a loud explosion to frighten wildlife by the ignition of a metered amount of propane at timed or random intervals.

Pyrotechnics – Various combustible projectiles launched from a shotgun, pistol or other device that produce noise, light and smoke to frighten wildlife.

Shoulder – An area adjacent to the edge of paved runways, taxiways, or aprons providing a transition between the pavement and the adjacent surface, support for aircraft running off the pavement, enhanced drainage, and blast protection (see AC 150/5300-13).

Take (of wildlife) – To pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect any wild animal.

Wildlife – Any wild animal, including all wild mammals, birds, reptiles, amphibians, and fish. As used in this manual, wildlife also includes feral animals and domestic animals while out of the control of their owners.

Wildlife attractants – Any human-made structure, land-use practice, or human-made or natural geographic feature which can attract or sustain hazardous wildlife within the landing or departure airspace, aircraft movement area, loading ramps, or aircraft parking areas of an airport. These attractants can include but are not limited to architectural features, landscaping, waste disposal sites, wastewater treatment facilities, agricultural or aquacultural activities, surface mining, or wetlands.

Wildlife hazard – A potential for a damaging aircraft collision with wildlife on or near an airport.

Wildlife strike – A wildlife strike is deemed to have occurred when:

1. A pilot reports striking one or more birds or other wildlife;
2. Aircraft maintenance personnel identify aircraft damage as having been caused by a wildlife strike;

3. Personnel on the ground report seeing an aircraft strike one or more birds or other wildlife;
4. Bird or other wildlife remains, whether in whole or in part, are found within 200 feet of a runway center line, unless another reason for the animal’s death is identified;
5. The animal’s presence on the airfield had a significant negative effect on a flight (i.e., aborted takeoff, aborted landing, high-speed emergency stop, or the aircraft left pavement area to avoid collision with animal).

1.0 INTRODUCTION

1.1 PURPOSE

1.1.1 BASH

BASH is an acronym that stands for Bird/Animal Aircraft Strike Hazard. The purpose of the BASH program is to manage the hazard associated with collisions between wildlife and aircraft. The program focuses on (1) managing habitat to reduce its attractiveness to wildlife and (2) managing wildlife populations, thereby minimizing the potential of wildlife/aircraft strikes. In addition, the program focuses on collaborating with installation personnel to improve the reporting and communicating of wildlife activity and wildlife/aircraft strikes, both damaging and non-damaging. Damaging strikes include holes in the fuselage of the aircraft, broken engine fan blades, cracks in the canopy, etc. Damaging strikes have the potential of resulting in loss of life to aircrew, costing the Navy millions of dollars per year in repairs to naval aircraft, and loss of training opportunities. Non-damaging strikes usually involve dents, blood smears or feather fragments struck to the aircraft without penetration to the body of the aircraft.

1.1.2 BASH Program Importance

It is important to institute a proactive BASH program at naval airfields to achieve several goals. The primary goal of the BASH program is to minimize the potential for loss of aircrew life. The BASH program achieves this objective by addressing the aviation safety hazard associated with wildlife on and near airfields. The BASH program needs to manage wildlife populations and work with installation personnel to improve bird strike reporting and communication of wildlife activities within the airfield environment. An effective BASH program also strives to minimize secondary BASH impacts, such as damage to aircraft and loss of training. Aircraft collisions with wildlife are too costly and hazardous to not be property addressed or managed.

Bird strikes to aircraft are a serious safety and economic problem in the United States, annually causing millions of dollars in damage to civilian and military aircraft and occasionally loss of human life. The Navy has experienced approximately 20,000 bird/aircraft strikes since 1980 resulting in two deaths, 25 aircraft destroyed and over $300 million in damage (Klope 2002). There have been 158, 117, and 19 bird/aircraft strikes reported at Naval Air Station North Island (NASNI), Naval Outlying Landing Field Imperial Beach (NOLFIB), and Naval Auxiliary Landing Field San Clemente Island (NALF SCI), respectively from 1980-2004 (Naval Safety Center 2005a). Naval Safety Center data indicates that sixty-five percent of all bird strikes occur within the primary surface area (PSA) of the airfield which is 750 feet in both directions from the centerline of the runway (Naval Safety Center 2005b). In addition, at NASNI, data indicates that only 30 percent of bird/aircraft strikes are actually reported, thus underestimating the number and severity of the problem (Cummings and Foley 1997). Federal Aviation Administration (FAA) PSA is 1,000 ft in both directions of the center line of the runway (FAA Advisory Circular 159/5300-13). FAA Part 139.337, a wildlife assessment is triggered by one of the following: 1) multiple animal strikes; 2) substantiated damage to the aircraft; 3) engine ingestion of wildlife; or 4) when size and numbers of wildlife on or near the airport are capable of causing a damaging event.

It was a mishap on August 24, 1995 when an E-2 departing on runway 18-36 at night struck a large flock of western gulls (*Larus occidentalis)* roosting on the runway, killing over 100 birds and damaging the aircraft inoperable, that initiated a Wildlife Hazard

Assessment at NAS North Island and began the BASH program at Naval Base Coronado (NBC) (Figure 1, 2). The National Wildlife Research Center (NWRC) conducted a Wildlife Hazard Assessment (WHA) from 1996-1997 (Cummings and Foley 1997 (Appendix 1)) and continued to conduct Wildlife Hazard Monitoring on the airfield from 1999 to 2002 to evaluate changes in bird numbers, locations and behavior resulting from Wildlife Services (WS) management activities, and determine additional measures that should be taken to reduce bird hazards at NAS North Island (York et al. 2000 (Appendix 2), York et al. 2001 (Appendix 3), Cummings and Sheffer 2003 (Appendix 4)). Since 1997 the number of reported bird/aircraft strikes at NAS North Island has decreased dramatically, primarily due to Wildlife Services ability to manage the Bird/Animal Aircraft Strike Hazard (Cummings and Sheffer 2003 (Appendix 4)).

Figure 1. E-2 departing NAS North Island August 24, 1995 at night on runway 18-36 struck a large flock of western gulls roosting on the runway killing over 100 birds.

Figure 2. E-2 bird strike with western gulls destroyed the aircraft. Pilots escaped without injuries.

The purpose of this BASH Plan is to provide guidance that will minimize wildlife populations on and around the airfield that pose a threat to aviation safety. This Plan is in accordance with Department of Defense (DOD) Instruction 4150.7, Pest Management Program, Chapter 9, Section D and Chief of Naval Operations Instruction (OPNAVINST) 5090.1B Chapter 22, which requires that Department of Defense installations, including Navy airfields, be responsible for preparing and implementing a BASH Plan, following the outcome of an ecological study or WHA, conducted for NAS North Island during 1996-1997, NOLF Imperial Beach during 1999-2001 and NALF San Clemente Island during 2002-2003. This Plan also fulfills OPNAVINST 3750.6R, Naval Aviation Safety Program (NASP), which requires the enhancement of Naval operational readiness by preserving the human personnel and material resources used in accomplishing naval aviation missions. An essential component of the NASP is the detection and elimination of aircraft hazards such as wildlife, specifically birds (Figure 3).

As indicated in the WHA report for NAS North Island, NOLF Imperial Beach, and NALF San Clemente Island, there are conditions within the PSA that need to be addressed to reduce or eliminate the potential for a major mishap (Cummings and Foley 1997 (Appendix 1),York et al. 2000 (Appendix 2), York et al. 2001 (Appendix 3), Sheffer et al. 2002 (Appendix 5), Cummings and Sheffer 2003 (Appendix 4), Landsford 2000 (Appendix 6)). Although there is no single solution that can solve the bird/animal aircraft strike hazard at these airfields, this Plan establishes specific procedures to manage known or potential wildlife, specifically bird hazards on and around these airfields. This Plan includes: 1) conduction of wildlife monitoring; 2) implementation of a habitat management program; 3) use of bird dispersal techniques when appropriate and warranted; 4) implementation of a species specific population control program; 5) development of operation procedures to address bird/animal aircraft strike hazards; 6) adoption of a zero-tolerance policy for birds within the PSA, exceptions maybe granted by the BHWG for specific birds such as threatened and endangered species or species of conservation concern; and 7) increased communications, safety and training of aviators, aircrews and operational personnel related to BASH issues.

Figure 3. Great blue herons fly across NAS North Island runways to feeding sites from a tree rookery on the northeast corner of the installation.

This Plan is designed to:

- Establish a NBC Bird/Animal Hazard Working Group (BHWG), including its composition, authority and responsibilities. NBC is made up of 7 installations, of which 6 have possible BASH concerns including NASNI, NAB Coronado, NOLF IB, NALF SCI, SERE Camp (Survival Evasion Resistance and Escape School), and La Posta (Special Warfare Mountain Training Center). Future expansion of air operations at locations within these installations should be accompanied by additional BASH planning appropriate for the level of air operations and will be included in BASH and safety meetings and BASH Plan updates as they arise.

- Identify those responsible for implementing the NBC BASH Plan.
- Identify training requirements for those responsible for implementing the NBC BASH Plan.
- Increase awareness among military and civilian personnel of the issues central to the success of the NBC BASH Program.
- Identify and provide information on hazardous bird/animal situations for NBC within the PSA and on or near the airfield and procedures for avoidance, i.e. Bird Monitoring Programs and Bird Hazard Conditions.
- Establish aircraft and airfield operation procedures to avoid high-hazard situations for NBC.
- Establish appropriate management techniques (habitat management, hazing, translocation and lethal take) to minimize the bird/animal hazard for NBC and recommend necessary equipment and supplies.
- Establish procedures for collecting and reporting bird/animal aircraft strikes for NBC.
- Establish procedures for monitoring BASH activities for NBC.

- Establish a policy of zero tolerance toward hazardous wildlife within the PSA for NBC, exceptions maybe granted by the BHWG for specific birds such as threatened and endangered species or species of conservation concern.
- Provide a method for disseminating information to all tenant and transient aircrews concerning BASH issues for NBC.

1.2 MISSION

It is the mission of the U.S. Navy at NBC and its environs to equip, maintain, train and support Naval surface and aviation units of the Pacific Fleet and other operating forces in order to conduct military operations in support of the fleet and other operational commanders. The mission of the Commander, Pacific Fleet (COMPACFLT) is to support the U.S. Pacific Command's theater strategy, and to provide inter-operatable, trained and combat-ready Naval forces to COMPACFLT and other U.S. unified commanders. As such, the U.S. Pacific Fleet is a "force provider" to unified commanders in various regions around the world (http://www.cpf.navy.mil).

Under DODINST 4150.7 and OPNAVINST 3750.6R, NASP, Naval Operations readiness is enhanced by preserving the safety of human personnel and material resources utilized in Naval aviation missions. An essential component of NASP is the detection and elimination of hazards to aircrafts from wildlife, specifically birds. In accordance with OPNAVINST 5090.3B Chapter 22 (March 2002), the Environmental Division or Natural Resource Section of a Naval Air Station is responsible for preparing and implementing the WHA and BASH Plan. Currently a draft BASH Instruction Policy is in review which would have Air Operations be responsible for preparing and implementing the WHA and BASH Plan (pers. commun. Matt Klope, NAVFAC BASH Coordinator, January 2008) The Commander Navy Region Southwest, Environmental Department, Natural Resource Office (NRO) is responsible for providing environmental support for NBC. It is the mission of the NRO to provide guidance and technical expertise that will enhance mission readiness and ensure environmental compliance.

1.2.1 Naval Air Station North Island

NAS North Island's mission is to arm, repair, provision, service and support the U.S. Pacific Fleet and other operating forces.

1.2.2 Naval Outlying Landing Field Imperial Beach

NOLF Imperial Beach's mission is to operate as an extension of NAS North Island, providing a practice field for helicopter operations and a location for miscellaneous personnel support facilities that serve the military population in the Imperial Beach area.

1.2.3 Naval Auxiliary Landing Field San Clemente Island

NALF San Clemente Island's mission is to support tactical training and research and development efforts in the San Clemente Island Range Complex (SCI RC) by maintaining and operating facilities and providing services, arms and material support to the U.S. Pacific Fleet and other operating forces.

1.2.4 Naval Amphibious Base Coronado, Turner Field

Turner Field, located 3 miles southwest of NASNI on the northeast side of Naval Amphibious Base adjacent to San Diego Bay, is used primarily for passenger embarkation and debarkation in support of Special Warfare and Marine operations. It consists of a 100 feet x 100 feet square helipad for use by helicopter smaller than the CH-

3. The helipad is within North Island Class D airspace. It is used for Marines and Naval Special Warfare (NSW) training and operations.

1.3 LOCATION AND SETTING

Naval air stations located along the coastal areas of the United States have a potentially high risk for bird/animal aircraft strikes because of their location (coastal areas) and the species of birds (including: gulls, terns, and wading birds) that are present on or around the airfield. In addition, the available habitat of a given site has a direct bearing on the abundance and diversity of the birds present.

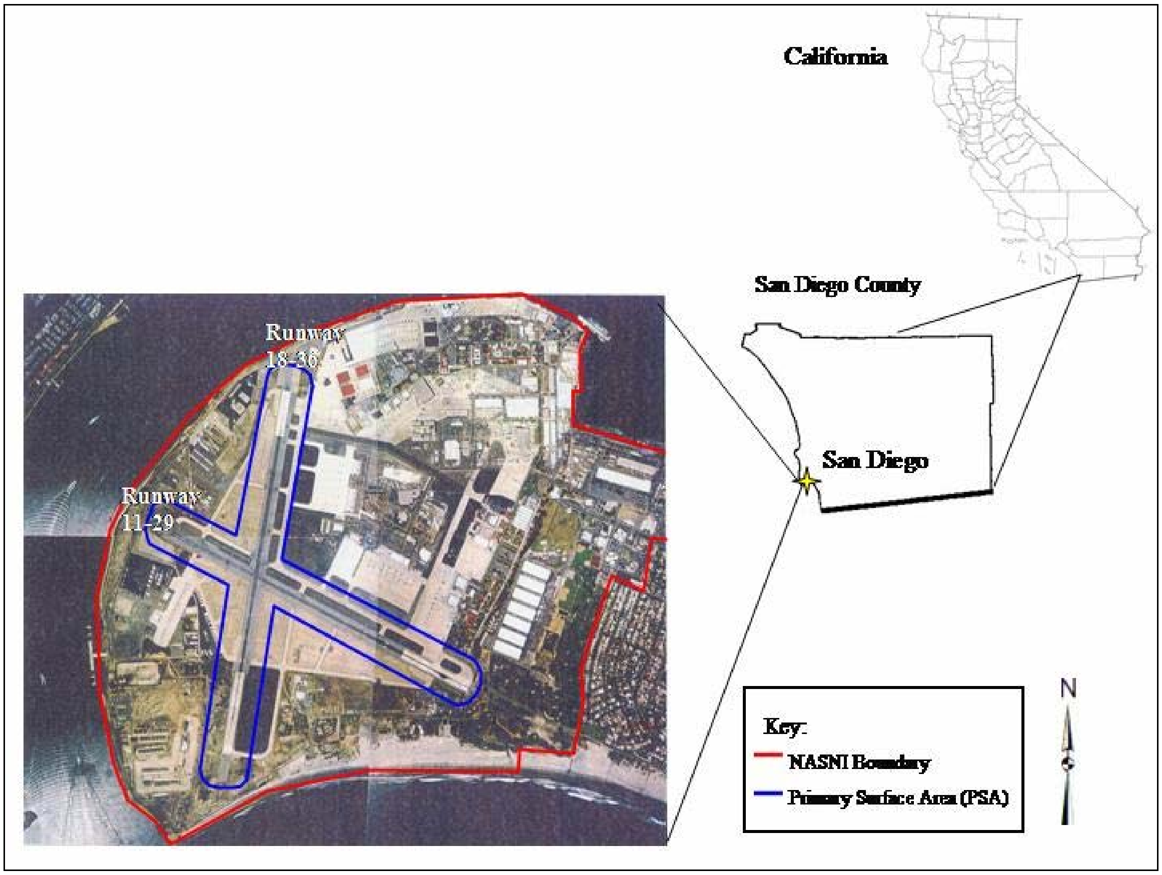

Figure 4. Naval Air Station North Island, San Diego, California.

1.3.1 Naval Air Station North Island

NAS North Island is a 2,866 acre installation of NBC located under the city limits of Coronado and San Diego, California that has a number of naturally occurring characteristics that make portions of the site attractive to birds (Figure 4). NAS North Island is bordered on the north and west by the San Diego Bay, on the south by the

Pacific Ocean and on the east by the city of Coronado. These surrounding areas support a number of activities and habitats that attract numerous bird species (e.g. gulls to sport and commercial fishing). The installation has ponds and water sources within the PSA that attract various species of waterbirds and other naturally occurring characteristics that make some areas within the PSA attractive to wildlife, specifically birds. It also has areas within the PSA that are delineated as endangered species habitat, which have to be carefully managed in coordination with the U.S. Fish and Wildlife Service (USFWS).

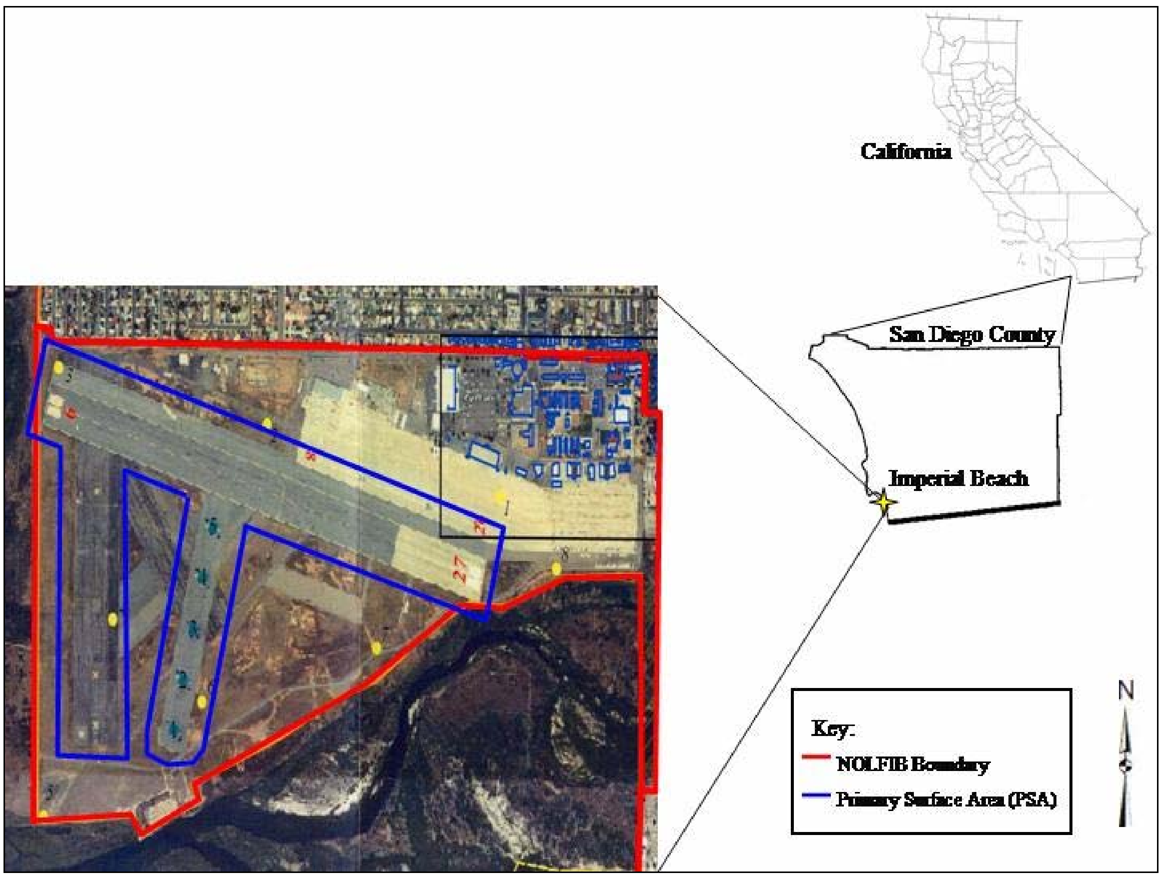

Figure 5. Naval Outlying Landing Field Imperial Beach, Imperial Beach, California.

1.3.2 Naval Outlying Landing Field Imperial Beach

NOLF Imperial Beach is located ten miles south of NAS North Island and 1.5 miles north of the U.S.-Mexican border in southwest San Diego County (Figure 5). NOLF Imperial Beach occupies 1,257 acres in the city of Imperial Beach in the Tijuana River Valley south of the Silver Strand peninsula. Approximately 283 acres of NOLF Imperial Beach's airfield accidental potential zone to both the south and southwest is considered part of the Tijuana River National Estuarine Research Reserve.

The airfield at NOLF Imperial Beach includes two runways and five helicopter pads. Runway 9/27 is 5,000 feet long by 350 feet wide; runway 8/26 is 2,339 feet long by 150 feet wide. Both runways are constructed of concrete and are daytime use only for stop-and-go or full-stop landing exercises by rotary wing aircraft. The helicopter pads are each 100 square feet and located south of runway 9/27. They are constructed of cement and the area between the pads is asphalt concrete. Helicopter pads are mainly used for landing practice, hover work, hoist operations or heavy external load practice day or night, air-traffic permitting (Lansford 2000).

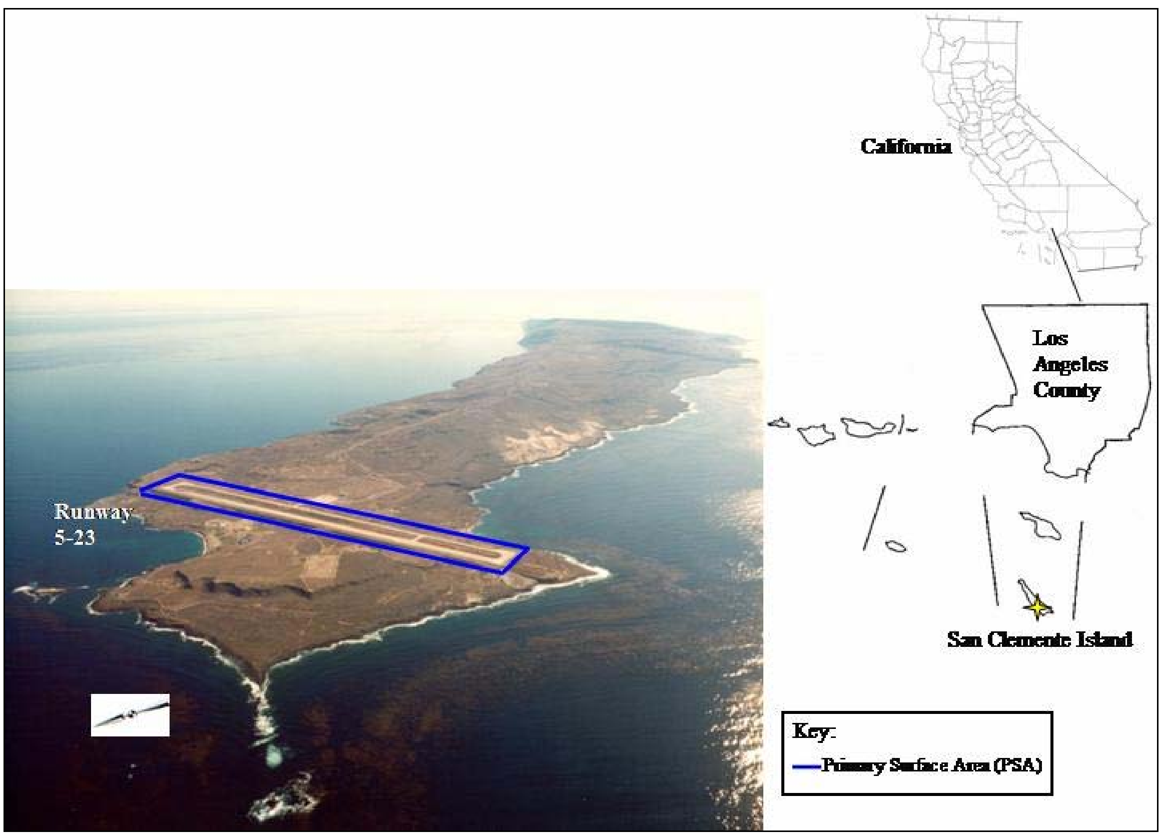

Figure 6. Naval Auxiliary Landing Field San Clemente Island, California.

1.3.3 Naval Auxiliary Landing Field San Clemente Island

San Clemente Island is the southernmost of the California Channel Islands (Figure 6). The island is located approximately 57 miles from the nearest mainland point (Palos Verdes) and approximately 68 miles from San Diego. The island is 21 miles long, varies in width from 1-1/2 miles to 4 miles, and encompasses 36,480 acres. The only operational airfield is located at the north end of the island and runs in an approximate southwest to northeast alignment. The airfield is referred to as Naval Auxiliary Landing Field (NALF) San Clemente Island. The runways, taxiways, and apron areas are a combination of asphalt and concrete. The runway sits 60 feet above sea level and is 9,300 feet long by 200 feet wide.

The island itself is the center of the SCI RC and is a cornerstone of tactical training and provides support for the Southern California Operations Area. Land, air, and sea ranges provide the U.S. Navy, U.S. Marine Corps, and other military services space and facilities which they use to conduct readiness training and test and evaluation activities. Both Navy and Marine Corps commands conduct training and testing activities on and around SCI. Activities range from aviation training, air warfare, surface warfare, under sea warfare, strike warfare, submarine warfare, amphibious warfare, special warfare, RDT&E, and Joint Task Force Exercises that include other military services.

The geographic isolation of the island and restricted airspace facilitate testing and training programs with minimal restrictions and maximum flexibility. Safety and security can be maintained since the island is wholly Navy-owned. SCIRC is able to employ the use of live fire and engage in exercises as would occur under actual battle conditions. The types of operations and activities that are conducted at SCIRC can be further broken down into seven broad types. Six of these occur in the onshore/near-shore environment. They are:

1. Shore Bombardment Area (SHOBA) Operations
2. Amphibious Training
3. Naval Special Warfare Training
4. Airfield Operations
5. RDT & E Tests
6. Other Island Operations

Offshore operations are one of the most complex categories with numerous operations and activities occurring in a variety of designated offshore ranges.

Due to the location of NALF SCI, bird/animals pose a high risk to cause potential aircraft strikes. The habitat attracts a wide variety of high risk species of birds, many of which have been observed within the operational flight paths of aircrafts or within close proximity to SCI's active runway 5-23. In 2002 eighty percent of the 15,310 air operations were Navy or Marine aircraft, the remainder were general aviation or other military aircraft.

1.4 TOPOGRAPHY AND HABITAT TYPES

1.4.1 Naval Air Station North Island

NAS North Island is essentially flat, with little or no vertical topography (average elevation of approximately 20 feet above sea level) beyond the narrow inter-tidal strip along portions of the perimeter of the island. Much of NAS North Island's coastline consists of artificial structures such as sea walls and piers. NAS North Island is located within the Southern California coastal plain, with bed rocks of California Cretaceous batholiths and Jurassic era peak volcanics. Seismic structures running close-by include the Rose Canyon Fault Branch, which runs north-to-south along the eastern side of the installation. This fault is believed to have the potential to produce a 7.5 magnitude quake. Soils of the central and eastern portions of NAS North Island are composed primarily of medium dense to very dense native materials. The remainder of the area is comprised of fill materials dredged from the bay.

Most of NAS North Island is paved or developed, and much of the remaining vegetated areas are located along the southern edge of the facility. The habitat types occurring there are primarily upland or upland-disturbed, and sandy beaches with areas of coastal dune vegetation. NAS North Island supports a variety of native vegetation communities including a number of rare plants species, i.e. red sand verbena (*Abronlia maritime*), southwestern spiny rush (*Juncus acutus var. leopoldii*), nuttall’s ltus (*Lotus nuttallianus*), coast woolly-heads (*Nemacaulis dendata var. denudate*) and Brands’s phacellia (*Phacellia stellaris*). The California least tern (*Sterna antillarum browni*) nesting site located in the center of the installation is primarily open sand placed over asphalt with little vegetation. There are no naturally occurring streams or other water courses on NAS North Island. The only natural water bodies are two sloughs located along the southern coastline. There are, however, man-made ponds on the golf course that are located next to the approach of runway 29, which are covered with grid wires. In addition, there are helicopter washes on the airfield that attract birds because of standing water. Improving the drainage will reduce standing water and the attraction of other birds.

The type of habitat directly affects the number and species of birds using NAS North Island. For instance, the golf course ponds, standing water at the helicopter washes, weed seeds in cracks on the runways, and various vegetation types in the PSA attract and support a variety of bird species. These include waterfowl, herons, gulls, owls, raptors and small passerines that can be serious threats to aviation safety (Figure 7). The movement patterns and weight of these species either individually or aggregated presents a risk to aviators using NAS North Island.

1.4.2 Naval Outlying Landing Field Imperial Beach

NOLF Imperial Beach (IB) consists mainly of dryland grasses. In the south and west portion of the property is 600 acres which is managed through a Memorandum of Understanding (MOU) established in 1992 with the USFWS as part of the Tijuana River National Estuarine Research Reserve and Tijuana Sough National Wildlife Refuge. This area contains tidal flats and is within the flood plain and near the mouth of the Tijuana River. This area is highly sensitive and supports large numbers of migratory songbirds including the federally endangered Leat Bell's Vireo (*Vireo bellii pusillus*). Two vernal pools located in the southern portion of NOLF IB with plant indicator species including, dwarf wooly-heads (*Psilocarphus brevissimus*)and grass poly (*Lythrum hyssopifolia*), support the federally endangered San Diego fairy shrimp.

The principal geological formations of NOLF IB consist of recent alluvial and slopewash deposits reaching depths of 130 feet with underlying sandstone, shale and limestone. Drainage on the airfield of NOLF IB is controlled by storm drains, while the Accidental Potential Zones (APZ) is subject to the Tijuana River Estuary's natural drainage. There have been periodic floods on the southern portion of NOLF IB due to the Tijuana River, but the flow of the river is controlled by reservoirs and the Rodriquez Dam on Rio de Las Palmas in Mexico.

1.4.3 Naval Auxiliary Landing Field San Clemente Island

San Clemente Island terrain is marked by a broad, high, plateau surrounded by deeply incised cliffs. The highest elevation on the 56 square mile island is 1,965feet. The runway lies 60 feet above sea level

The semi-arid San Clemente Island consists of six distinct ecological areas; the Coastal Terrace, the Upland Marine Terrace, the Plateau, the Eastern Escarpment, the Major Canyons, and the Sand Dunes. The Coastal Terrace is a generally flat, gradually sloping costal plain rising from sea level up to the Upland Marine Terrace. The bedrock is typically overlain with thin soil, and the predominant vegetation within the Coastal Terrace is Maritime Desert Scub. The Upland Marine Terrace has soil characteristics similar to that of the Coastal Terrace and its vegetation is transitional between Maritime Desert Scrub and island grasslands. This terrain covers 34% of the island. The plateau vegetation is primarily island grasses, which cover the central portion of the island. The Eastern Escarpment is associated with the San Clemente fault. This area is classified as Canyon Shrubland/Woodland flora as its cool moist environment harbors most of the islands trees and woody shrubs. Included in this area are island oak (*Quercus lomentella*), Catalina ironwood (*Lyonothamnus floribundus*), toyon (*Heteromeles arbutifolia*), and island cherry (*Prumus lyonii*). The Eastern Escarpment accounts for 11% of the island surface.

There are fifteen precipitous drainages along the southwestern slope of the island that comprise the Major Canyons. The cool, moist climate of the canyon floors support

Canyon Shrubland/Woodland flora, and plunge pools and other bedrock formations hold runoff throughout the year. The Sand Dunes are located at the northern edges of the island, and most of this area is bare of vegetation. Dunes are influenced by salt spray and wind-pruning. Soils include loamy sand over sand. Where prevailing conditions limit overall height, the tall shrub layer is predominant and its canopy tends to be very dense. A short shrub layer is often present and is generally found in the top layer. The herbaceous layer is very sparse to absent. There is often ridge and hollow micro-topography and trees tend to occur in hollows and shrubs on sandy ridges.

1.5 WEATHER

1.5.1 Naval Air Station North Island

The climate of NAS North Island is moderately humid with mild, moist winters and warm, dry summers. Data obtained from the Western Regional Climate Center for the period from 1914 to 2003 indicates that the average annual minimum temperature is 56^{o} F and the average annual maximum temperature is 70^{o} F, with the highest temperatures in August and the lowest temperatures in February (Western Regional Climate Center 2004). Average total monthly precipitation ranges from 0.02 inches in July to 2.05 inches in January, with an average total annual precipitation of 10.21 inches (Western Regional Climate Center 2004). Approximately 95 percent of the annual precipitation falls from October through April.

Wind speeds and directions near NAS North Island indicate seasonal variations. The onshore winds typically average seven mph from west-north-west. The highest wind speed recorded was 56 mph from south-east during January 1980.

1.5.2 Naval Outlying Landing Field Imperial Beach

NOLF Imperial Beach lies in the coastal plain subtropical climate zone. It is moderately humid with mild, moist winters and warm, dry summers. Data obtained from the Western Regional Climate Center for the period from 1914 to 2003 indicates that the average annual temperature ranges from is 53^{o} to 73^{o} F with the highest temperatures in August and the lowest temperatures in February (Western Regional Climate Center 2004). Average total annual precipitation of NOLF IB is approximately 10 inches (Western Regional Climate Center 2001). Approximately 95 percent of the annual precipitation falls from October through April.

1.5.3 Naval Auxiliary Landing Field San Clemente Island

The climate of NALF San Clemente Island is moderately humid with mild, moist winters and warm, dry summers. Data obtained from the Western Regional Climate Center for the period from 1945-1946 and 1962-1989 indicates that the average annual mean temperature ranges from 55-66^{o} F, the average annual maximum temperature is from 71-83^{o} F, and the average annual minimum temperature ranges from 43 to 58^{o} F (Western Regional Climate Center 2001). Average yearly precipitation is 6.7 inches with most occurring between November and April.

1.6 LAWS AND INSTRUCTIONS AFFECTING BASH

Relevant laws and U. S. Department of the Navy instructions that may pertain to BASH implementation include (Appendix 8):

- Naval Safety Center website (http://safetycenter.navy.mil)
- OPNAVINST 5090.3B Chapter 22 (March 2002): Navy Natural Resources Management Plan;

- OPNAVINST 3750.6R: Naval Aviation Safety Program;
- OPNAVINST 6250.4B: Pest Management Program;
- Naval Facilities (NAVFAC) P-73 Procedural Manual;
- NBC Integrated Natural Resource Management Plan (May 2002);
- SCI Integrated Natural Resource Management Plan (May 2002);
- Naval Facilities Instruction (NAVFACINST), Applied Biology Program Services and Training 6250.3;
- Federal Aviation Administration (FAA) Handbook 7110.65
- Migratory Bird Treaty Act 1918 (MBTA);
- Endangered Species Act 1973 (ESA);
- National Environmental Policy Act 1979 (NEPA);
- Federal Insecticide, Fungicide and Rodenticide Act 1996 (FIFRA);
- Clean Water Act (Federal and State);
- Estuary Protection Act;
- The Sikes Act Improvement Act; and
- California Fish and Game Codes

1.7 FLIGHT OPERATIONS

1.7.1 Naval Air Station North Island

NAS North Island has two paved runways, 11-29 which is 7,500 feet by 300 feet and 18-36 which is 8,000feet by 200 feet. In addition, there are aircraft ramp areas for respective squadrons, a control tower and several support structures (hangers, office buildings, maintenance shops, etc). There were 158,016 air operations on NAS North Island in 2000, 159,596 air operations in 2001 (airfield was closed for one month following September 11th), 152,524 air operations in 2002, 130,233 air operations in 2003, 112,570 air operations in 2004. 99,080 air operations in 2005, and 87,103 air operations in 2006. The number of yearly air operations has slightly dropped from 2000. These operations were conducted using the current arrival and departure tracks for both fixed-and rotary-wing aircraft (Figure 8).

Currently, NAS North Island supports the following tenant squadrons:

Helicopter Squadrons / *Fixed-Wing Squadrons*

- Commander Helicopter Sea Combat Wing U.S. Pacific Fleet (COMHSCWINGPAC)
- Commander Helicopter Maritime Strike U.S. Pacific Fleet (COMHSMWINGPAC)

Helicopter Squadrons

- Helicopter Sea Combat Squadron 23 (HSC-23)
- Helicopter Sea Combat Squadron Three (HSC-3)
- Helicopter Sea Combat Squadron 21 (HSC-21)
- Helicopter Sea Combat Squadron 85 (HSC-85)
- Helicopter Anti-Submarine Squadron Two (HS-2)
- Helicopter Anti-Submarine Squadron Four (HS-4)
- Helicopter Anti-Submarine Squadron Six (HS-6)
- Helicopter Anti-Submarine Squadron Eight (HS-8)
- Helicopter Anti-Submarine Squadron Ten (HS-10)
- Helicopter Maritime Strike Squadron 41 (HSM-41)
- Helicopter Maritime Strike Squadron 43 (HSM-43)
- Helicopter Maritime Strike Squadron 45 (HSM-45)
- Helicopter Maritime Strike Squadron 47 (HSM-47)
- Helicopter Maritime Strike Squadron 49 (HSM-49)

Fixed-Wing Squadrons

- Fleet Logistics Support Squadron 57 (VR-57)
- Fleet Logistics Support Squadron Three Zero (VRC-30)

Tenant squadrons at NAS North Island primarily operate the following rotary aircraft: SH-60F, CH-58A, HH-60H, SH-60B, MH-60S, MH-60R, OH-58, and fixed-wing aircraft: C-2A, C-12, UC-12B, P-3C, C-555, Cessna 211, B-207, and King Air. Transient aircraft that operate at NAS North Island include various helicopter, propeller, and jet aircraft up to and including the C-5 (the largest military cargo aircraft).

1.7.2 Naval Outlying Landing Field Imperial Beach

The airfield at NOLF Imperial Beach includes two runways and five helicopter pads. Runway 9/27 is 5,000feet long by 350feet wide; runway 8/26 is 2,339feet long by 150feetwide (Figure 9). Both runways are constructed of concrete and are daytime use only for stop-and-go or full-stop landing exercises by rotary wing aircraft. The helicopter pads are each 100 square feet and located south of runway 9/27. They are constructed of cement and the area between the pads is asphalt concrete. Helicopter pads are mainly used for landing practice, hover work, hoist operations or heavy external load practice day or night, air-traffic permitting. There were 245,771 air operations on NOLF Imperial Beach in 2002, 257,912 air operations in 2003, 248,410 air operations in 2004, 226,841 air operations in 2005, and 240,218 air operations in 2006. The number of yearly air operations has stayed fairly consistent since 2003. These operations were conducted using the current arrival and departure tracks for rotary-wing aircraft (Figure 10, 11).

1.7.3 Naval Auxiliary Landing Field San Clemente Island

NALF San Clemente Island's only operational airfield is located at the north end of the island and runs in an approximate southwest to northeast alignment (Figure 12). The runways, taxiways, and apron areas are a combination of asphalt and concrete. The runway sits 60 feet above sea level and is 9,300 feet long by 200 feet wide. There were 15,310 air operations on NALF San Clemente Island in 2002, 13,605 air operations in 2003, 25,682 air operations in 2004, 25,889 air operations in 2005, and 30,004 air operations in 2006. The number of yearly air operations has increased since 2002. These operations were conducted using the current arrival and departure tracks for fixed-and rotary-wing aircraft.

1.8 CURRENT BASH ADMINISTRATION

The Bird Hazard Working Group (BHWG) for NBC was formed in 2000 with representatives from NAS North Island, NOLF Imperial Beach, and NALF San Clemente Island. They meet quarterly unless there are specific BASH related problems that arise that need immediate attention. This group is organized to: 1) implement and monitor the NBC BASH Plan; 2) collect, compile, and review bird/animal aircraft strike data; 3) recommend actions and changes in operational procedures to reduce hazards and 4) act on problem issues brought up by BASH personnel on NBC. The BHWG representatives are expected to disseminate pertinent information monthly from the meetings to co-workers within their respective departments. Informational materials are posted in areas that aircrew and air field operational personnel use (e.g. flight briefing rooms, offices, break rooms, restrooms, etc.) and in the control tower and airfield operation center. The group also prepares informational programs to inform and educate aircrews, airfield facilities operation personnel, public works personnel and natural resource personnel about the hazards of bird/mammal aircraft strikes and the importance of reporting incidences. The BHWG Chairperson, usually the Naval Base Coronado Aviation Safety Officer, also acts as the chairperson of the Naval Base Coronado Aviation Safety Council where BASH information, data and materials are disseminated to specific NAS North Island wing commands and squadrons. In addition, the chairperson may assist the NBC Commanding Officer by acting as a point of contact for off-base BASH issues.

The NBC BHWG consists of representatives from the following departments that are involved in the airfield operating environment:

a. Naval Base Coronado Aviation Safety Officer (ASO) (Chairperson)

b. Commander Navy Region Southwest, Environment Department, Natural Resource Office (NRO)

c. NAS North Island Airfield Operations Department

d. NAS North Island Air Traffic Control Division

e. NALF San Clemente Island Airfield Operations Department

f. NALF San Clemente Island Air Traffic Control Department

g. NOLF Imperial Beach Airfield Operations Division

h. NOLF Imperial Beach Air Traffic Control Division

i. Public Works Department

j. Morale, Welfare and Recreation Department

k. BASH Program Personnel (currently United States Department of Agriculture (USDA), Wildlife Services).

2.0 BASH ORGANIZATION AND RESPONSIBILITIES

2.1 BIRD HAZARD WORKING GROUP (BHWG)

The NBC BHWG is organized to implement and monitor the BASH Plan; collect, compile, and review bird and animal aircraft strike data; and to recommend actions and changes in operational procedures to reduce wildlife hazards to aircraft. It allows base offices which are affected by wildlife problems, specifically birds, the opportunity to meet and discuss possible solutions. The BHWG meets quarterly with representatives from each organization concerned with bird/animal aircraft hazards. The BHWG representatives are expected to disseminate pertinent information monthly, such as current and forecast bird activity, hazardous bird conditions on or around the airfield and in flight tracks, and bird/animal aircraft strike data from the meetings to co-workers within their respective departments. Informational materials are expected to be posted in areas that aircrew and air field operational personnel use (e.g. flight briefing rooms, offices, break rooms, restrooms, etc.) and in the control tower and air field operation center and presented at the Aviation Safety Council (ASC) meeting. The group also prepares informational programs to inform and educate aircrews, airfield facilities operation personnel, public works personnel and natural resource personnel about the hazards of bird/animal aircraft strikes and the importance of reporting incidences. As a minimum, BHWG representatives and BASH contractors should keep current of present and emerging BASH issues and management technologies by attending BASH conferences, workshops or symposiums and be familiar with BASH resources, such as the BASH point of contact for the Navy BASH program, BASH related documents, and sources of supply for BASH management devices.

2.1.1 Composition

As a minimum, the BHWG shall have a representative assigned from the following departments that are involved in the airfield operating environment:

a. Naval Base Coronado Aviation Safety Officer (Chairperson)

b. Commander Navy Region Southwest, Environment Department, NRO

c. NAS North Island Airfield Operations Department

d. NAS North Island Air Traffic Control Department

e. NOLF Imperial Beach Airfield Operations Department

f. NOLF Imperial Beach Air Traffic Control Department

g. NALF San Clemente Island Aifield Operations Department

h. NALF San Clemente Island Air Traffic Control Department

i. Public Works Department

j. Morale, Welfare and Recreation Department

k. BASH Program Personnel (currently USDA, Wildlife Services).

2.1.2 Authority

The Commanding Officer NBC has responsibility for the BASH Program and is the approval authority for all BHWG recommendations. The Naval Base Coronado ASO will chair the BHWG. As part of the overall Aviation Safety Program the ASO is responsible for monitoring the effectiveness of the BASH program for NBC which includes Naval Base Coronado, NOLF Imperial Beach and NALF San Clemente Island. The Environmental Department, Natural Resource representative, Naval Safety Center and NAVFAC BASH Coordinator using information from the BASH contractor and other sources, shall be responsible for providing accurate data, analysis and recommendations relating to operations and reducing the bird/animal aircraft strike hazard, while working with federal and regulatory agencies, to insure compliance with regulation.

2.2 BIRD HAZARD WORKING GROUP: REPRESENTATIVE RESPONSIBILITIES

2.2.1 Chairperson – Aviation Safety Officer

a. Organize and lead all BHWG meetings.

b. Review and approve recommendations of the BHWG.

c. Issue specific guidance concerning actions required to implement the recommendations.

d. Ensure base-wide compliance with the BASH Plan.

e. Oversee BASH related issues at NOLF IB and NALF SCI.

f. In accordance with OPNAVINST 3750.6R and in coordination with respective squadron safety officers, ensure all aircrews comply with mandatory reporting of all bird aircraft strikes, both damaging and non-damaging to the Naval Safety Center.

g. Conduct periodic reviews of the BASH Program using the self-inspection checklist (Appendix 9).

h. Monitor the effectiveness of and adherence to the BASH Program.

i. Maintain a BASH awareness program.

j. Maintain the following databases: all bird/animal aircraft strikes, locations of hazardous bird/animal activity, monthly bird/animal numbers, runway crossings and locations.

k. Distribute BASH data to wings, squadrons, field operation personnel and others working in the airfield environment.

l. Recommend aircraft operational and maintenance changes to avoid areas and times of known hazardous bird concentrations.

m. Communicate frequently, daily or weekly, with airfield operational personnel conducting BASH management activities.

n. Ensure the BASH Program is discussed at Aviation Safety Council meetings, is part of other aerial activities held at NAS North Island (air shows), and is part of the safety review conducted by the Naval Safety Center.

o. Keeps current of present and emerging BASH issues and management technologies by attending BASH conferences, workshops or symposiums and be familiar with BASH resources, such as the BASH point of contact for the Navy BASH program, BASH related documents, and sources of supply for BASH management devices.

2.2.2 Commander Navy Region Southwest Environmental Department Natural Resource Office

a. Designate the most appropriate biologist to the BHWG.

b. Oversee and conduct ongoing avian/airfield surveys and provide data and analysis to the BHWG.

c. Initiate necessary environmental documentation for implementation of BASH management practices.

d. Develop the following NBC databases for Naval Base Coronado: all bird and wildlife aircraft strike, locations of hazardous bird/animal activity, monthly bird/animal numbers, runway crossings and locations.

e. Obtain and maintain federal permits required for depredation, salvage, collection, and possession of all protected wildlife species.

f. Develop and coordinate studies, as necessary, to document wildlife hazards and evaluate the effects of BASH management activities and its impacts on bird populations on and around the airfield.

g. Communicate BASH related information with operational personnel conducting BASH management activities.

h. Disseminate pertinent information monthly to ASO on current and forecasted bird hazards, BASH monitoring and management activity, and other BASH related issues.

i. Oversee and manage BASH related issues at NOLF Imperial Beach and NALF San Clemente Island.

k. Maintain BASH expertise by keeping current with present and emerging BASH issues and management technologies by attending BASH conferences, workshops or symposiums and familiarity with BASH resources, such as the BASH point of contact for the Navy BASH program, BASH related documents, and sources of supply for BASH management devices.

2.2.3 Air Operations Department

a. Designate a representative to the BHWG.

b. Monitor bird attractant vegetation, grass height, foliage growth, drainage ditches, persistent standing water, etc., and report problems to the Public Works Department and Environmental Department NRO and the NRMO.

c. Report all bird strikes to ASO, BASH personnel, and Environmental Department NRO.

d. Ensure that department personnel collect, bag and complete a remains form (Appendix 10) for any bird/animal remains found on the airfield and store them in a centralized BASH freezer.

e. Keep current of present and emerging BASH issues through ASO training programs.

f. Request and maintain funding in support of the BASH Plan and personnel assigned to conduct BASH program activities.

2.2.4 Air Traffic Control Department

a. Designate a representative to the BHWG.

b. At the discretion of the Tower Supervisor, declare Bird Watch Conditions (BWC) based on reported sightings or criteria discussed in Section 4.0-BASH Procedures**.** The Air Traffic Control (ATC) Tower Supervisor will have the responsibility of downgrading the BWC: SEVERE once updated information is available.

c. Advise the Aviation Safety Officer, CNRSW Environmental Department NRO, Airfield Operations Duty Officer and BASH contractor anytime BWC: SEVERE condition is declared.

d. Alert BASH contractor and/or Airfield Operations personnel of bird or animal watch conditions that require dispersal procedures.

e. Allow BASH contractor priority movement on the airfield to investigate or disperse birds or animals on or around the airfield.

f. Include BWC and bird advisory information in Automated Terminal Information Service (ATIS) broadcasts, update as necessary.

g. Issue bird advisory information to aircraft over ATC frequencies per FAA Orders 7110.65.

h. Establish a training program covering BASH for all ATC personnel (document and review training annually).

j. Keep current of BASH issues through ASO training programs.

k. Fill out bird strike report and notify ODO and ASO of bird strikes.

2.2.5 Public Works Department

a. Designate a representative to the BHWG.

b. Ensure the implementation of BHWG proposed projects approved by the CO to reduce wildlife and bird hazardous conditions on and around the airfield.

c. Maintain the PSA lateral and approach zones of the runway complexes of NAS North Island, NOLF Imperial Beach, and NOLF San Clemente Island in a manner that is least attractive to birds, based upon recommendations from the BHWG.

d. Manufacture and place signs in appropriate locations around the airfield that inform and educate the public to the potential hazards of wildlife, specifically birds, to aircraft operations.

e. Ensure all trash, road-kill, and other bird/animal attractants found on base are policed.

f. Ensure all trash receptacles near the PSA are kept covered and are emptied regularly to prevent overflow and be less attractive to birds/animals.

g. Keep current of present and emerging BASH issues through ASO training programs.

2.2.6 Morale, Welfare and Recreation Department

a. Designate a representative to the BHWG.

b. Report wildlife, specifically bird activity, on Morale, Welfare and Recreation (MWR) facilities, i.e. golf course, softball fields, to ASO that could be hazardous to aircraft operations.

c. Ensure implementation of BHWG proposed projects approved by the CO to reduce bird and animal watch conditions at MWR facilities near the airfield.

d. Keep current of present and emerging BASH issues through ASO training programs.

e. Manage habitats on golf course to reduce wildlife, specifically bird activity to might pose a hazard to aircraft.

2.2.7 BASH Program Personnel (currently USDA, Wildlife Services, Contractor)

a. Provide a representative to the BHWG.

b. Provide at least one full-time personnel operating on a flexible work schedule of 80 hours/pay period (every two weeks) to conduct BASH activities on NASNI, NOLFIB and NALFSCI. Generally, daily activities will be conducted during daylight hours on weekdays for approximately six to ten hours/day, however night and weekend activities may be necessary should hazardous conditions occur during aircraft operations within the PSA.

c. Conduct daily surveys of wildlife, specifically bird activity, on and around the airfield and maintain a daily log/database of these surveys.

d. Conduct BASH management operations for the purpose of identifying and managing wildlife (birds and animals) that are hazardous to aircraft operations.

e. Make the BWC reports to the Tower and recommend changes that occur in the watch, when the BASH contractor is patrolling the airfield.

f. Use an Integrated Wildlife Damage Management (IWDM) approach to managing wildlife, specifically birds, which pose a BASH hazard to aircraft operations.

g. Communicate frequently, daily or weekly, with ASO, NRO and airfield operational personnel regarding BASH management activities or issues.

h. Report all bird strikes to ASO and NRO.

i. Ensure that wildlife remains found are collected, location noted, bagged, a remains form (Appendix 10) is completed and stored in a centralized BASH freezer. A copy of the form should be sent to Matt Klope, NAVFAC BASH Coordinator.

j. Keep current of BASH management technologies by attending BASH conferences, workshops or symposiums and maintain familiarity with BASH resources, such as the BASH point of contact for the Navy BASH program, BASH related documents, and sources of supply for BASH management devices.

2.3 OPERATING AIRCREW RESPONSIBILITIES

The installation ASO is responsible for disseminating pertinent information regarding the BASH Plan, current and forecast bird activity, hazardous bird conditions on or around the airfield and in flight tracks, and bird/animal aircraft strike data to squadron ASOs either through the Aviation Safety Council meetings or squadron briefings.

2.3.1 Squadron ASO

a. Attend Aviation Safety Council meetings.

b. Ensure all aircrews comply with mandatory reporting of all bird/animal aircraft strikes, damaging and non-damaging.

c. Ensure aircrew briefings are conducted on BWCs, flight avoidance procedures, reporting bird activity to ATC, and reporting bird strikes.

d. Make BASH part of all briefings, especially during peak bird activity on and around the airfield and during bird migration periods.

e. Issue specific guidance to maintenance personnel for reporting of all discovered bird/animal strikes on aircraft.

f. Issue procedures for the preservation of bird remains if discovered on an aircraft.

2.3.2 Aircrew

Aircrew operating aircraft in the airfield-operating environment at NAS

North Island, NOLF Imperial Beach & NALF San Clemente Island must consider the BASH potential associated with the individual airfield and flight patterns. During flight mission planning aircrew must include considerations of the local BASH conditions at each field. The following recommendations for minimizing the potential of a bird/aircraft strike should be adopted by aircrew during the mission planning phase:

a. Check Flight Information Publication (FLIP) AP/1 (Supplementary Aerodrome Remarks) and Notices to Airmen (NOTAMS) for information about permanent and seasonal bird problems at both departure and destination airports and on route of flight.
b. Consult with the Squadron Aviation Safety Officer for BASH information.
c. Brief all crewmembers on potential bird problems.
d. Discuss emergency procedures before departure, including aborts following a strike and engine failures.
e. Report all bird/animal strikes using BASH reporting procedures and forms (Appendix 11). Also, report wildlife strike to ODO and ASO.
f. Discuss procedures for cockpit lost communications, including change of aircraft control.
g. Be familiar with BWC terminology.
h. Note ATIS BWC. Ask tower personnel for specific bird locations or information.
i. When taxiing, watch for birds on the airfield. Many birds have a gray or black coloring on their backs making them hard to see on the tarmac or concrete. Flocking birds may be partially hidden in grass areas. Look for

raptors circling overhead, perched in tress, tall bushes, and on airfield structures. Notify tower personnel of bird activity and request dispersal procedures be employed when applicable.

j. When conducting formation or section departures, increase the interval between aircraft departure to 30 seconds during bird watch condition “MODERATE” to eliminate a chance that the wingman may encounter birds flushed by the lead aircraft.

k. Use landing lights during take-off, climb, descent, approach and landing. Although, there is no conclusive evidence that birds see and avoid aircraft lights, they will make the aircraft more visible.

l. Travel as much as possible above the bird layer. More than 50% of all strikes occur below 100feetand 88% of all strikes occur below 2000feet. In practice, this means to climb to 500feet Above Ground Level (AGL) as rapidly and safely as possible and continue to climb without delay to 2000feet.

m. If you see birds ahead, attempt to pass above them, as birds usually break away downward when threatened.

n. If dense bird concentrations are expected, avoid high-speed descent and approach. Reducing speed can significantly reduce impact energy. (The force of impact is roughly proportional to the square of the aircrafts speed.)

o. If flocks are encountered during approach, go around for a second attempt; the approach area may then be clear.

p. When able, descend and climb-out in a straight line. This makes it easier for the birds to anticipate your flight path and thus get out of your way.

q. Be aware of the increased hazard one hour before and after dawn and dusk to the maximum extent practical.

r. When practical, reduce low-level flight time. Ninety-nine percent of all bird strikes occur below 2,300 feet AGL.

s. Reduce formation flying. The first aircraft can redirect birds into trailing aircraft.

t. Reduced airspeeds allow birds to be seen sooner and lessen damage in event of a strike.

u. Avoid areas with known raptor concentrations between times of 1000 to 1600 when there are increased thermals.

3.0 BASH WILDLIFE HAZARD ASSESSMENT, MONITORING, MANAGEMENT AND RECOMMENDATIONS

3.1 WILDLIFE HAZARD ASSESSMENT

3.1.1 NAS North Island: 1996-1997

The NWRC conducted a WHA during 1996-1997 to: 1) identify and map the NAS North Island environments that attract birds, 2) quantify bird use of NAS North Island by species and number, 3) monitor movement patterns of western gulls by tagging and telemetry, 4) summarize bird/animal aircraft strike information for NAS North Island, and 5) make recommendations to reduce bird/animal aircraft strike hazards at NAS North Island (Cummings and Foley 1997 (Appendix 1)).

3.1.1.1 Bird Attractants

During the NAS North Island WHA, all areas that represented the greatest risk to pilots and aircraft were mapped (Figure 7). These were areas that attracted significant numbers of birds of risk, were generally adjacent to runways, and posed the greatest risk to pilot and aircraft. Birds were attracted to these areas for foraging, nesting, loafing and/or roosting. The following are key areas that made the installation very attractive to birds during the WHA:

<u>1. Approach end of runway 18</u> - This area was a mix of low vegetation consisting primarily of ice plant. The vegetation pattern was intermittent in several areas due to the substrate being covered with a layer of soil cement several years earlier. The open area among ice plants was generally sand. This type of habitat was very attractive to western gulls for nesting and roosting because it protects against prevailing winds, is good ground

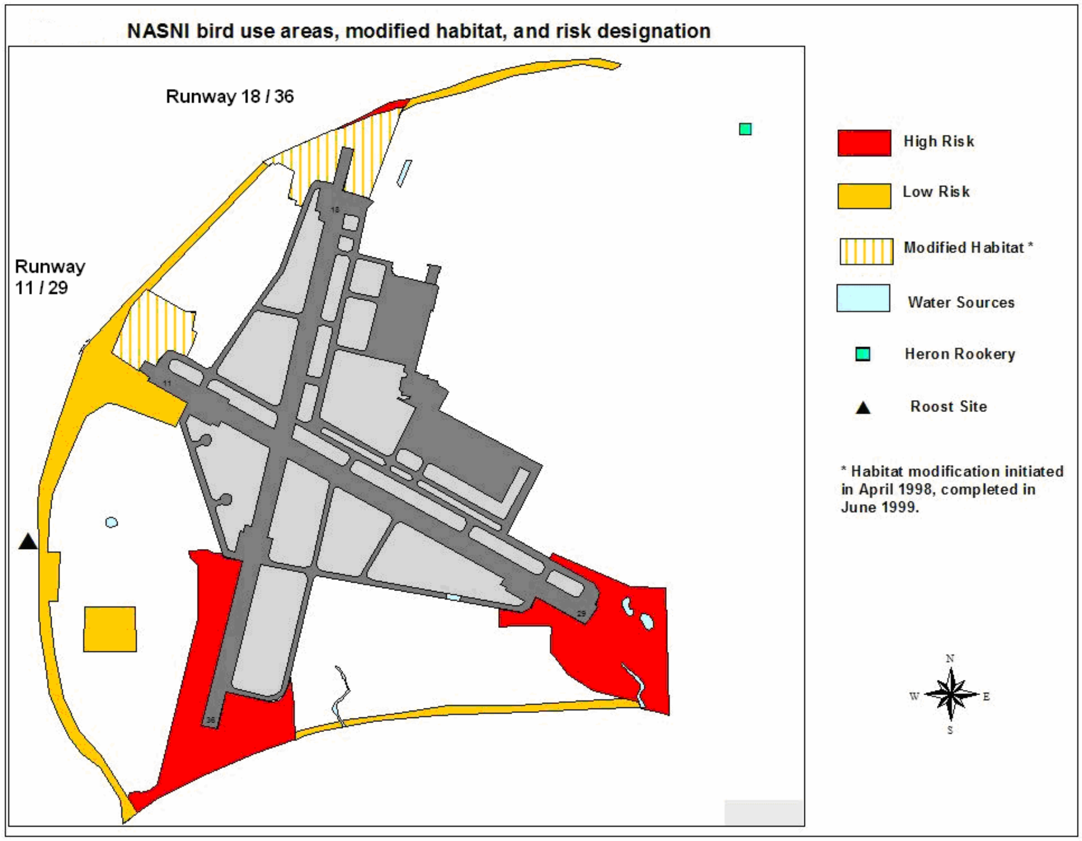

Figure 7. Risk areas at NAS North Island based on bird species, numbers and runway crossings during the WHA.

cover for nesting (Winnett-Murray 1979), is a good vantage point to observe other gull activities, and allows for good visual detection against intruders. In addition, great blue herons (*Ardea herodias*) and red-tailed hawks (*Buteo jamaicensis*) were attracted to this area primarily to prey on the resident ground squirrels (*Spermophilus beecheyi*). Burrowing owls (*Athene cunicularia*) use abandoned ground squirrel holes in this area for nesting and roosting. Rock pigeons (*Columba livia*) and mourning doves (*Zenaida macroura*) were attracted to this area because of the seed producing plants and grit.

2. Approach end of runway 11 - This area consisted of a large open tract of sand with virtually little vegetation and was identified as an alternate nesting site for endangered California least terns. Vegetated areas were dominated by ice plant. The

density and growth patterns of ice plant made this area very attractive to western gulls for nesting and loafing. Over 150 western gull nests and 2,500 roosting western gulls were recorded in this area. Great blue herons, red-tailed hawks and burrowing owls were observed foraging in this area. The beach area adjacent to the approach attracted as many as 800 to 1,000 birds including: waterfowl, shorebirds, California brown pelicans (*Pelecanus occidentalis californicus*) and other gulls that foraged and loafed here.

3. Approach end of runway 29 - This area has several diverse habitats. On either side of the approach end of runway 29 are dense stands of trees, fresh water ponds, a golf course and a large tract of mixed grasses and ice plant. A variety of birds are attracted to this area including American coots (*Fulica americana*) and several species of waterfowl and gulls were documented using the ponds. Over 500 ducks and coots were observed using this area daily;

4. Approach end of runway 36 - The primary vegetation type was ice plant. This area is not generally used by gulls, but instead by common ravens (*Corvus corax*), great blue herons, red-tailed hawks and European starlings (*Sturnus vulgaris*). However, the beach which is within 300 feet of the runway attracts brown pelicans, double-crested cormorants (*Phalacrocorax auritus*) and several species of gulls and shorebirds. Over 450 birds were observed in this area;

5. Weapons compound - Over 30 western gulls were observed nesting and 350 western gulls were observed roosting in this area, on the ground within the compound fences.

6. Heron rookery - A heron rookery in the northeast corner of the installation was not a direct threat to aircraft, but birds, primarily great blue herons from this rookery

would fly across the airfield (runways) to foraging sites. Most crossings occurred from April through July, with peaks in April and July. February was the only month without a documented heron runway crossing.

7. Beach - The beach and rocky areas surrounding the installation attract several species of birds including brown pelicans, double-crested cormorants and several species of gulls and shorebirds for loafing, foraging and roosting. The birds that use these areas, which are in close proximity to the airfield, represent a hazard to aircraft operation because of their movement patterns in and around the approaches and runways.

8. Piers and Ramps - The two primary locations that birds congregated for loafing and roosting were the weapons off-loading pier and the seaplane ramp number ten. More than 1,000 Heermann's gulls (*Larus heermanni*), western gulls and brown pelicans were documented using the weapons pier for roosting. The seaplane ramp was generally used during the day for loafing by western gulls, cormorants, brown pelicans and Heermann's gulls.

3.1.1.2 Bird Strikes

From April 1996 to April 1997, there were 27 bird/aircraft strikes on NAS North Island. Of these, western gulls represented 77%, mallards (*Anas platyrhynchos*) 9%, American coots 4.5%, and great blue herons 4.5%. The remaining 5% bird/aircraft strikes were divided between barn swallows (*Hirundo rustica*), ravens and lesser scaup (*Aythya affinis*). Most strikes that occurred between March and September were attributed to western gulls, whereas waterfowl were struck most often between October and February. Approximately half of all strikes occurred during landing. The strike reporting rate at NAS North Island during this period was about 30%, which is slightly higher than the 25% reported by the Naval Safety Center.

3.1.1.3 Bird Numbers and Runway Crossings

During the WHA period, bird use patterns on NAS North Island varied by species, time and location. There were 33 species of birds reported using the airfield. Observations indicated that the greatest bird activity on the airfield occurred during May (Figure 8).

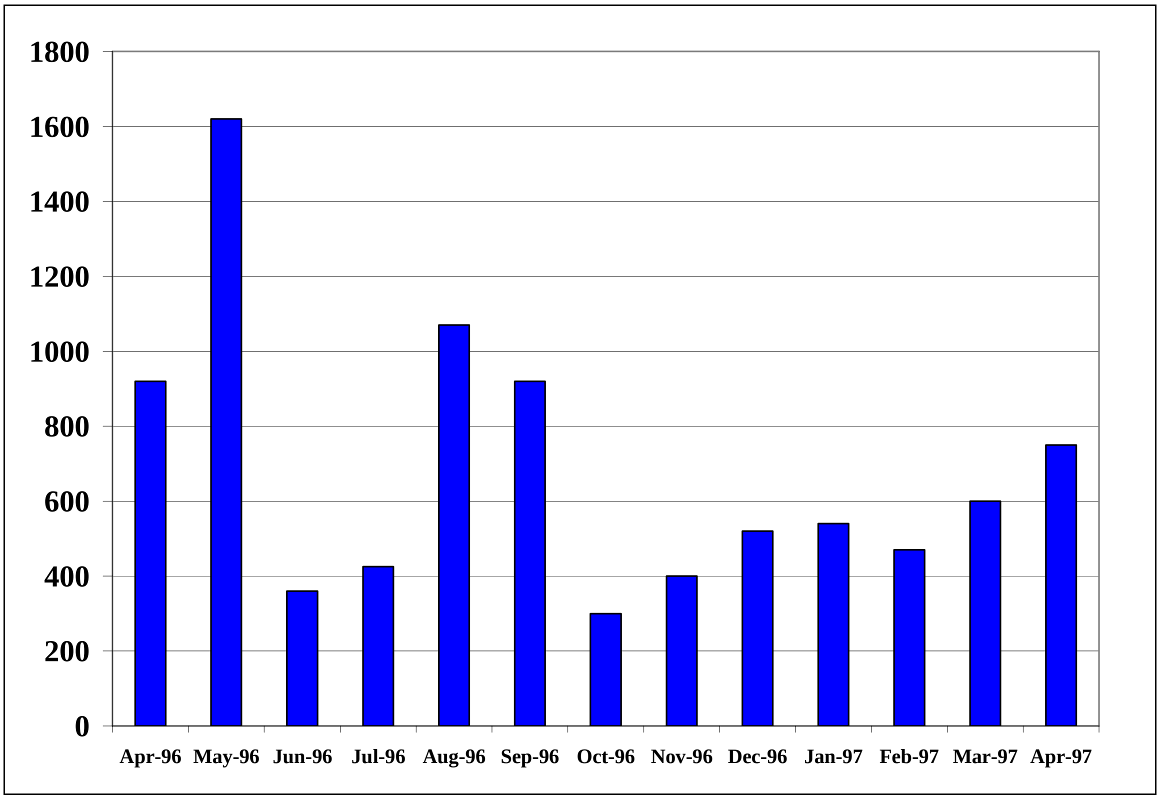

Figure 8. Daily bird numbers on NAS North Island April 1996 through April 1997 during the WHA.

Daily counts during this month documented about 1,600 birds, mostly western gulls, using the airfield. Waterfowl, specifically mallards, American wigeons (*Anas americana*) and American coots, peaked during December and January when birds were congregating on wintering areas. They mainly used the two ponds and the golf course adjacent to runway 29. Seasonal changes in bird populations on NAS North Island shifts the potential bird aircraft strike hazard from one species to another and from one location to another on the airfield. For example, there was a greater potential strike hazard on runway 18 during April and May from western gulls whereas during December and January there was a greater risk to aircraft from waterfowl at the approach of runway 29.

The greatest number of bird runway crossings occurred during May, August and April (Figure 9). Western gulls, great blue herons, starlings, mourning doves and pigeons

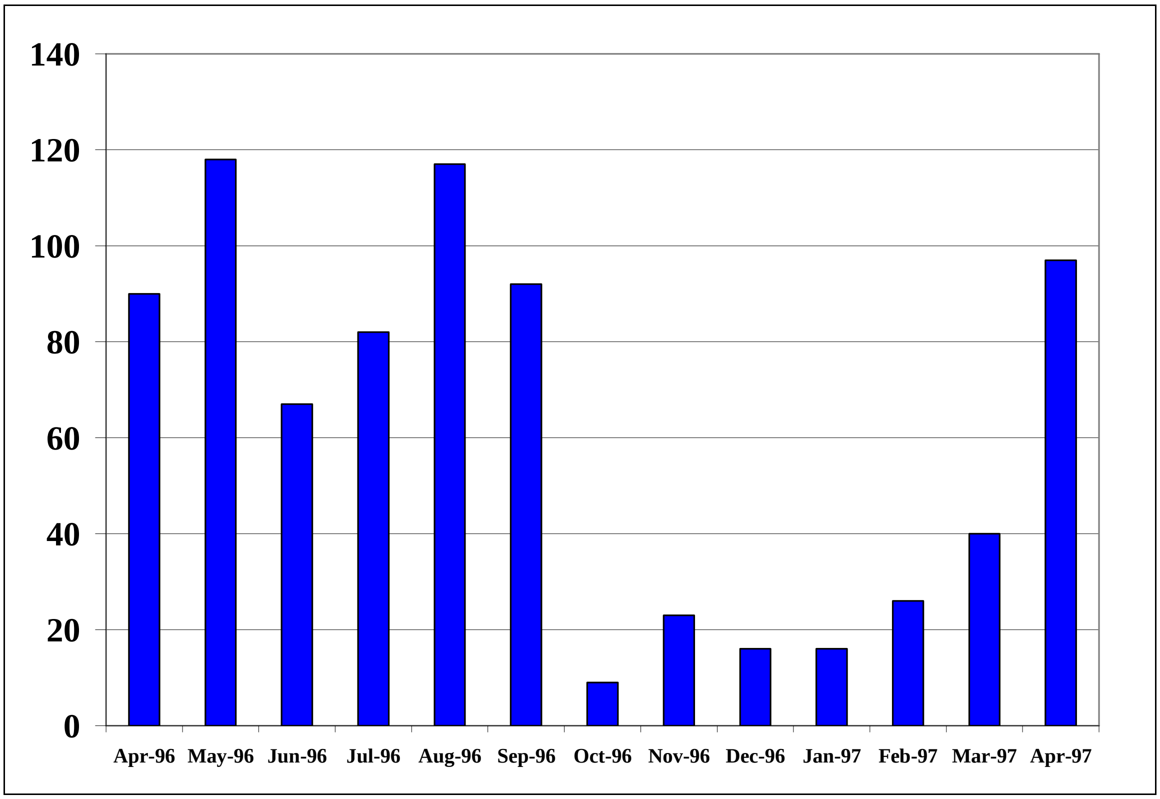

Figure 9. Daily runway crossings by birds on NAS North Island April 1996 through April 1997 during the WHA.

represented about 96% of all birds observed crossing runways. Double crested cormorants and brown pelicans were also observed infrequently crossing runways. Western gulls represented about 76% of all birds observed crossing runways. Over 87% of the runway crossings by western gulls occurred from April through September with a peak in May and August. These peaks are associated with pre- and post-nesting periods when bird movements are most numerous. During the nesting period, June and July, birds spend little time away from nesting territories except for short feeding bouts. The number of bird runway crossings during June and July dropped approximately 45% and 35%, respectively, over the previous months.

3.1.1.4 Summary

A number of BASH recommendations from the 1996-97 WHA which included habitat management, population control and integrated bird management were implemented following the assessment. Habitat that attracted ground squirrels, western gulls for loafing and nesting, and raptors for foraging was soil cemented which eliminated the use of this habitat by these species, contributing significantly to the reduction in the number of bird/animal aircraft strikes. Population control of breeding western gulls using the airfield and roosting on the runways at night also reduced the number of gulls using the airfield and the number of western gull bird/animal aircraft strikes.

3.1.2 Naval Air Station North Island: 1999 - 2002

3.1.2.1 Bird Numbers

A Wildlife Hazard Monitoring (WHM) program was started in 1999 and continued through 2002 (York et al. 2000 (Appendix 2), 2001 (Appendix 3), Sheffer and Cummings 2002 (Appendix 4), Cummings and Sheffer 2003 (Appendix 5)). During the 2002 WHM program, bird activity on the airfield peaked during August. The average daily number of birds using the airfield during this month was 730. Terns, including royal terns (*Sterna maxima*) and California least terns were observed mainly near structures close to the approach of runway 18 and gulls, including western gulls, accounted for about 54% and 23% of the number of birds observed during August, respectively. The lowest bird activity occurred during February 2002, when an average of 105 birds were observed daily on the airfield. Western gulls, European starlings, and house finches (*Carpodacus mexicanus*) were the most numerous bird species observed during the February monitoring period. The highest bird activity occurred during the morning observation periods (sunrise to 1000). Overall bird numbers during the 2002 monitoring period were lower than previous years, especially western gulls, which were 42% lower than what was observed in 1996-1997.

3.1.2.2 Bird Runway Crossings

The number of runway crossings by birds was highest during May and June 2002. More than 60 runway crossings by birds were documented during each month. The main areas of concern for runway crossings are the approach to runway 29 and the area northeast of the approach to runway 18. House finches and European starlings comprised 63% and 10%, respectively, of birds observed crossing runways during May, and 43% and 27%, respectively, of birds observed crossing runways during June. The lowest number of runway crossings occurred in December 2002 when an daily average of six birds were observed crossing runways. Western gulls, willets (*Catoptrophorus semipalmatus*) and American crows (*Corvus brachyrhynchos*) had the next highest number of runway crossings.

The greatest number of runway crossings occurred during the morning observation period. Since 1996-1997, overall runway crossings by birds have declined. For instance, western gull crossings have dropped from a mean daily number of 41 crossings in 1996 to three in 2002.

3.1.2.3 Bird Strikes

During the 2002 monitoring period, six bird/aircraft strikes were reported to the NSC which included two western gulls and four unidentified birds (unpubl.data. Naval Safety Center 2002). In addition, NWRC personnel found nine dead birds which were determined to be bird/animal aircraft strikes. Of these there were two California least terns, one house finch, one juvenile mourning dove, one European starling, one mallard, one double-crested cormorant and the remaining two were unidentified. All of these birds were found either on or in close proximity to the runways, and seven were found on or near runway 18-36. The number of reported annual bird aircraft strikes has decreased significantly from 27 in 1997 to 6 in 2002.

3.1.2.4 Bird Roosting Locations

No birds were observed roosting on the runway, but there were three areas in close proximity to the airfield where birds were observed roosting. These areas were Zuniga Beach and Zuniga Point (west of runway 18-36) and the Weapons Pier (northwest of runway 11-29). These areas had mean daily numbers of birds ranging from one to 19 with species such as western gulls, Heermann's gulls, sanderlings (*Calidris alba*) and California brown pelicans. The daily mean number of birds roosting in these areas was highest in August and September 2002 and lowest in February and March 2002. Movements of birds in these areas are generally restricted to open water or along the coastline just above water level. However, on occasion, several of the above species were observed flying through the flight path of departing or landing aircraft (Sheffer et al. 2002).

Bird roosting areas on and around the airfield have been dramatically affected since 1996-1997. For example, in 1999, 52 acres of gull nesting and loafing habitat at the approach end of runways 11 and 18 were soil cemented. This process reduced ground squirrel habitat and activity which in turn reduced the number of overall avian predators (i.e. hawks, herons and gulls) using this area (York et al. 2000 (Appendix 2)).

3.1.2.5 Summary

Of the birds observed on NAS North Island, house finches, European starlings and western gulls present the greatest risk to pilots and aircraft. An integrated management strategy directed at the species of concern, their foraging and loafing/roosting habitat should have a large impact on aircraft safety. Elimination of the golf course ponds near the approach to runway 29 and bird hazing at the approach to runway 18 could be the most effective measures to reduce the bird hazard on NAS North Island. If not possible, then grid wires over the top of the ponds will help to reduce the majority of the bird use. However, some birds such as gulls will forage between grid wires and some waterfowl will avoid landing directly on the ponds but still forage adjacent to the wire grid ponds. Also, maintenance of grid wires is key in not letting birds become habituated to the grid system.

While western gulls are still observed on the airfield, their numbers are far lower than in 1996-1997. Mean daily numbers observed were 453 in 1996-1997 as compared to 48 in 2002; mean daily number of runway crossings were 42 in 1996-1997 as compared to three in 2002. Western gull use of the NAS North Island airfield has been reduced significantly by lethal and non-lethal control efforts including hazing, effigies and elimination of nesting, loafing, foraging and roosting areas. However, percentage of tern including: Royal terns, Forster's terns (*Sterna fosteri*), Caspian terns (*Sterna caspia*) and elegant terns (*Sterna elegans*) have greatly increased since 1996. They represented 18% of the number of birds observed in 2002, and only 3% in 1996. Terns on or around the airfield were almost exclusively observed along the coastline of the San Diego Bay in areas on the edge of the airfield. These birds, because of their location, do not pose a great risk to aircraft operations.

Direct population control can be an effective short-term solution to reducing the bird/aircraft hazard at NAS North Island. Removal of European starlings and house finches especially just before and during the breeding season would be most beneficial since they pose the greatest problem at NAS North Island. Management of individual species should be based on population numbers, presence, movement patterns, size, weight, activities and habitat preference. Dispersing western gulls using gull effigies has been successful in the past and efforts should be continued in areas around the airfield where the gulls congregate for foraging, loafing, or roosting. Dispersing birds with hazing techniques or developing innovative control measures to manage the bird/aircraft hazard at NAS North Island will require significantly more logistical support for a longer duration.

3.1.2.6 Current Problem Birds at NAS North Island

The 2002 Wildlife Hazard Monitoring assessment ranked the top 15 birds of concern on NAS North Island based on mean daily runway crossings:

Birds of Concern	Mean Daily Runway Crossings
1. House finch	8
2. European starling	5
3. Western gull	3
4. Willet	2

5.	American crow	2
6.	Mourning dove	1
7.	Great blue heron	1
8.	Caspian tern	<1
9.	California least tern	<1
10.	Shorebird *spp*.	<1
11.	Barn swallow	<1
12.	Horned lark	<1
13.	Red-tailed hawk	<1
14.	Gull *spp*.	<1
15.	Common raven	<1

A bird profile has been developed for each of the above birds that pictorially identifies each bird, its habitat requirements, its food habits, its regulatory status, its annual presence, numbers and runway crossings on NAS North Island and the best management practices for each when present on or around the NAS North Island airfield (Appendix 12). The bird profiles will help airfield operation personnel and BASH operation personnel to understand the biology and habitat requirements of these birds, their movement patterns, and presence in the PSA, and management actions that can be taken to reduce or eliminate the BASH hazard from these respective birds.

3.1.2.7 Recommendations

1. Monitor and update bird/animal aircraft strike hazard plan for the installation per Department of Defense (DOD) Instruction 4150.7, Pest Management Program, Chapter 9, Section D and Chief of Naval Operations Instruction (OPNAVINST) 5090.1B Chapter 22,
2. Develop and implement a habitat management plan.
    - Prioritize bird hazard areas on NAS North Island based upon runway crossings, bird use, and bird strike locations.

- Restructure golf course ponds near the approach of runway 29 by filling, draining or moving them to other locations to reduce their attractiveness within the PSA.
- Remove all unnecessary structures, junk, and debris within the PSA (specifically the Federal Fire Department and Compass Rose graveyard) which are used by birds for loafing.
- Install anti-perching devices on structures remaining within the PSA, including buildings, equipment, markers and lights on the airfield and radar towers.
- Keep lids to trash dumpsters closed.

3. Continue to monitor and review BASH activities at NAS North Island. Continue ongoing monitoring activities of wildlife by NAS North Island personnel and/or BASH contractor. Apply these monitoring activities to high risk areas identified in this report.

4. Develop a set of operational procedures for ATC that takes into account risk of bird strikes based on seasonal and daily variability in numbers of birds, species present and historic estimates of runway crossings based upon existing and future monitoring data.

5. Provide information to all aircrews about current bird aircraft strike hazards at NAS North Island. It should be mandatory that all pilots, air operations, and ground personnel report any bird/animal aircraft related incidents, i.e. blood on the aircraft, bird parts on the runway or taxiway, damage to the aircraft, etc.

6. Implement a no bird/animal feeding program. Post “no feeding” signs at the air terminal and surrounding buildings that discuss the reasons birds and animals should not be fed. Police outside break and lunch areas for trash. Trash bins and dumpsters should always remain closed.

7. Implement a species specific population control program. Emphasis should be on small flocking birds.

- Lethal control of European starling and house finch populations.
- Non-lethal control, removal, and dispersal when it is practical and effective use of lasers, traps, mechanical devices and pyrotechnics.

8. Continue to employ a dedicated BASH person to implement and monitor BASH activities.

9. Train Navy personnel in wildlife hazing procedures and species identification.

10. Adopt a policy of zero tolerance toward hazardous wildlife within the PSA.

11. Discourage restoration or remediation of habitat adjacent to the airfield for endangered or threatened species.

12. Concentrate hazing efforts within the PSA.

13. The dedicated BASH person should continue to update the installation ASO on BASH threats and program activities.

3.1.2.8 Current BASH Management at NAS North Island: 2002

Wildlife Services rely mainly on non-lethal management tools to conduct BASH management at NAS North Island (Appendix 13). This includes habitat modification, translocation, grid wires and devices used to disperse birds including pyrotechnics, audio distress or alarm calls, and effigies. Effigies are used for gull species. Direct population control is usually used to reduce over-abundant bird populations such as starlings, finches and rock pigeons that are using the PSA (Figure 10). However, when bird species present an immediate threat to pilot and aircraft they are either trapped or shot.

Figure 10. Wildlife Services personnel use non-lethal trapping techniques to remove rock pigeons and other birds that are using the PSA at NAS North Island. (photo by Kevin Lansford, U.S. Department of Agriculture, Wildlife Services, El Cajon, CA, July 1996).

Wildlife Services personnel dispersed 5,944 birds from the NAS North Island airfield using pyrotechnic devices and audio harassment during the 2002 management period. The most commonly dispersed species were western gulls, Heermann's gulls, mallards, American coots and great blue herons. Western gulls and Heermann's gulls represented about 98% of all birds dispersed. The number of birds, chicks and eggs removed and/or destroyed in 2002 was 194. Of these, American coots, rock pigeons, and western gulls represent 41%, 18%, and 14%, respectively, of the birds removed. Wildlife Services personnel worked 1,609 staff-hours on direct bird control activities on the NAS North Island airfield from February 1, 2002 to January 31, 2003.

In February 2002 golf course management agreed to fill in the ponds on the golf course adjacent to runway 29 and convert them into “waste bunkers” eliminating the attraction to waterfowl. However, on July 15, 2002, WS, Commander Navy Region Southwest, Environmental Department, NRO and golf course personnel met to discuss the ponds and associated issues. At this time WS was informed that the golf course ponds would not be converted into waste bunkers as was previously agreed upon and would be relined in the future and the grid wire system would be reinstalled and maintained. On October 1, 2002, WS, with assistance from golf course personnel, completed construction of the grid wire system over all three ponds. The wire system included a 12 inch poultry fence surrounding the pond to discourage waterfowl from walking into the water, as well as a tightened 10’ x 10’ square grid pattern over the ponds.

Two red-tailed hawks were captured, banded and translocated approximately 110 miles east of NAS North Island near El Centro, Imperial County, California. Neither of these hawks returned to NAS North Island. Relocation of raptors to distances where they will not return would meet strategies outlined by NASNI.

3.1.3 NOLF Imperial Beach: 2000

A WHA was conducted at NOLF Imperial Beach from November 1999 to October 2000 to determine wildlife abundance, wildlife periods of activity, identify and quantify features and land-use practices that may attract wildlife, review wildlife strike records and provide management recommendations for reducing wildlife hazards (Lansford 2000 (Appendix 7)).

3.1.3.1 Bird Strikes

Wildlife strike records for NOLF Imperial Beach from the NSC indicated that 112 bird strikes were recorded between 1981 and 2000. During the WHA period, five strikes were reported to WS personnel which included two western gulls, one white-tailed kite (*Elanus leucurus*), one American pipit (*Anthus rubescens*) and a strike by multiple unknown birds. Forty percent of the 112 strikes occurred between March and May, 25% were December through February, 21% from June through August and 14% from September through November. The species of the birds struck by aircraft were only recorded for three birds, a pelican, sparrow and owl, species unknown.

3.1.3.2 Survey of Bird Populations

The overall bird population at NOLF Imperial Beach peaked from November through January and March through May. Several species exhibited higher densities during the fall and winter months such as flocking birds, including American pipits. This had an impact on the number of birds observed on the airfield. Overall bird numbers by observation station were similar through the assessment period. However, there were individual differences in geographical use-patterns for several species. The most abundant birds observed on the airfield were western gulls, red-tailed hawks, turkey vultures, rock pigeons, great blue herons, European starlings, egret *spp*., waterfowl *spp*., blackbird *spp*., sparrow *spp*. and finch *spp*.

3.1.3.3 Recommendations

1. Designate a representative for the BASH Working Group and delineate responsibilities.
2. Obtain the necessary permits to control wildlife.

3. Train personnel in wildlife hazing procedures and species identification.
4. Have wildlife control supplies available and stored on site.
5. Continue monitoring wildlife populations and use patterns on the airfield.
6. Develop a record keeping system for wildlife strikes and control/hazing actions.
7. Advise Tower personnel when hazards are expected or observed.
8. Reduce and maintain pigeon population at low levels.
9. Remove nests in facilities.
10. Conduct habitat manipulation and evaluate wildlife hazards for new construction or land use changes.
11. Adopt a zero-tolerance policy toward hazardous wildlife and a policy for lethal control of persistent wildlife on the airfield.

3.1.4 NALF San Clemente Island: 2003

Prior to 2002, no official WHA or BASH program had been initiated at NALF San Clemente Island. From February 2002 to January 2003, a WHA was conducted to determine the hazards wildlife posed to aircraft at NALF San Clemente Island (Sheffer and Cummings 2007 (Appendix 6)).

3.1.4.1 Bird Numbers

Fifty-three bird species were observed on NALF San Clemente Island during the Wildlife Hazard Assessment period (Appendix 6). Bird observations indicated the greatest bird activity on the airfield occurred between June and December 2002. Peak bird activity was in August and November 2002 with daily bird counts averaging approximately 200 birds. The lowest bird activity occurred in March 2002, during which only a daily mean of 46 birds were observed. Most numerous birds observed during the assessment period were, in descending order, horned larks (*Eremophila alpestris*), European starlings, house finches and western meadowlarks (*Sturnella neglecta*).

There was little evidence of bird activity at night in and around the airfield. The greatest bird numbers were observed during April, when there was an average of two birds observed on the runway each night. Of the birds that could be identified, barn owls (*Tyto alba*), western meadowlarks, western snowy plovers (*Charadrius alexandrinus*) and burrowing owls (*Athene cunicularia*) were most commonly observed on and around the airfield during night surveys.

3.1.4.2 Bird Habitats

The habitat types could not be identified because the area in and around the airfield has not been mapped into ecological units using the current mapping system. The relative risk of these areas was ranked high, moderate or low based on bird numbers, bird movement patterns, locations and habitat types. Areas representing a high risk attracted significant bird numbers, had numerous bird crossings and had habitat types that birds preferred for foraging, loafing and roosting. The Wildlife Hazard Assessment study area was divided into three areas and the habitat of each discussed.

Area 1: Approach end of Runway 23. This area encompasses portions of the runway at the approach to 23, the overrun area, which is a mixture of all types of vegetation found elsewhere on San Clemente Island, and the cliffs, beach and water in the approach path to runway 23. The overrun area attracts several species of birds, such as horned larks , western meadowlarks, and chukars (*Alectoris chukar*) which use this area for foraging, nesting and loafing. The cliffs attract several species of large birds such as western gulls, California brown pelicans and red-tailed hawks that use this area for nesting, loafing and roosting. Also, the cliff area is used by small passerines such as house finches, house sparrows (*Passer domesticus*) on a regular basis and large flocks of European starlings during certain periods of the year for roosting. The open water under the approach to runway 23 is a flight corridor for several species of large birds moving from roosting sites to daily foraging areas. The open water is also foraging habitat for California brown pelicans, western gulls and double-crested cormorants. On occasion, western gull flocks foraging in this area exhibit “towering behavior” where birds will circle as a flock from water level to over 1000 feet AGL.

<u>Area 2: Runway 5-23.</u> This area includes the runway, taxiways, support structures and areas adjacent to the runway. Several species of birds have been observed in this area including small passerines such as horned larks, western meadowlarks, and house finches, red-tailed hawks, and common ravens. Vegetation habitats in this area are a combination of all types of vegetation found elsewhere on San Clemente Island, and the cliffs that attract bird species for foraging, nesting and loafing. Also, within this area is a ramp used for aircraft parking. The pad-eyes used to tie down aircraft act as collection reservoirs for water and seeds which in turn attract small birds, such as horned larks.

<u>Area 3: Approach end of Runway 5.</u> This area encompasses portions of the runway at the approach to 5, the overrun area which is a mixture of all types of vegetation found elsewhere on San Clemente Island, and the cliffs, beach and water in the approach path to runway 5. This area also encompasses the West Cove, which attracts several species. Although West Cove is on the edge of the assessment area, birds from this area move across the runway to and from sites on the northeast side of the island.

These areas all represent various degrees of risk to flight operations at NALF San Clemente Island. In general, areas 1 and 3 can represent a high risk to pilots and aircraft based on bird numbers, species observed, bird movement patterns and habitat. Area 2 represents a moderate risk based on fewer large bird movements into flight patterns, bird numbers, bird species, and habitats.

In addition, red-tailed hawks, common ravens and American kestrels (*Falco sparverius*) are attracted to the airfield in search of prey. These species have all been observed foraging in and around the airfield by NWRC personnel as well as Institute for Wildlife Studies predator control team. All of these species have been observed crossing the runway at various locations and altitudes. Biologists with Institute for Wildlife Services have documented red-tailed hawks nesting near the Sea Test Facility and West Cove Beach. Common ravens have been documented nesting near the Navy Seals camp, in the vicinity of the Sea Test Field, and near West Cove Beach. American kestrels have been documented nesting near the Sea Test Facility. Movements of these species from nest sites to foraging sites intersect the runway at various locations.

3.1.4.3 Bird Runway Crossings

Runway crossings varied each month, and daily mean runway crossings were most abundant from May to November 2002 with the greatest number of runway crossings occurring in August and September 2002. The lowest number of runway crossings occurred in March 2002 and January 2003, during which the daily mean number of birds crossing the runway was six. The greatest number of birds crossing the runway was, in descending order, horned larks, European starlings and house finches.

Daily mean runway crossings during August and September 2002 documented about 48 crossings, primarily by horned larks.

Observations by station indicate that station three had the greatest number of crossings and station five had the least number of crossings. Horned larks were the most abundant species crossing the runway at stations three and five. The peak daily mean number of runway crossings by station varied during the assessment period. For example, at station one, daily mean runway crossings peaked in July and August 2002, at station three, runway crossings peaked in August 2002, and at station six, runway crossings peaked in September, November, and December 2002.

During night observations, birds were only observed crossing the runway during two months of the assessment period. Most of these runway crossings occurred during April when an average of one bird was observed crossing the runway each night. Of birds that could be identified, western meadowlarks were most commonly observed crossing the runway.

3.1.4.4 Bird Strikes

During the WHA period, three bird/aircraft strikes were reported to the NSO which included a western meadowlark, a western gull and an unidentified small bird. Strikes occurred in March, April and August, respectively. Of the three strikes, the small, unidentified bird struck by an S-3 during final approach impacted the number one engine. Inspection revealed that the eleventh stage compressor blades cracked. The engine was removed and repaired.

In addition, NWRC personnel found eight dead birds during the WHA period which were determined as strikes and were informed by Berry Aviation of one other. Of these, three were horned larks, one was a western meadowlark, one was a barn owl, one was a northern fulmar (*Fulmarus glacialis*) and the remaining three were unidentified. All of these birds were found in close proximity to the runway.

3.1.4.5 Bird Roosting Locations

No birds were observed roosting on the runway, but there were four areas in close proximity to the airfield where birds were observed staging or roosting. These areas were Seal Island (north of the airfield), Sea Test Facility (southeast of the airfield), West Cove (southwest of the airfield), and Seals Beach (north of the airfield). Overall, double-crested cormorants (66%), unidentified gulls (11%), western gulls (10%), California brown pelicans (6%), European starlings (2%), and Heermann's gulls (2%) were the most frequently observed species roosting at areas around the NALF San Clemente Island airfield. Of the birds observed on Seal Island, double-crested cormorants represented about 84%, western gulls represented 6%, and California brown pelicans represented 5%. Of the birds observed roosting on concrete buoys and the cliffs near the Sea Test Facility, unidentified gulls represented about 44%, double-crested cormorants 25%, and European starlings 14%. Of the birds observed roosting on West Cove, western gulls represented about 40%, Heermann's gulls 19%, and double-crested cormorants 16%. Of the birds observed on Seals Beach, western gulls represented about 44%, California brown pelicans 18%, and Heermann's gulls 15%. Movements of these birds are generally restricted to open water or along the island's coastline just above water level. However, on occasion gull species have been observed flying or towering in the flight path of departing or landing aircraft.

3.1.4.6 Summary

Birds on and around NALF San Clemente Island airfield do represent a direct safety risk to aircraft operations. Every reasonable effort should be made to discourage birds from using NALF San Clemente Island habitat within the PSA of the airfield. Particular emphasis should be made to discourage birds from using habitat around and/or crossing the area near the approach to runway 23 and mid-field near station three. This habitat attracts a wide variety of bird species. Of the birds observed on NALF San Clemente Island horned larks, European starlings, house finches, barn swallows, red-tailed hawks, common ravens and western meadowlarks present the greatest risk to pilots and aircraft. An integrated management strategy directed at these species and others would have a large impact on aircraft safety and should be directed at the species itself, its foraging source and its loafing/roosting habitat.

Data gathered from the WHA indicates that habitat management, direct population control, innovative management techniques and dispersing birds from NALF San Clemente Island should significantly reduce the bird/aircraft hazard. Habitat management of the vegetation areas on either side of the runway could be the most effective measure to reduce the bird hazard on NALF San Clemente Island. The lack of a vegetation management plan on or around the airfield could result in a flight safety issue and compromise the operational readiness of the airfield. Horned lark, western meadowlark and chukar numbers could be greatly reduced by managing these areas with a covering material or mowing the vegetation to reduce seeding and/or bird cover. Making the airfield vegetation fairly uniform would also result in it being less attractive to wildlife species, especially birds. A vegetation management plan should be developed in order to understand the impacts of BASH recommendations.

Direct population control will be an effective short-term solution to reducing the bird/aircraft hazard at NALF San Clemente Island. Individual species could be targeted for management based upon their level of bird/aircraft strike risk. Small passerine birds (e.g. horned larks and house finches), European starlings, western meadowlarks, barn swallows, common ravens, red-tailed hawks and western gulls pose the greatest problems at NALF San Clemente Island and some species present a greater risk than others. Management of individual species should be based on population numbers, presence, movement patterns, size, weight, activities and habitat preference.

Dispersing birds with hazing techniques or developing innovative control measures to manage the bird/aircraft hazard at NALF San Clemente Island will require significantly more logistical support for a longer duration. For example, the presence of raptors and ravens around the airfield present a two-fold problem because they are large birds [red-tailed hawks: 1028-1224 g; ravens 1158-1240 g (Dunning 1984)] that are capable of causing significant damage to aircraft if struck. Dispersing these birds can be difficult, but not impossible. Eliminating nesting sites for either bird on the north side of the runway could reduce the number of runway crossings. Also, direct control of these species in and around the airfield would also alleviate the problem. Translocation of these species to other parts of the island would probably be ineffective. However, translocation of these species off the island to the mainland could be effective.

NALF San Clemente Island’s peak operating times are 0800 to 1600 hours Monday through Friday. The aircraft vary from multi-engine turbo prop to helicopters to fighter jets, but the majority of traffic is from twin-engine turbo props. The greatest daily bird activity was observed from June through December 2002 at all stations, with the peak months being August and November 2002. During these months, efforts such as mowing/weeding, pyrotechnics and hazing techniques should be taken to decrease the number of birds on and around the airfield. The birds generating the greatest risk on NALF San Clemente Island are, in descending order, horned larks, European starlings, house finches and western gulls. Removal of loafing, foraging and nesting habitat from the vicinity of the airfield by the above management techniques would greatly decrease the bird/aircraft strike hazard. Although three of these bird species are small in size, they are capable of causing damage to aircraft. In fact, European starlings are considered "feathered bullets" as they have a body density 27% higher than herring gulls. A flock of European starlings caused a C-130 military aircraft to crash in Eindhoven, Netherlands in 1996, killing 34 people (Dolbeer and Eschenfelder 2002). Horned larks represent 27% of NALF San Clemente Island strikes.

Stations three and five had the greatest daily bird activity during the WHA period, but many of the birds at station five were observed on West Cove Beach, thus there were very few runway crossings at station five. The greatest overall risk to aircraft operations is near station three (midfield between markers three and four on runway 5-23), where most bird runway crossings occur. Demolition of many of the buildings in station three, installation of anti-perching devices to any remaining structures, and vacuuming the pad-eyes in the ramp area would greatly reduce the foraging, nesting and roosting habitat in this station.

The greatest number of daily runway crossings occurred from May to November 2002, with peak months being August and September 2002. During these months, efforts such as mowing/weeding, pyrotechnics, hazing teams and translocation of birds should be taken to decrease the number of birds on and around the airfield. The birds generating the greatest risk to aircraft regarding runway crossings on NALF SCI are, in descending order, horned larks, European starlings and house finches. Forty-five percent of strikes have been found in the overrun areas of the approach to runway 5-23 have involved both small and large birds (horned larks to Northern fulmars). Thirty-six percent of strikes have been found alongside runway 5-23 from stations two through five and have involved both small and large birds (horned larks, western meadowlarks and barn owls). Thus, it appears station three and station five (between markers two and three on Runway 5-23, West Cove and West Cove Beach) present areas where the majority of birds are observed, also presenting a high risk to aircraft. Efforts should be made, especially in these areas, to decrease bird use of NALF San Clemente Island airfield.

NALF San Clemente Island conducts night operations from 1800 to 2300 hours on a regular basis, with field carrier landing practice being the most common. The greatest nightly bird activity was observed from February through March 2002, with the other months having no bird activity. Of birds observed, unidentified birds were most abundant (72%) with the rest consisting of barn owls (11%), burrowing owls, snowy plovers and western meadowlarks (5.5% each). Barn owls represent 10% and western meadowlarks represent 18% of bird strikes on NALF San Clemente Island. Runway crossings by birds occurred in March and April during the WHA. Unidentified birds crossing the runway on NALF San Clemente Island represent 80% and western meadowlarks represent 20%. As mentioned before, western meadowlarks represent 18% and barn owls represent 9% of strikes on NALF San Clemente Island. However, nighttime bird activity is low therefore the meadowlark strike most likely occurred during daytime air operations.

Birds crossing the airfield from roosting areas did not appear to present a high risk to aircraft since these areas were some distance from the airfield. West Cove and West Cove Beach attract several species of gulls, double-crested cormorants and California brown pelicans, which may cause some risk to aircraft if these birds cross the airfield from roosting to foraging areas.

3.1.4.7 Recommendations

1. Implement a habitat management plan.
    - Prioritize bird hazard areas on NALF San Clemente Island based upon runway crossings, bird use, and bird strike locations.
    - Conduct a plant survey around the airfield to ensure there are no threatened or endangered plant species on the airfield.
    - If vegetation cannot be removed, develop a mowing plan and conduct weed maintenance on the above-mentioned areas.
    - Address erosion issues per BASH recommendations.
    - Remove/demolish unnecessary structures in the vicinity of the airfield (such as buildings and unexploited equipment in Station 3).
    - Vacuum the pad-eyes in the ramp area on a regular basis.

- Install anti-loafing devices on structures remaining on or near the airfield, including buildings, equipment, markers and lights on the airfield and utility poles.
- Close lids of trash dumpsters around the airfield and in town.

3. Continue to monitor and review BASH activities at NALF San Clemente Island.
4. Establish a BHWG or assign a representative to the BHWG.
5. Develop high bird strike hazard airfield operation procedures. Develop a set of operational procedures for air traffic that takes into account risk of bird strikes based on seasonal and daily variability in numbers of birds, species present and historic estimates of runway crossings based upon existing and future monitoring data.
6. Provide information to all aircrews about the bird hazard at NALF San Clemente Island.
7. Implement a no bird/mammal feeding program.
8. Implement a species specific population control program. Emphasis should be on small flocking birds. Use of techniques identified in this report and lethal control actions should be used to reduce runway crossing by species of concern. All techniques must be approved by safety personnel before being implemented on NALF San Clemente Island.
    - Lethal control for populations of horned larks, European starlings, and house sparrows, when and where it can be legally implemented with traps.
    - Non-lethal control, removal, and dispersal when it is practical and effective using lasers, traps, mechanical devices and pyrotechnics.

9. Employ a wildlife specialist to implement and conduct wildlife, specifically bird control measures to reduce the bird/aircraft hazard.
10. Train Navy personnel in wildlife hazing procedures and species identification.
11. Adopt a policy of zero tolerance toward hazardous wildlife.
12. Continue BASH research. Continue research which improves on existing information and allows managers to accurately address BASH problems at NALF San Clemente Island.
13. Provide safety officer regular updates on BASH threats and program activities.

4.0 BASH PROCEDURES

4.1 OPERATING PROCEDURES AND BIRD HAZARD CONDITIONS

A procedure should be established for the immediate exchange of information between ground crews and aircrews concerning the existence and location of birds that could pose a hazard to air operations. The following standard Bird Watch Conditions (BWC) will be used at NAS North Island to warn aircrew and support personnel of the current bird-related threat to air operations. These codes are identical to the U.S. Air Force codes in Section B of the Department of Defense (DOD) FLIP Flight Information Handbook (refer to http://164.214.2.62/dafif/dafif_0502_ed6/PLAN/FIH.PDF) and are based on the bird strike potential for the occurrence of damage. Bird locations should be given with the condition code.

This system has three levels of bird watch conditions: SEVERE, MODERATE and LOW. A **SEVERE** bird watch condition exists when heavy concentrations of birds are on or immediately above active runways or in locations that represent an immediate hazard. Bird activity for this condition is greater than 15 large birds or greater than 30 small birds. A **MODERATE** bird watch condition exists when concentrations of birds are observed in locations that represent a probable hazard to air operations. This condition requires heightened vigilance by all agencies and supervisors and extreme caution by aircrews. Bird activity for this condition is five to 15 large birds or 15 to 30 small birds. A **LOW** bird watch condition exists when there is normal bird activity on and above the airfield with a low probability of hazard. Bird activity for this condition is less than five large birds or 15 small birds or sparse bird activity.

When locations are given to aircrews, the bird watch condition code should be included (severe, moderate or low). During periods of flight operations, bird watch conditions of severe or moderate should be included in the hourly ATIS summary. Under the sever condition, air traffic control should ensure that all pilots understand the high hazard situation.

The most accurate and real-time reporting of bird watch information can be obtained from the dedicated BASH person when on site. When the BASH person is patrolling the airfield, he/she should have the primary responsibility to make the BWC reports to the ATC Tower and recommend changes that occur in the hazard. The BWC report should include the following:

- Identity of the caller, i.e. BASH ONE;
- Location;
- Altitude;
- Time of sighting;
- Approximate number of birds;
- Species of birds (e.g. mallard or duck or waterfowl);
- Behavior of the birds, i.e. loafing, roosting, flying, foraging, etc.
- Recommended BWC (severe, moderate, low)

The ATC tower will have the responsibility of downgrading the BWC once any updated information is available.

Operational limits and go/no-go criteria that standardize the potential hazard of a bird/animal aircraft strike have been established. These bird watch conditions will be broadcast on the ATIS. In the event that the BWC is severe or moderate, the following actions are recommended.

4.1.1 Bird Watch Condition Severe

Landing or departing in a BWC SEVERE may result in aircraft damage from a bird/animal aircraft strike. If a known bird/animal hazard exists proximate to the runway, the ATC Tower will issue an advisory and may issue a clearance in accordance with FAA directives. Accordingly, all operations will be at the discretion and risk of the pilot in command.

1. BASH dispersal efforts will be initiated immediately after BWC SEVERE is set if bird activity is on the runway or taxiway. Normally, the hazard can be removed within five minutes. However, if initial dispersal efforts fail, the ATC Tower will update delay information in five minute intervals to allow aircrew ample time to calculate fuel/divert/mission planning.
2. In lieu of specific guidance from squadron/wing commanders, the following aircrew actions are recommended:
    - (a) Fuel and weather permitting, inbound aircraft will hold until natural movements or runway/taxiway dispersal actions have lowered the hazard condition.
    - (b) Departing aircraft will hold on deck until dispersal actions or natural movements have lowered the hazard condition.
    - (c) Wind and weather permitting, pilots may request a runway change from ATC, if the runway's BWC is lower.

4.1.2 Bird Watch Condition Moderate

Initial take-offs and full stop landings are at the aircraft commander's discretion. In lieu of specific guidance from squadron/wing commanders, the following aircrew actions are recommended:

1. Delay or terminate practice approaches.
2. Modify altitude above the hazard (restricted low approach to 500 feet AGL, etc.)
3. Increase spacing to a minimum of 600 feet between landing aircraft.

4.2 REPORTING BIRD AIRCRAFT STRIKES

All wildlife strike data is entered into the NSC databases to help track and identify strike incidents and bird hazards. All aircrews should be briefed on the importance of reporting bird/animal aircraft strikes whether damaging or non-damaging. The procedure for reporting bird/animal aircraft strikes should be clearly outlined and a supply of Wildlife Strike forms (Appendix 11) should be readily available for aircrews at all times.

Reporting actual wildlife strikes will provide the most accurate and real time information for improving pilot awareness. Information about the location of the strike relative to the airfield-operating environment, phase of flight, speed, altitude, time of strike, location, landing lights (on or off), aircraft impact point, species and number of birds, and pilot's knowledge of any bird hazard warning. This data will be instrumental in determining potentially hazardous areas within the airfield-operating environment and issuing/modifying bird watch condition warnings. However, the aircrew involved in a wildlife strike is not always aware that the event occurred. Therefore, maintenance personnel typically discover the remains of wildlife strike during post-flight inspection of the aircraft. In these cases, it is equally important to stress the necessity of collecting bird remains, no matter how small (e.g. even one down feather), and turning them over to the ASO, NRO personnel or BASH person along with the aircraft information (type, day, location of impact) and a Wildlife Strike form (Appendix 11). If the species cannot be determined from the remains, place the remains in a plastic bag and send them to Matthew Klope, NAVFAC BASH Program Manager. The strike should be reported to the NSC within 30 days per OPNAVINST 3750.6R.

4.2.1 Reporting Procedures

Post flight follow-up and reporting of bird strikes are an essential and important part of the BASH program, and an essential requirement of aircrew. The following procedures outline how aircrew should report a bird/animal aircraft strike.

a. If airborne, inform traffic control tower and complete emergency landing if required;

b. After post-flight inspection, preserve any remains (however small, i.e. blood, feather, etc) and notify the base ODO and ASO immediately. Installation ASO, NRO, Field Operations personnel or the BASH person will collect the remains and take pictures, if appropriate. During normal working hours, leave the remains on the aircraft and contact base operations ASO, NRO or BASH person. They will coordinate a representative to come and retrieve the remains. After hours or on weekends, contact the BASH person or leave a voice-mail message for the ASO or NRO. If a contact can not be made, remove remains from aircraft, and place in a zip-lock plastic bag. Place the remains (Appendix 10) and a wildlife strike form (Appendix 11) in a sealable bag and place it in the BASH freezer;

c. Report strikes even if no bird remains are found on the aircraft as soon as possible. Airfield Operations personnel or BASH person may be able to retrieve the bird on the airfield. Both damaging and non-damaging strikes are to be reported;

d. Near misses that involve evasive action are encouraged to be reported to the BASH person.

4.2.2 Pilot Avoidance of a Bird Aircraft Strike

The effectiveness of a maneuver to avoid birds is dependent on a number of factors including human physiology, the decision process and aircraft response to pilot inputs. Pilot reaction studies have shown that it requires approximately four seconds from the time of initial object detection until the aircraft has moved sufficiently to avoid a bird strike. At 500 knots (575 mph), a bird must be observed from a distance of 0.63 miles to avoid a strike. When a bird is at a distance of 0.63 miles or closer, it is unreasonable to assume that the pilot can avoid a strike. At these times it is best to remain level, possibly duck your head, and take the strike. Maneuvering when a bird is this close may only create additional problems such as pilot disorientation, loss of aircraft control, unusual aircraft altitude, or increased damages following the bird strike (DeFusco 1986; Turner 1986).

When a bird is observed farther than 0.63 miles, maneuvering the aircraft to avoid the birds may avoid a strike. In most cases, a bird will tuck their wings and dive down if they perceive the oncoming aircraft as a threat. However, there are exceptions. Gulls, in particular, often turn and attempt to outrun the oncoming aircraft and are often struck from the rear. A few birds (e.g. mallards and red-tailed hawks) move laterally to avoid danger, but it is very rare for birds to climb. Therefore, since there is not enough time to categorize the bird and determine its most likely reaction, the best tactic is to climb. Besides avoiding the bird, it also gives one altitude and time for coping with a strike if it does occur. By pulling upwards the pilot may be able to protect the more vulnerable part of the aircraft, such as the canopy or engines, by taking a strike on the undersurface. In addition, by pulling up, the possibility of colliding with ground or other structures is reduced (DeFusco 1986; Turner 1986).

5.0 BASH MANAGEMENT STRATEGERIES

5.1 Naval Air Station NORTH ISLAND

Since 1997, USDA, WS has been hired by NAS North Island to actively manage BASH issues at NAS North Island to reduce the wildlife hazard, specifically birds, to air operations (Figure 11). For example, there were 15 documented bird/aircraft strikes

Figure 11. The BASH hazard to aircraft at NAS North Island has been reduced by using an integrated management plan. Wildlife Services Specialist, John Adams, sets a propane exploder to frighten western gulls loafing on runway 11-29. (Photo by John Cummings, U.S. Department of Agriculture, National Wildlife Research Center, Fort Collins, CO, April 1997).

between June 1996 and January 1997, as compared to six reported bird strikes between June 1999 and January 2000, and five strikes between April 2000 and January 2001, resulting in a reduction of about 60% (York et al. 2000, 2001 (Appendices 2,3)). There has been a 95% reduction in gulls observed on NAS North Island since 1996 and the number of runway crossings by all birds has decreased significantly (Cummings and

Foley 1997 (Appendix 1), York et al. 2000, 2001 (Appendices 2,3), Sheffer and Cummings 2002 (Appendix 4), Cummings and Sheffer 2003 (Appendix 5)). The average number of daily runway crossings has decreased from 100 birds in 1996 to ten in 1999, 13 in 2000, 14 in 2001 and 30 in 2002. This reduction in the number of runway crossings by birds, specifically western gulls, has reduced the potential hazard to air operations on NAS North Island, and is a direct result of WS BASH management.

In addition, in 1999 the Public Works Department soil cemented 52 acres at the approach end of runways 11 and 18 to reduce the attraction of this area to gulls, herons and raptors for nesting, loafing and foraging. This effort greatly reduced the incident of runway crossings by all species of birds in this area of the airfield.

Although overall bird use of NAS North Island has been reduced significantly, the presence of gulls, great blue herons, raptors, waterfowl and small passerines still present a hazard to air operations at various times during the year underscoring the importance of BASH planning and management at NAS North Island.

5.1.1 NAS North Island Bird Attractants

At NAS North Island there still remains a number of wildlife, specifically bird attractants within the PSA:

1. Golf course ponds near the approach of runway 29 are a strong attractant to a number of bird species especially during December through January (Figure 12). Even though the ponds are covered with grid wires which help to prevent their use by some species of birds, the visual presence of water still remains as a strong attractant.

2. Ground vegetation near the approach of runways 29 and 36 supports a number of different species for loafing and foraging. Raptors, specifically red-tailed hawks and

Figure 12. American coot, American widgeon and other waterbird use of the NAS North Island golf course ponds adjacent to the approach of runway 29 pose a risk to departing and arriving aircraft. Wire grids over the ponds reduce some of the bird use of the pond. (Photo by John Cummings, U.S. Department of Agriculture, National Wildlife Research Center, Fort Collins, CO, December 1996).

burrowing owls, have been observed in these areas foraging, loafing and roosting. The shrubs and trees on both sides of the approach to runway 29 also provide roosting, nesting and loafing for starlings and other small passerines.

3. Standing water near the wash site on taxiway Charlie (when in operation) is attractive to most birds for drinking. Several different species, mostly starlings and small passerines, have been observed using the wash site at various times throughout the year.

4. Beach and shoreline surrounding the installation are attractant to several species of birds for foraging. These areas are particularly populated with shorebirds during spring and fall migration periods. At low tides, gulls and herons use these areas to forage for shellfish. In addition, brown pelicans sometime congregate in large feeding flocks along the shore in shallow waters (Figure 13). Their flight patterns are relatively low when foraging but the presence of avian predators or thermals will put these birds in the altitudes of departing and arriving aircraft.

Figure 13. Brown pelicans foraging at the approach of runway 36, NAS North Island. (Photo by John Cummings, U.S. Department of Agriculture National Wildlife Research Center, Fort Collins, CO, July 1996).

5. The runways and surrounding tarmac are attractive loafing or roosting sites for gulls, as well as mourning doves and small passerine birds foraging on seeds and grit. Peregrine falcons (*Falco peregrinus*) have also been observed near the approach of runway 36 training fledglings with live caught pigeons.

6. Facilities that surround the airfield can attract certain species for roosting, foraging and nesting. Gulls, ravens, pigeons and crows have been observed foraging through trash, garbage, and other refuse associated with these facilities when it is not put in a sealable container.

5.2 NOLF IMPERIAL BEACH

Prior to November 1999, no official WHA or BASH program had been initiated at NOLF Imperial Beach. From November 1999 to October 2000, a WHA was conducted to determine the hazards wildlife posed to aircraft at NOLF Imperial beach (Lansford 2000 (Appendix 7)). In 2003, a BASH program was initiated at NOLF Imperial Beach to address wildlife hazards.

5.2.1 NOLF Imperial Beach Bird Attractants

1. The Tijuana River is located directly south of NOLF Imperial Beach and the Pacific Ocean directly to the west. The combination of both marine and fresh water systems has created the Tijuana Estuary system. The Estuary is a combination of riparian, wetland and coastal habitats. The diverse habitat of the Estuary is a major attractant for several species of raptors, waterfowl, herons/egrets and shorebirds.

2. Varies vegetation types and patterns on NOLF Imperial Beach attractant a variety of wildlife. Edge areas (where two habitats meet) are most prominent along the south and west perimeters of NOLF Imperial Beach. These edges are a concern because they typically attract the greatest number and diversity of wildlife. In addition, there are a number of mature trees and snags adjacent to the airfield. These trees and snags are used by raptors.

3. There are a number of man-made structures at NOLF Imperial Beach that serve as perching, loafing, and nesting habitat for birds. The perimeter fences, light poles, power lines and telephone poles, mainly on the north side of NOLF Imperial Beach are commonly used by birds. There are also the tower, buildings, runways markers, wind socks, bunkers and warehouses that are used by birds.

5.3 NALF SAN CLEMENTE ISLAND

Prior to 2002, no official WHA or BASH program had been initiated at NALF San Clemente Island. From February 2002 to January 2003, a WHA was conducted to determine the hazards wildlife posed to aircraft at NALF San Clemente Island (Sheffer and Cummings 2007 (Appendix 6)). As of 2005, there is no BASH program in place at NALF San Clemente Island to address wildlife hazards.

At NALF San Clemente Island there were 12 bird/aircraft report strikes during the Wildlife Hazard Assessment from February 2002 through January 2003. Of these, horned larks and western meadowlarks represented 41% and the remaining strikes were distributed among a wide variety of other bird species. Most strikes occurred between August and December and the strike reporting rate was about 25%.

5.3.1 NALF San Clemente Island Bird Attractants

NALF SCI in its entirety attracts wildlife, specifically birds that could potentially represent a risk to pilots and aircraft. Key habitat types such as vegetation on either side of the runway, and the cliffs, beach and open water at either end of the runway offer foraging, loafing, nesting and roosting for several species of birds. In addition, predators such as San Clemente Island foxes, red-tailed hawks, common ravens and American kestrels are attracted to the airfield in search of prey.

5.4 HABITAT MANAGEMENT: NAS NORTH ISLAND, NOLF IMPERIAL BEACH AND NALF SAN CLEMENTE ISLAND

Habitat management should always be done in preference to bird dispersal or reduction techniques. Attempts at reducing the number of birds in an area is expensive and generally unsuccessful for some species since new birds will most often move in to replace displaced or removed birds. The number of birds should be decreased by direct manipulation of habitat for long term reductions. There are several habitat management principles that directly relate to managing abundance and diversity of bird species in an area. Maximum reduction in BASH can be achieved by incorporating the following principles into management actions but must be compatible with the INRMP and current management strategies:

a. Reducing habitat area reduces bird numbers.

b. Eliminating habitat eliminates bird populations suited to that habitat.

c. Diversifying types of habitat increases the diversity of species.

d. Homogenizing habitats reduces species diversity but increases population of species adapted to that habitat.

e. Managing habitats can be inexpensive or costly but usually is the longest lasting wildlife management activity that directly has an effect on the populations of target species.

f. Focusing management efforts by selecting habitats particular to the problem species will eliminate or reduce those bird species that present the greatest risk of bird/animal aircraft strikes.

g. Maintaining habitat modifications is the only long term solution to reducing the risk of bird aircraft strikes.

5.4.1 Habitat Modification

Modification of habitat involves changing the environment to make it less attractive or inaccessible to problem bird species. All wildlife needs food, cover and water to survive. Any action that reduces, eliminates, or excludes one or more of these elements will result in reduction in the wildlife population at the airfield. The following are habitat modification measures that could reduce the bird hazard:

a. Reducing “edges” between habitats that some birds, especially small passerines, use such as the edge between brush and a grassy area.

b. Replacing dirt (bare ground) with other materials such as gravel, asphalt or artificial turf to eliminate available grit sources that birds such as doves and pigeons need.

c. Surveys conducted by other organizations have noted that sensitive plant species occur in the vicinity of the airfield. This should be taken into consideration when planning vegetation management on or around the airfield.

d. Sensitive plants need to be taken into consideration. Managing grass or forbs to a height that reflects the particular species of interest. Grass next to the runway should be kept to a height of three to four inches to enable clear inspection of the area and also to ensure cutting before plants seed. On San Clemente Island, vegetation at the approach of either runway on steep areas will be difficult to control and could cause erosion if removed. In these areas alternative techniques need to be used.

e. Control burns could be an alternative to vegetation removal or mowing especially at San Clemente Island. These should be coordinated with the SCI Botany Program.

f. Managing weeds for the entire airfield on a regular basis year round because they can provide a food source and cover for small passerine birds and rodents.

g. Reducing, clearing, and/or thinning the number of trees or bushes that produce nesting, foraging, or roosting opportunities for birds around the entire airfield.

h. Water areas within the PSA should be filled, drained or covered with netting or a wire grid system. Depressions on the runways that collect water should be repaired to eliminate standing water.

i. Maintain a monoculture within the PSA with consideration to sensitive species.

5.4.2 Habitat Management Guidelines

The objective of habitat management for birds at NAS North Island, NOLF Imperial Beach and NALF San Clemente Island is to reduce the number and quality of specific habitat types that attract birds to the PSA (Figure 14, 15). The general goal at these facilities should be to maintain the PSA, the airfield, and the surrounding habitat as

Figure 14. Prior to 1999, habitat at the approach of runways 11 and 18 attracted gulls, herons and raptors for nesting, loafing and foraging, the feathers at the edge of the runway in the right photo give an indication of the large number of gulls using this area. Photo by John Cummings, U.S. Department of Agriculture, National Wildlife Research Center, Fort Collins, CO, May 1996).

a monoculture, to support as few bird species as possible. For example, since 1999, areas at NAS North Island deemed a risk to air operations based on habitat type and bird species have been managed by discing and soil cementing. In both cases, these habitat modifications have reduced the bird use of these areas which in turn has reduced the risk for potential bird aircraft strikes.

Figure 15. In 1999, the Public Works Department soil cemented 52 acres at the approach end of runways 11 and 18 to reduce the incident of runway crossings by all species of birds in this area of the airfield. (Photo by John Cummings, U.S. Department of Agriculture, National Wildlife Research Center, Fort Collins, CO, July 1999).

Only native plants should be used as methods of controlling and managing habitat. Habitat management also directly relates to the effectiveness of bird dispersal methods, since the less attractive the habitat is, the easier it is to disperse birds (Stout and Schwab 1979). All habitats can have a seasonal proliferation of food resources, such as insects, fruits and seeds. In these instances management of the periodic resource may be more appropriate than attempting to change the habitat. Mowing or thinning may prevent seed or fruit production and application of chemical insecticides may eliminate insect populations.

5.4.2.1 Hard Surfaces: Tarmac

Four features of tarmac are attractive to birds: openness, availability of fine gravel, standing water, and concentrations of food resources. The openness of the tarmac usually can not be altered as this is inherent to an airfield. Fine gravel, ingested by some birds to aid in digestion (e.g. doves) could be swept from tarmacs if it is found to be a significant attractant. Standing water on tarmac surfaces can be reduced by resurfacing areas that are prone to water collection or adding an aversive agent, such as methyl anthranilate, or an orange dye to discourage birds from using these sites (Cleary and

Dolbeer 1999, Lipcius 1980). Other sources of water, such as heli- or aircraft wash systems on the airfield should be regularly inspected and maintained to reduce availability of standing water from leaks or broken fixtures.

Reduction of food resources is the most important habitat management tool. The PSA, roadways around the airfield and runways should be checked daily for dead birds or animals that may attract vultures or other scavengers. Any remains which are determined to have resulted from a collision with aircraft should be forwarded to the BASH person responsible for bird identification. Insect-eating birds may feed next to runway lights that attract insects during dawn, dusk and night hours. Replacing the white lenses with orange lenses reduces the attraction of insects to lights. Birds of prey often like to perch on lights, boards and posts along the runway. These can be fitted with anti-perching devices such as wire spikes or sprayed with sticky substances to discourage perching. Impacts on threaten and endangered species should be monitored to determine any adverse effects from implication of management techniques.

5.4.2.2 Open Areas: Grasses, Weeds, Forbs and Bare Soil

The management of vegetation, including grasses, weeds and forbs, to minimize bird activity is a controversial subject in North America (Cleary and Dolbeer 1999). The general recommendation, based on studies in England in the 1960s and 1970s, has been to maintain a monoculture of grass at a height of six to ten inches (Transport Canada 2001) or seven to 14 inches (U.S. Dept. Defense 2004). By inferring with visibility and ground movements, tall grass is thought to discourage many species of birds from loafing and feeding. However, studies monitoring bird use of short (three to six inches) and tall (seven to 12 inches) grass plots in Ohio showed no differences between bird numbers on plots. It has been shown though that certain species, such as the American robin prefer short grass, where as meadowlarks prefer tall grass. Starlings used all plots equally (Seamans et al. unpubl. data). In addition, Canada geese do not appear to be discouraged by tall grass (Seaman et al. unpubl. data). Tall grass may result in increased rodent populations, a food source for raptors and other predators (Seaman et al. unpubl. data). Maintenance of uniform stands of tall grass is difficult on many airfields because of environmental conditions.

If there is a bird species posing a particular problem, the grasses should be managed to make it least attractive to that species (Blokpoel 1976). Grass should be cut before it goes to seed to discourage attracting seed-eating birds. In addition, brush piles, grass clippings and other dead vegetation should be removed as soon as possible since it provides protective cover for birds and other animals. It should also be noted that during and immediately after cutting grass and weeds birds may be attracted to the site since insects will be disturbed by the mower and readily available. Control tower operators should be aware of these areas during and for several days after mowing. Mowing should also be scheduled during times of low flight activity to the greatest extent possible.

The soil conditions at NAS North Island preclude managing for uniform stands of grass. On Naval Base Coronado airfields, vegetation management should concentrate on identifying vegetation types that attract birds on the airfield and remove these if they are deemed attractants for birds.

Managing vegetation at NALF San Clemente in and around the airfield by mowing or covering could reduce the numbers of horned larks, western meadowlarks and chukars that use these areas. Making the airfield vegetation fairly uniform would also result in it being less attractive to wildlife species, especially birds.

5.4.2.3 Standing Water, Ditches and Ponds

To reduce standing water in and around the PSA of the airfield, the topography should be evened and gently sloped, so low areas that may hold water do not exist, and water moves faster across the field (Figure 16). Inexpensive soil amendments can be used to improve water infiltration rates. Any temporary ponds, drainage ditches, sewage outlets etc. should be covered with netting or grid wires, drained, removed or allowed to dry up when possible. Marsh and wetland vegetation growing in canals and along rivers provide habitat for birds and should be controlled when possible. For example at NAS North Island the golf course ponds and the ditches near the approach of runway 29 should be netted, drained, flagged, covered with grid wires or enclosed to reduce the bird attraction.

Figure 16. Open drainage ditches near the approach of runway 29 attract a number of bird species such as waterfowl and shorebirds. (Photo by John Cummings, U.S. Department of Agriculture, National Wildlife Research Center, Fort Collins, CO, April 1996).

5.4.2.4 Perching, Roosting and Nesting Sites

The number of potential roosting, perching, and nesting sites should be reduced, and sites that cannot be removed (e.g. buildings) made less attractive to birds. If trees or large shrubs are present they may be used by birds for roosting. Trees or posts that are not needed should be removed. Trees and shrubs may also be thinned to discourage birds from roosting by removing protective cover (Booth 1983). Mechanical devices, distress or alarm calls, effigies, and flagging can be used to discourage birds such as gulls and pelicans from piers, docks, buildings and breaker walls. Birds, such as starlings and pigeons, that nest or roost in hangars and aircraft can be discouraged by netting, plastic strips or covers. Also, trapping with nest box, walk-in or decoy traps will manage bird populations, especially starlings, pigeons and blackbirds. Since many birds use the edges of buildings for perching, one method to discourage perching is to use wires that emit an electrical shock placed at the edge of the building. This is a costly method, but has been successfully used on commercial buildings.

5.4.2.5 Buildings, Hangars and Structures

Remove unused structures that may offer nesting or perch sites. Often, bird-proofing of buildings and hangars is required to exclude pigeons, starlings, sparrows and swallows. Denying access by screening windows, closing doors and blocking entry holes is most effective. Verify that management methods are compatible with DOD pest Program. When other methods fail, consider the following:

- **Avitrol**-a chemical avicide that is registered for the control of pigeons, sparrows, blackbirds and other bird species. The chemical when ingested by a bird causes the target bird to emit distress calls which will frighten the others away. This chemical can only be applied by a certified applicator. All label instructions should be followed when applying this bait (see section 5.4.3a).

- **<u>Trapping and Removal</u>**-a variety of trapping techniques are available for bird species found on and around the airfield. These include use of modified Australian crow-traps, decoy traps, nest traps or cannon nets for capturing species including gulls, terns, sparrows, and raptors (McClure 1984). Trapping can be used to successfully manage over-abundant bird populations using structures on and around the airfield (Figure 17).

Figure 17. Cannon nets, decoy traps or nest traps can be used to manage local over-abundant birds in a number of situations. Over 1,200 western gulls were captured with cannon nets at NAS North Island. (Photo by John Cummings, U.S. Department of Agriculture, National Wildlife Research Center, Fort Collins, CO, May 1996).

- **<u>Effigies</u>**-actual bird carcasses, stuff birds or manufactured birds which resemble dead birds can be effective in frightening birds away. Effigies seem to be most effective on gulls, vultures, crows, ravens (pers. commun. Mike

Avery, 2007). Pigeons, starlings, and sparrows are not affected by the presents of a effigy of the same species.

- **Design features**-if designing new structures, consider locating supports on the exterior. This will help to eliminate flat ledge and right angles where bird nests can be constructed or birds can roost. Also, plug all hole or cracks where birds can enter.
- **Door coverings**-netted or plastic strips (e.g. freeze strips) can be suspended from the top of the door to the floor to exclude birds. Ensure no tears or holes are present, which would allow bird access.
- **Sharp Projections**-these devices come in various configurations and can be attached to horizontal loafing and roosting sites, such as ledges and overhangs, to prevent bird use of these areas.
- **Harassment**-high pressure water or air can be used to deter or disperse birds from using hangars. Owls were relocated from a large warehouse building using high pressure water and did not return (Cummings unpubl. data).

5.4.2.6 Refuse

Refuse around dumpsters and buildings is a strong attractant for a number of species, particularly gulls, crows, ravens, sparrows, and starlings. Birds frequent these sites if garbage and other refuse is not appropriately maintained. Refuse sites on and around the airfields should be monitored and maintained by the Public Work Department on a regular bases so that refuse is not accessible to birds. Status reports should be provided by the Public Work Departments representative at the monthly BHWG meeting.

5.5 BIRD DISPERSAL AND DETERRENT TECHNIQUES

It is impossible to completely manage wildlife through habitat management. Birds, in particular, are difficult to manage because they are mobile and readily adapt to changing environments. In most situations, active removal, dispersal and/or deterrence decisions are situation-specific, depending on the species, legal status, biology, behavior, habitat, costs, logistics and public attitudes. One of the most important factors is to develop a BASH Plan that is strongly endorsed by the Commander NBC and conducted by motivated personnel. Drury (1962) and Solman (1981) suggest that human motivation is a primary factor in a successful hazing program. The techniques that are most likely to be effective will depend on the species of birds present, the reason for their presence in the area, how mobile they are and the ability to deploy the appropriate species or group specific dispersal or deterrent technique (Appendix 14). The task of dispersing or deterring birds is ongoing and requires constant vigilance. Birds must not be allowed to establish or reestablish feeding, breeding, roosting or loafing areas, even when few birds are present (DeFusco and Nagy 1983). Birds are more apt to leave a site that they have occupied for only a brief period of time. Pro-active deterrent actions can greatly reduce the time and effort needed to disperse the birds. Use of dispersal techniques should always consider the impacts on threaten and endangered species.

The key to effective bird dispersal or deterrence is bird behavior knowledge, organization, timing, persistence, and the ability to use several dispersal techniques. An integrated management program is better than using a single approach. The program must be carried out every day until success is achieved (Booth 1983). A mobile, aggressive, imaginative and persistent human patrol group will be able to remove or control most birds from an airfield. Variety and novelty are important to successful hazing because most bird species will habituate to the use of the same technique over a long period of time.

The top birds of concern on NAS North Island, NOLF Imperial Beach and NALF San Clemente and management techniques that have been proposed for each species are found in Appendix 12.

5.5.1 Human Patrols

Human presence is probably the best technique used to reinforce the danger associated with other frightening techniques during their operation. It is generally accepted that human presence can reduce the presence of birds or modify bird behavior at a particular location. The use of human effigies with static or active control techniques adds effectiveness (Cummings et al. 1986).

When combined with other techniques human presence can enhance the hazing results, but it is unclear whether it is cost-effective as a sole control method. Human presence alone often may not be sufficiently frightening to disperse birds for prolong periods (Owens 1977, Kenward 1978). Depending on the bird species and the situation, birds may already be accustomed to people or rapidly habituate to human presence unless it is occasionally reinforced with other methods such as shooting. For example, American coots on the NAS North Island golf course near the approach of runway 29 are extremely difficult to haze effectively with just human presence because they have habituated to the presence of golfers. Human presence is most effective when combined with the use of other frightening devices or lethal control. This is also true on NALF San

Clemente Island, where horned larks and meadow larks have adapted to the present of humans in and around the airfield.

5.5.2 Audio Dispersal Techniques

5.5.2.1 Gas-operated exploders

Use of gas-operated exploders, generally referred to as propane cannons, have been commonly used to disperse birds from airfields (Figure 18). These devices produce loud, intermittent explosions, ranging from one to 30 minute intervals effective from one to five acres. Some newer versions emit up to three explosions in rapid succession and in various directions. New technology is also permitting remote activation from a central location. Although expensive, these units can be placed in areas frequented by birds and remotely activated by the ATC tower personnel when birds are present. The advantage of this unit is that birds would be less apt to habituate to the presence of these devices.

Figure 18. John Adams, Wildlife Services Specialist, deploys propane cannon near runway 11-29 to frighten western gulls and other birds from loafing on the runway. (Photo by John Cummings, U.S. Department of Agriculture, National Wildlife Research Center, Fort Collins, CO, April 1997).

The effectiveness of propane exploders depends on a variety of factors, such as the bird species and number present, availability of alternate sites for hazed birds, the density of exploders, interval between explosions, and wind conditions. Blokpoel (1976) cites that gulls normally do not react to propane cannons when activated. Wright (1963) concluded that exploders have little effect in deterring birds from runway areas at British airports. However, exploders used to disperse gulls at NAS North Island and NOLF Imperial Beach have worked well when moved frequently and supplemented with other hazing tools (J. Turman 2004, pers. commun.).

Advantages:

- Direction, timing and volume of the explosion can be controlled;
- Low labor costs and inexpensive to operate;
- Portable;
- Effective day or night.

Disadvantages:

- Must move frequently to prevent rapid habituation
- Cannons may be a hazard during flight operations because random firing may cause birds to disperse into the path of aircraft;
- Their short range means many cannons may be required to cover the expanse of the airfield;
- Noise levels may become annoying for installation personnel and surrounding community citizens.
- Regular maintenance is required.

5.5.2.2 Pyrotechnics

Pyrotechnics include various devices that are fired from shotguns, starter and flare pistols or specialized launchers (Figure 19). They include shell crackers, flares, firecrackers, rockets, and screamers/whistlers which produce a loud auditory blast or scream, as well as smoke and flashing lights. These devices travel 25 to 300 yards before emitting a blast, flash or bright light. Some will emit a screaming or whistling sound during flight. Pyrotechnics, when used in combination with other hazing techniques and limited lethal control, can be very useful in hazing birds from the airfield.

Figure 19. Pyrotechnic devices, used to haze birds. (File photo, U.S. Department of Agriculture, National Wildlife Research Center, Fort Collins, CO).

For safety reasons, these devices should only be fired by personnel trained in the correct use of pyrotechnics (see section 6.5.2) and from single-shot shotguns or pistols which allows for easy inspections of the barrel. Other safety precautions that should be taken in any program using pyrotechnics are:

- Operators should wear eye and ear protection at all times;
- Shell crackers should be fired from open choked, single-shot shotguns;

- Shell crackers may misfire, so gun barrels should be checked regularly for obstructions;
- Cracker shells are corrosive, so guns should be cleaned each day after use;
- Pyrotechnics can be a fire hazard and all necessary precautions should be taken;
- Pyrotechnics should not be fired from inside a vehicle.

The effectiveness of pyrotechnics varies with species. They are effective against gulls, crows, ravens, starlings and waterfowl, but raptors, vultures, shorebirds and small birds are less responsive.

Advantages:

- Used correctly, pyrotechnics provide one of the most effective methods available for bird dispersal;
- The direction of dispersal can often be controlled by the placement of the shots;
- Pyrotechnics are effective both day and night;
- Pyrotechnics can be used as complementary devices with other deterrents.

Disadvantages:

- Use of pyrotechnics is labor intensive;
- Pyrotechnics give rise to Foreign Object Debris / Damage (FOD) on the runway;
- Birds may habituate to pyrotechnics, especially if they are used improperly, i.e. used repeatedly or over used;

- There is a degree of fire hazard associated with these devices if used during dry conditions.

5.5.2.3 Biosonics

Biosonics involves the use of sounds such as bird distress and alarm calls or predator calls to disperse birds. Bio-acoustical frightening techniques are considered to be among the best methods of bird control available (Kolz and Johnson 1974). Most gregarious birds use alarm calls to indicate the visual presence of a predator and alert notes to warn of impending danger. Distress calls are usually given once a bird is captured by a predator or when the bird suffers injury. Distress calls are short duration broad-banded frequencies that are easily located by other birds, not necessarily of the same species. The birds (especially gulls) usually respond by approaching the source of the noise, and would typically mob the predator (Woronecki 1988). When no predator is present the birds usually disperse.

Alarm calls are short wavelength, long in duration, and are difficult to pinpoint. The response of birds to alarm calls depends on the species; however, usually mixed flocks of birds will disperse immediately upon hearing an alarm call, whether of their own species or not. Response to distress and alarm calls may also be affected by the time of year and day, physiological state and activity of the bird, weather conditions, previous experience, and quality of the sound. It has been found that birds do not become accustomed to natural calls as easily as to non-natural sounds, but gradually learn that these calls are not, in fact, a genuine hazard and may stop responding to them. Birds take longer to become accustomed to good quality recordings of distress calls and predator calls. Changing rate of playback, position of speakers, and alternating several types of calls will help to reduce habituation to calls. The most effective way to reinforce calls is with an additional preferably visual stimulus like a smoke puff or shell cracker.

Starlings and blackbirds respond strongly to both distress and alarm calls. Horned larks and sparrows have been dispersed using distress calls, especially when in flocks of five or more (Boudreau 1972; Wooten *et al.* 1973). However, the distance hazed flocks of horned larks move can be less than 150-200 feet (Cummings unpubl. data) which could occur on NALF San Clemente Island. Most birds respond differently to hazing, for example: doves have no distress call and are not strongly affected by tapes of other calls, raptors have no response to calls, and herons were shown to respond to distress calls of young and adult herons in one study with an 80% dispersal rate (Spanier 1980). Alarm and distress or predatory calls can be used day or night and in all weather conditions. Habituation is low when calls are properly used, i.e. not over used but timing is a minimum of 30 minutes between calls. These factors make distress and alarm calls an attractive technique, especially when combined with other methods of dispersal (DeFusco and Nagy 1983).

Use of biosonics may be restricted in certain areas on the installations, and their use should be coordinated with and approved by the appropriate frequency manager and explosive safety officer for the specific locations in which they are needed.

5.5.2.4 Ultrasonic sound

Sounds above 20,000 Hz, defined as ultrasonic, have not been found to be effective, probably because birds cannot hear in this range (Thiessen and Shaw 1957; Murton and Wright 1968, Erickson et al. 1992, Kerns 1985). Tests conducted on pigeons showed no response when exposed within ten feet to a fully functional, high-frequency sound generating device (Cleary and Dolbeer 1999). These devices are not recommended for use in hangars, buildings or airfields to deter or disperse birds.

Other sound producing devices discussed in this section have the advantage of being low cost and can be left unattended. However, some of these sound devices (i.e. alarm and distress calls) have no effect on some bird species and, if left unattended, birds will habituate to the device.

5.5.3 Visual Dispersal Techniques

Overall, there has not been much success using visual methods to scare birds, mainly because birds become accustomed to the stimuli and realize that it poses no danger. Visual dispersal techniques consist of hawk kites, hawk silhouettes, lights, eye-spot balloons, flags, mylar reflective tape, lines, effigies and scarecrows (human or predator). Most of these devices are effective for a short period before birds habituate to them (Blokpoel 1976, Aguero et al. 1991, Andelt and Burnham 1993, Blokpoel and Tessier 1983, Blokpoel and Tessier 1984). To prevent this, stimuli must be changed or reinforced by other means such as lethal control.

Figure 20. Hawk-kite has been shown to be effective in some situations to frighten birds from air fields. (File photo, U.S. Department of Agriculture, National Wildlife Research Center, Fort Collins, CO).

5.5.3.1 Hawk-kites and balloons

Kites and balloons when suspended in various patterns have shown some success (Tipton et al. 1989). However, these devices should not be used too near the ends of runways to avoid pilot confusion (Figure 20). Red, yellow, or white tetroon balloons are recommended for airport use (DeFusco and Nagy 1983). Deterioration and high winds can be a problem for balloons, and hawk-kites are not effective against all species (such as sparrows) (Tipton et al. 1989). These types of techniques could impact sensitive species. Their use in such areas should be monitored to determine any adverse effects.

5.5.3.2 Flagging and mylar streamers

Flagging and streamers are inexpensive but require frequent monitoring and maintenance. Monitoring is especially required during periods of high wind because flagging and streamers become tangled decreasing their effectiveness. Flagging has been used to frighten waterfowl from agriculture fields and water-ways and ditches (Knittle and Porter 1988, Mason et al. 1993, Mason and Clark 1994, Mason 1995, L. Muhs, 2003, NAS Point Mugu, pers. commun.).

5.5.3.3 Scarecrows and effigies

To be effective scarecrows and effigies must be moved every few days and should include moving parts if possible (DeFusco and Nagy 1983). They are inexpensive and require little maintenance. Avery et al. (2002) and Tillman et al. (2002) have both used vulture carcasses to effectively disperse vultures from traditional roost sites and foraging grounds. At NAS Point Mugu in 2002, a vulture carcass hung in a vulture roost dispersed birds from the roost site. However, some birds did return to the vicinity of NAS Point Mugu airfield to search for food. In New Zealand, gull carcasses preserved with formalin and nailed on boards were effective in eliminating gulls from loafing at these sites for up to three months. At NAS North Island and NOLF Imperial Beach, gull effigies have been effective in discouraging gulls from using structures for loafing and roosting. Special permits from the U.S. Fish and Wildlife Service are required to salvage gulls for this purpose.

5.5.3.4 Lasers

Lasers have been shown to be effective at night and low light conditions to haze birds (Blackwell et al. 2002). They are very effective on geese, waterfowl, egrets and corvids (Gorenzal et al. 2002). Snowy (*Egretta thula*) and great egrets (*Casmerodius albus*) have been successfully moved about 2,400 feet from night time roosts adjacent to a runway using a laser (Avian Dissuader) for about ten minutes (J. Cummings, 2003 pers. commun.). Not all bird species responded to the laser. The devices are about $800, light-weight, have a dispersal range of over 2,000 feet and are effective on a wide range of bird species. The disadvantages of the laser are cost, ineffectiveness on some bird species, need for extreme caution when in use and possible need for approval before it is used at certain military installations. No permits are required to use the laser. They are commercially available.

5.5.3.5 Falconry

Falconry has been found to be effective for large flocks of birds but requires the falcon to be continuously flown until the flock leaves the airfield PSA (Figure 21). This is not a cost-effective method of control. The right species for the job must be properly trained and used regularly by skilled, experienced and conscientious falconer. To train, fly, and care for falcons, a staff of at least two full time, well-trained personnel is necessary. Several falcons are required in order to have at least one falcon on standby at all times (Blokpoel 1976).

Figure 21. Although falconry has been successful in some places, it is not generally used. Drawbacks

include: falcons do not fly at night or in bad weather, falcons can be moody or sick reducing flight time, they are expensive and difficult to handle and train.   Jim Foley, Wildlife Biologist, National Wildlife Research Center, Fort Collins, CO and David Gambini, Wildlife Specialist, Wildlife Services. (Photo by John Cummings, U.S. Department of Agriculture, National Wildlife Research Center, Fort Collins, CO, May 1997).

Although falconry has been successful in some places, it is not generally used. There are very few if any advantages to using falconry. Disadvantages include: falcons do not fly at night or in bad weather, falcons can be moody or sick reducing flight time, they are expensive and difficult to handle, training and maintaining them is time-consuming, and birds often regroup in other areas of the airport where the falcon is not active (Burger 1983). Because falconers have generally used distress calls in addition to the falcon, it is difficult to evaluate the effectiveness of the falcons alone. Reduced aircraft strikes may have also resulted from increased levels of human activity (Burger 1983).

An analysis of strike data for John F. Kennedy (JFK) International Airport from 1988-1998 indicated the 1996-1998 falconry programs, although providing positive publicity for JFK and enhancing the overall bird-management program, had little effect on strike rates (Dolbeer 1998).

5.5.3.6 Dogs

Certain breeds of dog, such as border collies, can serve as an effective means of dispersing some bird species. Dogs represent an actual, not perceived, threat to the wildlife on the airfield, thereby eliminating the problems of habituation. Dogs should be used by a trained dog handler. They can work almost all weather conditions and can travel over all types of terrain, including marshes or ditches. They can be directed with relative precision, enabling directional dispersals of birds. They can work for long period of times and can learn from various situations and adapt to changing circumstances.

Dogs can also create positive public relations, and be handled by trained operation personnel for use on and around the airfield. For example, dogs have been used effectively to reduce the number of coots using the NAS North Island golf course (B. Stewart, 2003 pers. commun.)

5.5.3.7 Radio controlled model aircraft, helicopters and boats

Use of radio controlled model aircraft helicopters and boats, which provide both visual and auditory dispersal, show varying degrees of success. The effectiveness of radio-controlled devices depends on the level of experience of the operator. These devices have several advantages: they eliminate the hazard to humans associated with flying around live birds, which can be unpredictable in certain situations; can be directed precisely to move birds away from the airfield; can be used both during the day and at night; are inexpensive; and can cover a wide area. Operators of these devices should insure that these devices are approved and radio frequencies being used are compatible with other electronic uses in the airfield environment. Helicopters have been used successfully at the Reno Airport to move Canada geese. Geese did not habituate to the helicopter and, in most cases, just the start of the engine dispersed geese (J. Cummings 2003, pers. commun.).

5.6 WILDLIFE REMOVAL TECHNIQUES

Habitat modification, exclusion, and repellent techniques should be considered first in any BASH management plan before proceeding with techniques that will translocate or remove animals. The removal of individual animals prior to eliminating other attractants may eliminate an immediate hazard but will not provide a long-term solution, as other animals will replace those that have been removed. There are cases at airfields that will call for immediate, direct control when the risk to pilot and aircraft are high and when timing precludes use of other actions. Direct control should be done humanely and only by individuals trained in these techniques. The continued use of this method will depend on the respectful treatment of all animals; in poisoning, shooting, and trapping, their suffering should be minimized. Capture for translocation or removal and direct control will require a federal migratory bird depredation permit, state permit (when relocating off of federal property) and authorization from the U. S. Geological Services, Bird Banding Laboratory to band/tag for translocation. When handling birds or mammals, extreme caution must be exercised to protect against transmitted diseases. Personnel should always use recommended personal protective equipment (Appendix 15).

5.6.1 Live-Capture for Translocation

There are a wide variety of trapping techniques discussed by McClure (1984). Other techniques may include the use of a chemical capturing agent such as alpha chloralose to live-capture birds and mammals for translocation or removal. The disposition of live-captured birds or mammals will depend on the legal, political, and social realities of each situation (Cleary and Dolbeer 1999). Some state wildlife agencies have restrictions on what can and can not be translocated because of designated federal or state threatened and endangered status for the species, possible disease transmission and creation of additional problems at other locations. When approved by the USFWS under a migratory bird depredation permit, captured birds should be euthanized using procedures recommended by the Association of Wildlife Veterinarians (AWV) (Appendix 16).

Alpha chloralose is a chemical registered with the Food and Drug Administration (FDA) as an immobilizing agent, for use in capturing waterfowl, ravens, coots, and pigeons. It can only be used by a certified applicator (see section 6.5.3) working under the authority of USDA, WS. It can be put on a variety of baits that are readily accepted by the target species. Immobilizing time is between 30 to 90 minutes for most species. Recovery can be over eight hours.

Translocation of captured animals, especially birds, has been successful for a number of species. Adult red-tailed hawks captured at NAS North Island and at O'Hare International Airport and translocated over 60 km had return rates of 50% and <16%, respectively (York et al. 2000, 2001 and Schafer et al. 2002). The return rate of hatching year birds in the O'Hare study was 3.2% and no juvenile birds returned to NAS North Island. These studies concluded that translocation is effective in reducing the number of birds around the airfield and reducing the number of aircraft strikes. Also, Humphrey et al. (2000) showed limited success with relocating turkey vultures but Muhs (pers commun. 2005) indicated that relocating turkey vultures was effective tool used at NAS Point Mugu. In addition, a study with common nighthawks showed that only one of 121 returned to the captured site after being translocated >30 km (Cummings et al. 2003). The study showed that this particular type of translocation could be costly, extremely time consuming and a tedious approach to managing birds within the PSA.

5.6.2 Live Capture for Removal

Virtually the same trapping techniques as in section 5.6.1-live-capture can be utilized. AWV euthanasia equipment and procedures should be used. This technique can be time consuming and costly, and is not very effective in keeping over abundant populations under control.

5.6.3 Lethal Removal

In order to justify lethal control and to minimize adverse public reaction to a program involving lethal take, the following information should be developed:

- Documentation that the wildlife species is an economic, safety or health threat on the airfield;
- Justification of why non-lethal options are not adequate to solve the problem;
- An assessment of the impact that the lethal take will have on local and regional populations of the species;
- Documentation of the effectiveness of the lethal take program in helping to solve the problem;
- Recommended steps to be taken, if any are feasible, to reduce the need for lethal take in the future.

5.6.3.1 Chemicals

The use of a chemical poison for birds and mammals can be very effective at reducing populations when preformed by trained individuals. There are two EPA registered compounds for controlling bird populations: Avitrol and DRC-1339. Each chemical has a restricted-use, Avitrol can only be applied by a certified applicator and DRC-1339 can only be applied by USDA WS personnel or under their supervision. Both compounds can be used against a number of bird species such as gulls, blackbirds, ravens, crows, sparrows, pigeons, and starlings. The label for each chemical should be reviewed for its approved target species, mixing and application instructions, personnel protection equipment and restrictions.

There are several registered poisons for mammals such as rodenticides, anticoagulants, tracking powders and fumigants. Each are EPA labeled only for certain species and should only be used by a certified trained applicator.

5.6.3.2 Shooting

The use of firearms for BASH management practices must adhere to all BASE policies and regulations and security concerns. Spent ammunition shells, bullets or shot on taxiways and runways can create a FOD hazard. The use of steel shot on and around taxiways and runways is preferred over lead because it can easily be recovered with magnet fitted sweepers. When removing birds or animals by shooting, the same vehicle should be used when approaching the target species to reinforce the association of danger with an object. Eventually, the birds will disperse on sight of the vehicle (Clark and Smedley 1977; O'Neil 1981). Shooting birds regularly is not always useful since other birds of the same or different species usually move in (Blokpoel 1976) or even worse, increased numbers of birds may replace the killed bird once its territory is vacant. Shooting birds can, however, play an important role in reinforcing non-natural dispersal sounds. Shooting long-lived birds such as gulls, raptors, waterfowl, and geese can reduce local populations that are impacting air operations and reduce the strike rate. Removal of over 800 western gulls from NAS North Island in 1997-1998 significantly reduced the number of gull-runway crossings and has modified gull behavior so they react to the BASH operator’s vehicle and presence, and tend to avoid the installation. Dolbeer et al. (2003) reported that a shooting program at JFK International airport from 1991-2002 using two to five people reduced the laughing gull strike rate 97% and altered their movement patterns to avoid the airport.

A shooting program should consist of the following:

- Personnel should be firearm-certified, trained and proficient with all the firearms that will be used and follow all base policies and regulations;
- Personnel who can accurately identify birds;
- Use proper firearm and ammunition for the situation as not to create a FOD hazard;
- Have proper federal and state permits;
- Keep detailed records of the location, date, time and bird species taken;
- Follow the proper station and airfield procedures, i.e. notify the ATC tower personnel before and after discharging a firearm, make sure of your target and background, inform tower of the bird hazard conditions before and after discharging a firearm, know the endangered species areas, etc.

6.0 BASH MANAGEMENT TRAINING

This NBC BASH Plan must be implemented by well-trained and knowledgeable individuals to be effective and successful. For NBC it is recommended that there be a minimum of one full time wildlife specialist/wildlife biologist to conduct wildlife management activities and censuses. Additional support can be from NBC operation personnel or other wildlife specialist on an “as needed basis”. It is important that individuals conducting the wildlife management or census work have educational and scientific training as well as field experience in wildlife biology. They need sufficient training to be knowledgeable in the basic principles of wildlife management and in the identification, behavior, general life history and legal status of the bird species, including threatened and endangered species found on and around NBC airfields.

6.1 BIRD IDENTIFICATION

Accurate identification of birds is important to an effective BASH management program. The most numerous and hazardous birds and the best management practices for those species found at NAS North Island, NOLF Imperial Beach and NALF San Clemente Island are listed in appendix 12. The BASH person should also be trained in the proper implementation or deployment of the various control strategies and techniques outlined in the NBC BASH Plan. In addition, it is critical to be knowledgeable of endangered and threatened wildlife species and their habitats on NBC airfields.

Quality binoculars are essential for detailed, accurate observations sometimes necessary for identification as well as for the detection and identification of birds or other wildlife at a distance. The NBC BASH person should have binoculars, be trained in their use and carry a bird identification field guide in the vehicle while on patrol.

6.2 MAMMAL IDENTIFICATION

On NBC airfields there are only a few mammal species that could be a potential hazard to aircraft. These include feral cats, feral dogs, coyote and rabbits on NAS North Island and NOLF Imperial Beach, and San Clemente foxes on NALF San Clemente Island. The NBC BASH person should be able to identify, not only by sight but also by sign (e.g., tracks, burrows, and fecal material), these mammals found on NBC airfields. Also, the BASH person needs to be trained in identification of and census techniques for small mammals to determine when populations increase which can signal an increase in avian predators. A mammal field guide should be carried in the vehicle while on patrol.

6.3 BASIC LIFE HISTORIES AND BEHAVIOR OF COMMON SPECIES

The BASH person should have understanding of the biology and behavior of species found on NBC airfields. This will be useful in anticipating problems and deploying management tools more effectively. For each species of bird, it is important to know if the species is present year-round or only in summer, winter, or during migration. For example, in which habitats and at what time of year do locally breeding bird species nest and when are young fledged? What are the daily movement patterns between roosting, feeding and loafing areas in relation to the airfield? What feeding behaviors and food preferences does the species have on the airfield? Which habitats does the species prefer? How does each species react to approaching aircraft and to various repellent devices? By being observant and noting the behavior of these hazardous species, useful insights may be gained that will lead to more effective habitat management or repellent strategies. Most bird and mammal field guides provide information on geographic range, feeding habits and habitat preferences for each species. Ehrlich et al. (1988) provides a concise summary of life history information (nesting, feeding, and habitat use) for most birds in North America. Appendix 12 provides bird profiles and some life-history facts for the top ranked birds of concern on and around NBC airfields.

6.4 WILDLIFE AND ENVIRONMENTAL LAWS AND REGULATIONS

There is a complexity of federal and state laws protecting wildlife and regulating the issuance of permits to take (capture or kill) individuals causing problems. In addition, environmental laws and regulations regarding pesticide applications, drainage of wetlands, and endangered species must be considered in implementing NBC's BASH Plan.

The BASH person should have a basic understanding of the federal MBTA whereby almost all native migratory birds are protected regardless of their abundance. They should understand that federal and often state permits must be issued before these species can be taken. Wild mammals are regulated at the state level, which may require permits for activities involving removal. Non-native birds, such as pigeons, house sparrows and starlings, and gallinaceous game birds, such as turkeys, grouse and pheasants, are not protected by the MBTA but may have state protection.

The BASH person involved in taking any wildlife species should have a clear understanding of which species has no legal protection and, for all others, the species and numbers allowed to be taken under permits issued. Permits also will list the methods of removal and disposition of removed wildlife.

6.5 WILDLIFE CONTROL TECHNIQUES

The wildlife specialist and operation personnel need to be trained to deploy wildlife control techniques safely and effectively.

6.5.1 Firearms

It is critical that only personnel trained in the use of firearms, authorized under depredation permit, and knowledgeable in field identification of the target and similar-looking non-target species, are allowed to use firearms on NBC airfields. Skill, experience and the proper equipment are needed to be safe and to maximize the effectiveness of a shooting program, whether it is to remove specific problem animals or to kill one or more individuals to reinforce repellent techniques. All discharged shell casings are potential FOD and should be picked up.

6.5.2 Pyrotechnics

Pyrotechnics can cause injury or damage if discharged incorrectly or carelessly. For example, serious injuries have occurred when pyrotechnics were accidentally discharged inside vehicles. Proper equipment (safety glasses, ear protection) and training is essential for safe use of pyrotechnics. In addition, training is needed to deploy the correct pyrotechnic for each situation and wildlife species and to minimize habituation. It is critical that pyrotechnics (and other repellent devices) not be deployed in situations where the birds or mammals might be flushed into the path of departing or arriving aircraft. This is why continuous communication with ATC while on the airfield is important.

6.5.3 Pesticide application

The wildlife specialist applying restricted-use pesticides, applying pesticides for hire, or applying pesticides to the land of another, must be a Certified Applicator, or working under the direct supervision of a Certified Applicator and then may only use pesticides covered by the Certified Applicator's certification. Proper application equipment and safety clothing must be used. Detailed records of pesticide applications must be maintained. For information on the training requirements for becoming a Certified Pesticide Applicator, contact the State University Cooperative Extension Service.

6.5.4 Distress call tapes, propane cannons and miscellaneous techniques

A major problem in the use of repellent techniques or devices is habituation of the wildlife species to the threats. These techniques all require training for their proper deployment. The most critical factor for most repellent devices is that they be deployed sparingly and appropriately when the target wildlife is present, and be reinforced occasionally by a real threat such as shooting. Pyrotechnics can cause a fire, be FOD, and are a human safety hazard if used improperly. Also, birds can quickly habituate to pyrotechnics. Therefore, only trained personnel should use pyrotechnics at NBC Airfields.

6.6 RECORD KEEPING AND STRIKE REPORTING

A key component of the NBC BASH Plan is developing a system to 1) document the daily activities of the BASH person, 2) log information about wildlife, specifically birds, numbers and behavior on the airfield, and 3) record all wildlife strikes with aircraft. This information is essential to document the effort being made by NBC in reducing wildlife aircraft hazards on NAS North Island, NOLF Imperial Beach, and NALF San Clemente Island. The information is also extremely useful during periodic evaluations of BASH Program. The BASH person and operation personnel should be instructed on the importance of record keeping and be trained to record this information in a standardized format.

6.7 BASH TRAINING SOURCES

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- Naval Safety Center: Web site-

  www.safetycenter.navy.mil/aviation/operations/bash

- Wildlife Management workshops

- Wildlife Conferences

- Bird Strike Committee USA meetings

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APPENDIX 1: Cummings Foley

Potential Bird/Aircraft Strike Hazards at Naval Air Station North Island, San Diego, California.

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Prepared by: U.S. Department of Agriculture, National Wildlife Research Center, 1716 Heath Parkway, Fort Collins, Colorado 80524 Technical Report 97-3

USDA Project Coordinator: John L. Cummings, 970-416-4502

POTENTIAL BIRD/AIRCRAFT STRIKE HAZARDS AT

NAVAL AIRSTATION NORTH ISLAND, SAN DIEGO, CALIFORNIA.

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1997

EXECUTIVE SUMMARY

Birds present a direct hazard to aviation safety at Naval Air Station North Island, San Diego, California. Every reasonable effort should be made to discourage birds from using the Station. We documented 27 bird/aircraft strikes on NASNI from April 1996 to April 1997. Of these, western gulls represented 77%, mallards 9%, American coots 4.5% and great blue herons 4.5%. The remaining 5% was divided between barn swallows, ravens, and lesser scaup. Most strikes that occurred between March and September were attributed to western gulls, where as waterfowl were struck most often between October and February. The Command Navy Safety Center in Norfolk, Virginia reported 102 bird strikes to aircraft at NASNI between 1980-1996. Approximately half of those strikes occurred during landing. The strike reporting rate is approximately 30%.

NASNI has a number of key areas that make the Station very attractive to birds. 1. approach end of runway 18; 2. approach end of runway 11; 3. approach end of runway 29; 4. approach end of runway 36; and 5. weapons compound. In addition, a heron rookery in the northeast corner of the station is not a direct threat to aircraft, but birds, primarily great blue herons from this rookery fly to and across the airfield.

Bird use patterns on NASNI varied by species, time and location. We observed 33 species of birds on the airfield. Observation indicated that the greatest bird activity on the airfield occurred during May. Daily counts during this month documented approximately 1,600 birds, mostly western gulls, using the airfield. Waterfowl, specifically mallards and American coots, peaked during December and January. The

greatest bird activity on NASNI occurred in Zone 4 (the southwest portion of the airfield). The greatest number of daily bird runway crossings occurred in May and August. The greatest number of bird runway crossings occurred in Zone 2 and 4, which covers runway 18 and its approaches. Western gulls, great blue herons, starlings, mourning doves and pigeons represent approximately 96% of all birds observed crossing runways.

We color-marked 800 western gulls and fitted satellite transmitters to 12 others. Observations of color-marked western gulls indicated that gulls dispersed to a number of other loafing/roosting sites away from NASNI. Of 650 gulls color-marked on NASNI with blue tags, only 23 were observed at any one time on the Station. This suggests a high turnover rate of gulls using NASNI. During the study period, we obtained 888 class 1 and 2 telemetry readings from 12 western gulls fitted with satellite transmitters. Most radioed gulls dispersed to other locations. Only 3 of 12 gulls consistently used NASNI. Overall, only 8-10% of the telemetry readings were on NASNI. The greatest distance a gull dispersed from NASNI was 800km (Monterrey, California).

A Bird Aircraft Strike Plan and recommendations to reduce the bird aircraft hazards on NASNI are included in this report. We discuss the BASH plan, habitat management, population control, and integrated bird management.

INTRODUCTION

Bird strikes to aircraft are a serious economic and safety problem in the United States, annually causing 200 million dollars in damage to civilian and military aircraft and the occasional loss of human life (Dolbeer et al 1995). The most significant military aircraft disaster caused by birds in the United States occurred at Elmendorf Air Force Base, Anchorage, Alaska on September 22, 1995, when an E-3 Sentry Airborne Warning and Control System aircraft ingested several Canada geese on take off and crashed, killing 24 people.

At Naval Air Station North Island (NASNI), San Diego, California, USA, several bird strikes have been reported since the start of record keeping in 1980. However, it is only recently that birds have cased severe damage to aircraft. On August 24, 1885 an E-2 departing on runway 18 struck a large flock of western gulls roosting on the runway, killing over 100 birds. The take off was aborted with no loss of life but severe damage to the aircraft. Another incident as NASNI occurred on August 15, 1996, when a departing P3 aircraft struck western gulls on runway 18 resulting in damage to the aircraft. Both incidents occurred during night time operations. An F-18 departing NASNI on 0800 on June 11, 1996 struck a great blue heron. The heron was nearly ingested into the left engine intake. As bird numbers increase on NASNI, the potential exists for a bird strike that could cause loss of aircraft and human life.

Factors that attribute to NASNI's bird attractiveness are the abundant foraging opportunities in close proximity to the airfield, available habitat for birds to nest, forage, and roost on and around the airfield, mitigation procedures which have established and protected bird habitat adjacent to the airfield and a lack of a Bird Aircraft Strike Hazard

Program. The only attempt to "manage" bird populations on NASNI has been directed at nesting western gulls. Since 1990, western gull nests have been destroyed or eggs addled with white mineral oil in an attempt to stabilize the growth of the NASNI western gull population (Cox, T. 1996 Control of nesting western gull population on Naval Air Station North Island 1996 season. USDA unpubl. rpt.).

NASNI has several species of birds, especially western gulls, great blue herons, ravens, red-tailed hawks, and waterfowl that have been observed on runways and within the airdome of arriving and departing aircraft. The western gull is perceived as the most significant bird hazard as NASNI. They are a medium-sized white-headed gull with males weighing from 1050-1250 g and female from 800-980 g. First breeding takes place during the fourth year. Pairswill maintain a breeding territory generally 4-10 m^2. Clutch size is normally 3 eggs. Survival of the eggs to hatching is 70-80%; of hatched chicks to fledgling is 50-70%; of fledgling to age of first breeding (4 yrs) <50%. After first breeding, adult survival is 90%/yr until age 10. Maximum longevity is 20-25 yr, 10-15 yr is typical.

Western gulls primarily range along the Pacific Coast from Washington to central Baja California. The single largest colony in on the southeast Farallon Island, California which has approximately 13,000 pairs (Pierotti and Annett 1995). This colony represents approximately 30% of the world western gull population. El Nino conditions in 1982-84 and 1991-94 have led to declines in western gull numbers. Overall, western gull populations do not seem to be increasing (Pierotti and Annett 1995). However, western gull breeding and non-breeding populations seem to have increased on NASNI since

1990 (C. Winchell 1996, pers. commun.). Up to 3,000 gulls have been observed loafing and roosting on runways and in the infield area of the airfield at NASNI (J. Cummings 1996, pers. commun.). In addition, an estimated 200 pairs of western gulls have been nested in close proximity to the approach end of runway 11. Also, a heron rookery is located within 2 km of each main runway. Herons are frequently observed crossing the runways at 2 to 5 m above ground level (AGL). All indications are that populations of birds on NASNI will continue to grow, thus increasing the chance of another serious accident involving birds.

In April 1996, the National Wildlife Research Center initiated a cooperative study with the U.S. Department of Navy on NASNI to identify and document management practices and technologies that could reduce bird/aircraft hazards. This report summarizes the results of those objectives which were to: 1) identify and map the air station environments that attract birds. 2) quantify bird use of NASNI by species and number, 3) monitor movement patterns of NASNI western gulls by tagging and telemetry, 4) summarize bird/aircraft strike information for NASNI and 5) make recommendations to reduce bird/aircraft strike hazards at NASNI.

STUDY AREA

The available habitat of a given site has a direct bearing on theabundance and diversity of the birds present. NASNI is a 1,160 ha air station located on Coronado Island, San Diego, California that has a number of naturallyoccurring characteristics that make portions of the site attractive to birds. NASNI is bordered on the north and west by the San Diego Bay, on the south by the Pacific Ocean and on the east by the city of Coronado. On NASNI there are vast areas of vegetative habitat which support an array of wildlife, there are intermittent and permanent water sources, and there are large flat open areas (Fig. 1).

We divided the airfield into six bird survey zones and four runway crossing zones (Fig. 2). Bird survey zones identify a portion of the airfield. These zones also were used to determine the area of the airfield having the greatest potential risk of a bird/aircraft strike. Runway crossing zones identify portions of runway 18 and 29. The zones were used to determine portion of the runway having the greatest risk of a bird aircraft strike. Future management plans addressing bird hazards at NASNI can based on these three zones.

METHODS

MAPPING NASNI BIRD HABITATS

We obtained both a base map and 4 aerial photos of NASNI. Photos were taken June 1995 at a scale of 1 cm = 130 m. They were adjoined and photographically reproduced into one 20 cm x 25 cm photo. This photo showed enough detail to delineate potential high-risk areas that attracted birds for nesting, foraging, loafing and/or roosting. These bird habitats were identified and outlined on the NASNI base map (Fig. 3).

BIRD USE OF NASNI

We conducted a series of bird surveys from April 1996 to April 1997 to index the species and number of birds using NASNI. Counts of both live and dead birds were made from stations and transects associated with runways; and from vantage points in areas that are attractive to birds. Starting in April 1996, once a month for 4 consecutive days the following surveys were conducted:

1. Station Counts: We established 8 permanent stations thatencompassed NASNI airfield (Fig. 4). Stations were numbered consecutively from 1 to 8. We drove a route that connected each station. The route was driven in the morning starting at sunrise and reversed in the evening starting at 1800 hr. Each day the starting location was switched between station 1 and 8 in order to reduce time bias. At each station, we recorded the starting time and for 10 minutes the number and species of birds and their activities: flying, feeding, loafing, roosting, etc. within approximately 1 km of the station. The location of each species, the species direction of flight and the species altitude above ground level (AGL) were recorded on to the base map (60 x 60 cm). We used symbols and abbreviations to prevent over crowding of the map with details. For example, the initials WG and the number 2 within a circle with an arrow pointing northeast from the circle and a number 42 on the edge of the circle means that two western gulls are flying northeast at an estimated height of 42 m AGL (Fig. 5). A circle without an arrow or outside number means the bird is sitting at that location.

2. Dead Bird Searches: Following the station counts, we drove and/or walked each runway and approach area to search for dead or injured birds. All remains, i.e. feathers, bones, and carcasses were collected, labeled, recordedand frozen. We mapped

the location of each item on the base map. Bird carcasses found by NASNI airfield personnel were also collected, labeled, recorded, frozen and mapped. Injured birds were collected and euthanized.

3. Roosting Bird Survey: We searched the airfield for roosting birds between 2200 and 2400 hrs each day. The species, number and location of roosting birds were recorded. We used binoculars, spotting scopes, and night vision scopes during bird surveys to observe birds. A range finder was used to determine altitude of birds and aircraft. Data was recorded on base maps/forms and the analysis was based on the respective survey zones. We followed NASNI procedures for airfield operations and radio communication with the tower.

MONITORING BIRD MOVEMENT PATTERNS

We used cannon nets and nest-traps to capture breeding and roosting western gulls during May and June 1996. The date and location of these captures were recorded. Western gulls were individually banded with a U.S. Fish and Wildlife Service band and patagial tagged with a colored tag (2.4 x 7.5 cm) to determine their movements, dispersal and use of NASNI. Breeding/nesting western gulls were marked with orange tags, non-breeding and <3 year old western gulls that used the runways for roosting or beaches for loafing and/or foraging were marked with blue tags. In addition, 12 non-breeding western gulls (>3 years old) were randomly selected from western gulls captured near or on runway 29 during June 1996. Each was fitted with a satellite transmitter and color-marked with a green patagial tag. All western gulls were tagged on the right wing and immediately released.

Tagged gull surveys were conducted to determine movements of marked gulls from NASNI. During each tagged gull survey period, we drove a route that encompassed gull loafing, roosting, and nesting sites that were within 50 KM of NASNI. We recorded the number of tagged gulls observed, their location and the size of the associated flock of gulls. We also advised interested wildlife groups and the public about the color-marked gulls and requested sightings of these birds. A sighting request was also placed on the Internet.

Western gulls fitted with satellite transmitters were tracked via the French Argos receiving satellites. Transmitters were programmed to transmit approximately 8 hours every 120 hours for approximately one year except during nesting season. At this time transmitters were programmed to transmit approximately 8 hours every 360 hours for two cycles. We obtained up to 4 locations during a transmission period. We mapped the movement data using the Atlas Geographic Information System.

BIRD/AIRCRAFT STRIKES

We determined the number of bird/aircraft strikes that occurred during our study period, April 1996 through April 1997 from dead bird searches. A strike was considered one or more birds still intact and found at one location on the airfield. If possible, the type of aircraft was identified using records from flight operations.

In addition, the Command Navy Safety Center at Norfolk, Virginia has documented bird/animal strikes to aircraft at Navy Air Stations since 1980. We requested all bird/animal aircraft strikes from the center that have occurred at NASNI from 1980 to date. Using their data we determined the number of reported bird/aircraft strikes on NASNI. Bird Strikes to aircraft were categorized by year, month, aircraft type, altitude, and occurrence (i.e. landing, take-off, etc).

RESULTS

MAPPING NASNI BIRD HABITATS

We mapped all areas that represent the greatest risk to pilots and aircraft (Fig. 6). These are areas that attracted significant numbers of bird species, are generally adjacent to runways, and pose the greatest risk to pilot and aircraft. Birds are attracted to these areas for foraging, nesting, loafing and/or roosting. NASNI has a number of key habitat types that make the station very attractive to birds:

Area 1: Approach end of runway 18. This area is a mix of low vegetation consisting primarily of ice plant. The vegetative pattern is intermittent in several areas due to the substrate being covered with as layer of soil cement several years earlier (date unknown). The open area among ice plants is generally sand. This type of habitat is very attractive to western gulls for nesting and roosting because it protects against prevailing winds, it has good ground cover for nesting (Winnett 1979), it's a good vantage point to observe other gull activities, and it allows a good visual detection against intruders.

Great blue herons and raptors specifically red-tailed hawks are also attracted to this area primarily to prey on ground squirrels. Burrowing owls use abandoned squirrel holes in this area for nesting and roosting. Pigeons and doves are attracted to this area because of the seed producing plants and grit (sand). Pigeons are also supplementally fed in this area.

Area 2: Approach end of runway 11. This area consists of a large open tract of sand with virtually no vegetation that has mitigated as an alternate nesting side for the California least tern. The remainder of the area is dominated primarily by ice plant. The density and growth patterns of ice plant makes this area very attractive to western gulls for nesting and loafing. Over 150 western gull nests and 2,500 roosting western gulls have been documented in this area. It also attracts great blue herons, red-tailed hawks and burrowing owls for foraging. The beach adjacent to the approach attracts a number of waterfowl, shorebirds, brown pelicans and other gulls for foraging and loafing.

Area 3: Approach end of runway 29. This area has several diverse habitats. On either side of the approach end of runway 29 are dense stands of trees, fresh water ponds, a golf course and a large tract of mixed grasses and ice plant. A variety of birds use this area primarily for foraging and loafing. The greatest attractions are the ponds and golf course. Several species of waterfowl and gulls; and American coots have been documented loafing and foraging on or near the ponds. Peak use of these ponds occurs during December – January. Over 500 ducks and coots have been documented using this area.

Area 4: Approach end of runway 36. The primary vegetation surrounding runway 36 is ice plant. The vegetation is dense with very limited exposed sand. The area is not used by western gulls for nesting and loafing. It is only used on a limited basis by ravens, blue herons, red-tailed hawks and starlings for foraging. However, the beach which is within 100 meters of the runway, attracts several species of gulls, shore birds, brown pelicans and double-crested cormorants. As many as 212 western gulls, 156 heermann's gulls, 37 brown pelican and 55 cormorants have been observed within this area at one time. Also, western gulls have been observed towering up from the beach to altitudes of 1000 meters over this area.

Area 5: Weapons Compound. The area of primary concern is a relatively large open tract within the weapons compound that is sparsely vegetated with ice plant and grasses. This area is mainly used by western gulls for nesting and roosting. Over 30 western gull nests and 350 western gulls have been documented in this area.

We also mapped all low risk areas (Fig. 6). These are areas that generally are not in the direct flight path of aircraft.

Area 6: Beach. The beach and rocky areas surrounding the station attract several species of birds for loafing, foraging and roosting. These areas represent a reservoir of birds that can attribute to bird hazards at NASNI.

Area 7: Piers and Ramps. The two primary locations that birds congregate for loafing and roosting are the weapons off loading pier and the seaplane ramp 10. More that 1000 birds have been documented using the weapons pier for roosting. Three main species represent 70%, 22% and 8% of the birds observed on the pier, respectively. The seaplane ramp is generally used during the day for loafing by western gulls, brown pelicans, heermann's gulls and cormorants. During the study period 41 tagged western gulls (13 orange and 28 blue were observed loafing on this ramp. Indications are that these birds pass through air traffic to get to this locations.

Area 8: Heron Rookery. The stand of trees, predominantly eucalyptus (Eucalyptus spp.) on the northeast corner of the NASNI near the junction of Wright Road and Roe Street attracts several species of herons for nesting. The rookery which is 3 km from the NASNI runways is not a direct threat to aircraft, but birds, primarily great blue herons from this rookery fly to and across the airfield to foraging sites.

BIRD USE OF NASNI

Airfield Zones

Bird use patterns on NANSI varied by species, time and location. Thirty-three species of birds were observed in the study area (Table 1). In addition, twelve species of shore birds not considered to be a risk to aircraft were observed on the periphery of the study area along the beaches.

Bird observations indicated that the greatest bird activity on the airfield (all survey zones) occurred during May (Fig. 7). Daily counts during this month documented approximately 1,600 birds, primarily western gulls, using the airfield. The lowest bird activity occurred in October where <250 birds were observed using the airfield (Fig. 7). Of interest, bird activity was relatively high in April, August, September, December and

January. These peaks were associated with specific species. The number of western gulls using NASNI for nesting and loafing increased significantly during April mainly because of available nesting habitat. Increases in western gull numbers in August and September is attributed to gulls from surrounding areas using the airfield as a post-nesting staging area. December and January peaks were attributed to a greater number of migrating waterfowl, specifically mallards and American coots using two ponds and a large expanse of turf grass (gold course) near the approach of runway 29. Seasonal changes in bird populations on NASNI due to migration can shift the potential strike hazards from one species to another and from one location to other on the airfield. For example, there is a greater potential strike hazard on runway 18 during April and May from western gulls where as during December and January there is a greater risk to aircraft from American coots on the approach to runway 29.

Observations by zones indicated that Zones 2, 4, and 6 had the most bird activity (Fig.8). Also, bird activity specifically by western gulls was greater in Zone 4 between April and September than in other zones. Seasonal changes affected the species composition among zones. For example, western gulls, morning doves, and starlings were the most predominant species in Zone 6 from April to October. However, with winter migration mallards and American coot became predominant species between November and March in Zone 6. Bird activity in Zone 5 was minimal but constant throughout the study. This area attracted a variety of bird species, mostly starlings and small passerines, because of heli-wash (water), vegetation type (grasses), and tree stands.

Of the birds observed on the airfield (includes all zones) western gulls, great blue herons, American coots, mallards, and red-tailed hawks present the greatest hazard to aircraft based on numbers, size and weight (Table 2). Western gulls are most numerous from April through September, peaking in May and August (Table 2). Great blue herons were most numerous during the same time period as western gulls, but peaked in July and September (Table 2). Mallards and American coots were most numerous from October to March. Mallard numbers peaked in February and American coots peaked in January (Table 2). Red-tailed hawks were most numerous between October and December, peaking in December (Table 2). Starlings, mourning dives and pigeons are not considered a hazard when present as individuals. However, their gregarious behavior at various times of the year can create relatively high risk to aircraft.

Runway Crossing Zones

Bird observations indicated that the greatest number of daily bird runway crossings occurred from April through September, peaking in May and August (Fig. 9). These peaks are associated with pre- and post-nesting periods when bird movements are most numerous. During the nesting period, June and July, birds spend little time away from nesting territories except for short feeding bouts. The number of bird runway crossings during these months dropped approximately 45% and 35%, respectively, over the previous month.

The greatest number of bird runway crossings occurred in Zones 2 and 4 which covers runway 18 and its approaches (Fig. 10). A number of factors attributed to this level of bird activity. Birds, specifically western gulls and great blue heron were attracted to either side of runway 18 because of foraging opportunities, the availability of fresh water (north heli-wash) and roosting sites. Also, the beach area on the north side of the Station offered foraging opportunities at low-tide. In some cases western gulls retrieved clams from this area and then dropped them in the SH helicopter area in order to break the shell. This creates both a nuisance and fod hazard for helicopters and personnel from broken shells. In addition, as fishing boats returned to the bay large flocks of western gulls, brown pelicans, and double-crested cormorants follow these boats starting near the weapons pier and continue the Station to a point adjacent to the seaplane ramp 10. On one occasion 2,700 western gulls, 250 brown pelicans and 175 double-crested cormorants were observed following boats. The bird/aircraft hazard associated with these large feeding flocks occurs when birds cross runways leaving and returning from these feeding frenzies.

Overall, western gulls, great blue herons, starlings, pigeons and mourning doves represent approximately 96% of all the birds observed crossing runways (Table 3). Of those, western gulls represent approximately 76%. Over 87% of the runway crossings by western gulls occurred from April through September with peaks in May and August. Most great blue heron runway crossings occurred from April through July, with peaks in April and July. Starlings runway crossings were fairly common throughout the study period where as pigeon runway crossings were sporadic. Runway crossings by mourning doves were most numerous from May through September.

Dead Bird Searches

We (including NASNI personnel) found 43 dead birds representing 27 bird/aircraft strikes on NASNI during the study period (Table 4). Of these, western gulls represented 77%, mallards 9%, American coots 4.5% and great blue herons 4.5%. The remaining 5% was divided between barn swallows, ravens and lesser scaup. Most birds were found intact. Death was generally attributed to a broken neck or internal injuries. The recoveries suggested that none of the birds were ingested into an engine.

Roosting Bird Surveys

All birds observed roosting on NASNI airfield were western gulls (Fig.11). Great Blue herons were observed in the weapons and flightline compounds. Heermann's gulls and brown pelicans were observed roosting on the weapons pier. Western gulls use 4 primary roosting sites on the airfield: approach end of runway 11, helipad-zone 4, weapons compound and infield-zone 2 (Fig. 12). The number of western gulls using those sites varied nightly. We attributed this to periodic flock disturbances from NASNI personnel, wildlife (feral cats, burrowing owls, and/or rabbits) and air traffic especially when especially when forward landing lights were in use. Western gulls that were disturbed would circle at altitudes between 1 and 40 m AGL. We observed that the disturbance did nothave to be persistent or startling in order for gulls to move to other areas of the airfield.

Western gulls were only present on the NASNI airfield from April through September. Numbers peaked during May. They are attracted to the airfield because of its openness, close proximity to forage, available breeding sites, and safety.

WESTERN GULL MOVEMENT PATTERNS

Patagial Color Marking

In 1996 we color-marked 800 western gulls on NASNI between May and July. Of those, we marked 138 breeding/nesting western gulls with orange patagial tags at 4 sites on NASNI: the approach end of runway 11 (76), the approach end of runway 18 (7), the flightline compound (32), and the weapons compound (23). We marked 650 non-breeding western gulls with blue patagial tags that used either the approach of runway 11, compass rose (infield), or weapons beach. We marked 12 non-breeding western gulls captured on the approach end of runway 11 with green patagial tags and fitted each with a satellite transmitter. One transmitted gull was recovered 11 days after it was released due to an injury. The transmitter was transferred to another western gull.

We searched for color-marked gulls along a 50 km survey route starting at the Mexico border and ending near Del Mar, California. Searches were conducted by boat, vehicle and/or on foot. The route included mostly beach areas that were used by gulls for foraging and loafing. Some of those sites were: Imperial Beach, Silver Strand, Point Loma, Mission Bay, Shelter Bay, Ocean Beach, and Harbor Drive. In addition, sightings from the public were included.

During the study period we had 74 sightings of orange marked gulls, 103 sightings of blue marked gulls, and 3 sightings of green marked gulls (Fig. 13,14). The majority (73%) of gulls were sighted within 5 km of NASNI (Table 5). The greatest number of sightings occurred at NASNI, the San Diego bait barge, Silver Strand and Shelter Island. Most sightings occurred during June and July which represented approximately 50% of the color-marked gulls observed. The remaining sightings were spread throughout the study period. The furthest sighting of a breeding western gull (orange) was at Doheny Beach, California on October 23, 1996, a distance of 141 km from NASNI. The furthest sighting of a non-breeding western gull (Blue) was at Pismo Beach, California on October 9, 1996, a distance of 561 km from NASNI. Other sightings of interest were 2 non-breeding western gull, one sighted on San Clemente Island and the other near Santee, California.

Observations of color-marked western gulls indicated that gulls dispersed to a number of other loafing/roosting and foraging sites away from NASNI. Of 650 western gulls on NASNI color-marked with blue tags, only 23 were observed at any one time on the Station. This indicates that the daily turnover rate of western gulls is probably >80%

based on the number of color-marked gulls observed on the Station. This also suggests that the population of western gulls that use NASNI is greater than roost counts indicate.

Satellite Telemetry

We captured 12 non-breeding adult western gulls on the approach end of runway 11 at NASNI and fitted each with a satellite transmitter. We tracked each gull from June 1996 to June 1997. Movements of western gulls 16973, 16974, 16975, 16976, 16977, and 16978 are shown is figures 15-27 and movements of western gulls 16979, 16980, 169781, 16982, 16983, and 16984 are shown in figures 28-40. There was no contact with gull 16973 after six months and gulls 16981 and 16983 after 2 months.

We obtained 888 class 1 and 2 satellite telemetry readings from June 1996 to June 1997. The average number of monthly readings was 74. Class 1 and 2 readings are very reliable and the actual gull would be found within 100 m of the location.

During June 1996, 4 of 12 radio-tagged gulls used NASNI. However, only 8% of their time was spent on NASNI. Gulls spent approximately 29% of their time at sea foraging. The remainder of their time was spent inland or along the coast at several different sites. They ranged up to 50 km out to sea, 60 km inland and up to 200 km north along the coast (Fig. 15, 28).

We recorded 290 reading from July through September 1996 (Fig. 16-18, 29-31). During this period 7 radioed gulls dispersed from NASNI to other foraging and roosting sites. The greatest movement was to a site near Monterey/Salinas, California, a distance of approximately 800 km. Most of these gulls established home sites north and south of NASNI. Sites were centered in Mexico, Chula Vista, Laguna Beach, Monterey, Santa Monica, and Long Beach, respectively. Gulls would forage out to between 30-40 km from these centers. However, there were occasions when gulls foraged up to 200 km from the site. Their foraging bouts ranged up to 75 km out to sea and up to 200 km inland. During this period, gulls spent 30% of their time foraging at sea. We recorded only 6 of 12 , 4 of 12, and 2 of 10 radioed gulls using NASNI during July, August, and September, respectively. Their use of NASNI represented approximately 10% of all readings.

We recorded 294 reading from October 1996 through February 1997 (Fig. 19-23, 32-36). During this period, only 2 of 10 radioed gulls used NASNI. Their use of NASNI represented approximately 8% of all readings. Approximately 24% of their time was spent at sea foraging. Their remaining time was spent inland or along the coast at different foraging/roosting sites.

The NASNI gull population is part of a highly mobile regional population. Their movements and dispersal patterns seemed to be framed between the Santa Monica Bay area and the northwest coast of Mexico. Indications are that 70-80% of the NASNI gull population can be considered transients. Observations of color-marked and telemetry gulls suggest that ASNI is used for a relative short period of time by transients before they move to other sites. Due to this high turnover rate, the actual number of individual gulls using NASNI maybe greater that what is reflected by roost counts.

The use of telemetry has proven invaluable in determining the movements and dispersal patterns of western gulls from NASNI. Satellite telemetry is unique in the sense that a complete picture of the bird's movements can be developed without the complicating factors that are associated with standard telemetry or color-marking. In our study satellite transmitters produced approximately six times more information than color-marking. We located gulls at sites that would not have found by standard ground surveys.

BIRD/AIRCRAFT STRIKES

We documented 27 bird/aircraft strikes on NASNI during the study period (Table 4). Of these, western gulls represented 77%, Mallards 9%, American coots 4.5% and great blue herons 4.5%. The remaining 5% was divided between barn swallows, ravens, and lesser scaup. Bird strikes peaked during April and June with no strikes occurring during January. Most strikes that occurred between March and September were attributed to western gulls, where as waterfowl were struck most often between October and February. Species specific strikes during these periods are related to population numbers. Greater numbers of western gulls between March and September substantially increased the chances of this species being struck by an aircraft. Increased waterfowl strikes between October and February are attributed to greater numbers of migratory waterfowl in the area, the attraction of waterfowl to golf course ponds situated adjacent to the approach of runway 29, the number of aircraft using runway 29 for training, and the altitude (20-25 m AGL) of aircraft on approach when they are adjacent to golf course ponds. Observations indicate that waterfowl flying to and from these ponds transect the flight path of most aircraft landing on runway 29.

NAVY BIRD STRIKE DATA BASE

Since 1981, 102 bird strikes to aircraft have been reported to the Command Navy Safety Center in Norfolk, Virginia (Table X). The most numerous bird strikes occurred in 1987 and 1990 which possibly could be due to the heightened awareness of the problem and reporting during those years (Fig. 42). Of interest is the low number of bird strike reported since 1992. Our data indicates approximately a ten fold increase over what has been reported for NASNI in 1996. The low reporting rate can probably be attributed to pilots being unaware that the aircraft struck a bird and/or a lack of reporting by maintenance crews. Unless substantial damage occurs or there is good evidence a bird struck the aircraft, a bird strike will probably go unreported.

Reported bird/aircraft strikes by month from 1981 through 1996 for NASNI indicated that peaks occur in April and September (Fig. 43). The trend generally follows the results of our study on NASNI, except that June has a greater frequency of bird strikes. We attribute this to western gull population increases over the past 5 years in and around NASNI. Greater numbers of gulls translates to increased chances of a bird strike. Also, more inexperience gulls are probably joining the NASNI population from surrounding areas which could attribute to more strikes.

Bird/aircraft reporting data indicates that most strikes at NASNI occur on landing (Fig. 44). Landing represent approximately 46% of the strikes, in flight approximately 20%, take-offs approximately 15% and taxiing approximately 7% of the bird strikes at NASNI. The remainder were unknown.

BIRD ALTITUDES

We determined the altitude of 1939 western gulls that crossed NASNI runways. Of those, 911 (47%) crossed runways at under 17m (AGL), 501 (26%) crossed runways between 18-33 m (AGL), 305 (16%) crossed runways between 51-68 m (AGL), and 87 (4%) crossed runways above 68 m (AGL). Depending on the type of aircraft landing or departing, over 95% of these western gulls could intercept the there flight pattern.

DISCUSSION

Birds present a direct hazard to aviation safety at NASNI. Every reasonable effort should be made to discourage birds from using NASNI. All birds are capable of causing damage to aircraft. For example, a single horned lark was responsible for the 1994 crash of a T38, resulting in the loss of the plane and injury to the pilot. However, of the birds observed on NASNI the western gull, great blue heron, American coot, mallard, red-tailed hawk, starling, mourning dove and pigeon present the greatest risk to pilots. Western gulls represent 77% of the NASNI strikes, 70% of the birds observed on the airfield and 76% of the runway crossings. Management of this species and others would have a big impact on aircraft safety and should be directed at the species itself, its foraging source, and its nesting/roosting habitat.

Data gathered from this study indicates that habitat management, direct population control and dispersing birds from NASNI should significantly reduce the bird/aircraft hazard. Habitat management will be the single most effective long-term measure to reduce the bird hazard on NASNI. The bird habitats identified on the Station are prioritized in the order they are cited in the text. Four bird species, western gulls, great blue herons, mallards and American coots would be severely reduced by simply discing or soil cementing the existing bird habitats at the approach ends of NASNI runways; by griding the golf course ponds with overhead strands of Kevlar or monofilament; and by thinning or removing eucalyptus from the heron rookery. Of importance is that habitat modifications such as discing removes all vegetation and leaves the soil surface smooth. Leaving furrow and vegetation will only enhance nesting by gulls. An alternative to removing trees in the heron rookery would be to translocate nests/adults to another location away from NASNI.

Direct population control can be an effective short-term solution to reduce a bird-aircraft hazard. Removal of over 1,000 gulls from high risk areas of NASNI had an impact on numbers of birds observed on the airfield and the number of bird runway crossings (Olson, A. 1997 Bird air strike hazard (BASH) at Naval Air Station North Island, San Diego, California 1997. USDA/WS unpubl. Rpt.). Direct population control could have a significant effect on population dynamics of local western gull population levels since western gulls are long lived, surviving up to 25 years, typically 10-15 years, have a survival rate of >90% after the first breeding season and have a low recruitment rate. The breeding bird survey indicates that western gulls removed from NASNI represent approximately 1.3% of the worlds population.

Dispersing foraging/roosting birds with hazing techniques could reduce the bird/aircraft hazard on NASNI. However, this approach will require significantly more logistical support for a longer duration that direct control.

RECOMMENDATIONS

1. **Develop a bird/aircraft strike plan.** The plan should outline procedures and set forth guidelines to address bird/aircraft strikes at NASNI. We outlined the following plan for NASNI Natural Resource personnel during a Command briefing *(Appendix 1)*.

2. **Implement a habitat management program.**

- Prioritize bird hazard areas on NASNI. We have prioritized these areas in this report based on bird use, foraging, loafing and roosting patterns.
- Remove vegetation from the approach end of runway 18 and 11; remove vegetation from nesting areas near the approach to runway 11, taxiway 4, and in weapons compound.

- Thin or remove eucalyptus trees at heron rookery and/or translocate adults and nests.
- Level dirt piles near weapons to prevent heron use.
- Grid or net golf course ponds to prevent waterfowl use.
- Demolish seaplane ramp #10 to disperse loafing gulls.
- Modify the roof of building 805 to discourage gull loafing.
- Install anti-loafing devices on light poles in fuel farm area and along weapons compound.

3. **Implement a population control program.** Emphasis should be on western gulls, American coots, and domesticated mallards. Use techniques outlined in the BASH plan and information from this report. For gulls, start in April removing birds attempting to nest on NASNI that occur in the high risk areas. For waterfowl, start in November removing (permits) or translocating birds from the approach area of runway 29.

4. Implement a integrated bird management program. This would involve hazing with bird management techniques outlined in the BASH plan and the Prevention and Control of Wildlife Damage manual (Timm 1983). Use information from the BASH plan and this report to determine the location and timing of implementing control strategies.

5. Monitor and review BASH activities at NASNI. Follow procedures outlined in this report to identify high risk situations and evaluate management strategies. See Methods section.

6. **Establish a Bird Hazard Working Group.**

7**. Make NASNI personnel aware of the bird/aircraft strike hazard issue.**

8. Establish airfield operation procedures to avoid high-hazard situations. We recommended that runways be driven by NASNI personnel to disperse roosting birds prior to nightly take-offs or landings. In addition, if possible modify flight operation schedules around high risk times of the year, season, and or day.

9. Provide information to all aircrews about the bird hazard at NASNI. This report should be distributed to all personnel involved with aircraft and airfield operations. It should be a priority to have pilots, air operations, and ground personnel report any bird/aircraft related incidents, i.e. blood on the aircraft, bird parts on the runway, damage to the aircraft, etc. Documentation is the key to increased safety.

10. **Establish a bird free zone around runways with a reporting phone number for individuals to call if they observe birds in this zone.**

11. Implement a no bird feeding program. Post no feeding signs near the golf ponds. The signs should discuss the hazard. Police outside break and lunch areas for trash. Dumpsters should always remain closed.

12. **Keep NASNI Safety Officer informed of all BASH related activities.**

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Committee.

APPENDIX 2: NASNI BASH 2000

BIRD AIR STRIKE HAZARD (BASH) MANAGEMENT AND MONITORING AT NAVAL AIR STATION NORTH ISLAND
2000

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BIRD AIR STRIKE HAZARD (BASH) MANAGEMENT AND MONITORING AT NAVAL AIR STATION NORTH ISLAND 2000

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EXECUTIVE SUMMARY

Biologists from the National Wildlife Research Center (NWRC) have worked with North Island Naval Air Station (NASNI) and the U.S. Department of Agriculture's Wildlife Services (WS) since 1996 to evaluate and reduce the hazards birds pose to aircraft on NASNI. In a continuing effort NWRC conducted a bird/aircraft strike hazard (BASH) assessment from April 2000 through January 2001 to assess bird populations, to identify and quantify the bird species most threatening to flight operations, and to evaluate the bird/airstrike mitigation efforts initiated in 1996.

Data from NWRC bird observations in 2000 indicated overall bird numbers on NASNI decreased throughout the Airfield for the second straight year since 1999. However, bird numbers increased by approximately 50% in July and August 2000 compared to 1999 survey data. These increases were related to the large numbers of Mourning Doves and Western Gulls migrating through NASNI during these months. Numbers of Great Blue Herons, Double-crested Cormorants, American Coots, Rock Doves, and European Starlings all declined on NASNI during 2000.

Crossings of Runways 36, 29, 18, and 11 continued to vary from month to month in 2000. The approach to Runway 29 continued to experience the most crossings. Crossings of all runways peaked May through August. These peaks have been reported in the past and were related to pre-and post-nesting periods when bird movements were most numerous. Of note were the greater number of crossings observed at Runway 29 in June. Four dead birds were found on NASNI during the study period. Due to location

and type of injuries, all deaths were attributed to collisions with aircraft. An additional bird/aircraft strike involving a helicopter flying over San Diego Bay and striking a shorebird species (*Calidris* spp.) was reported during the study period. These five strikes were a slight increase from 1999 when 4 strikes occurred. The approach to Runway 29 sustained the most bird/aircraft collisions, as well as the largest number of observed runway crossings by birds.

This reduction in aircraft strike hazards can be attributed to early initiation of the 2000 BASH program. WS personnel eliminated gull nesting in problem areas, and thereby reducing gull recruitment into the local population. Total birds dispersed by WS personnel on NASNI increased by approximately 4% from 1999 dispersals. The total number of birds, chicks, and eggs removed and/or destroyed increased by approximately 7% from 1999 levels. Western Gulls, Rock Doves, and American Coots comprised 66%, 19%, and 12%, respectively, of all the birds taken by lethal methods on NASNI in 2000. Of these, eighty American Coots were removed with alpha-chloralose (AC) bait from the NASNI golf course. Consistent hazing, installation of grid-wire systems over two of the golf course ponds, and the AC bait project were successful in reducing coot numbers on NASNI by 40% when compared to coot numbers in 1999.

The raptor relocation effort initiated in 1999 continued through 2000 with favorable results. In 2000, WS relocated five Red-tailed Hawks approximately 110 miles to the east to Imperial County near El Centro, California. None of these hawks have returned to NASNI.

WS bird dispersal have almost eliminated gulls roosting on NASNI, however the Weapons Pier remained as an occasional roosting location for gulls and pelicans on NASNI. The peak of roosting activity on the Weapons Pier occurred in August, which is the historical pattern. However, there was an 85% reduction in gull numbers using the Pier in 2000 compared to 1999 roosting observations.

The past soil stabilization efforts have deterred birds from nesting and roosting near runways. However, at this writing soil cementing was in place for less than two years. As it deteriorates, continual monitoring will be essential for early detection of reoccupation by various bird species. The sandy, short-grass areas on the approach end of Runway 29 remains an area of concern, and we recommend soil stabilization in this area to eliminate foraging opportunities for birds. In July 2000, over 200 European Starlings, three Great Blue Herons, and three Western Gulls were observed foraging and/or loafing in this area. We also recommend filling the golf course ponds adjacent to the approach of Runway 29, and if this is not possible, leaving the grid-wire systems up throughout the year to discourage bird use. In addition, the approach to Runway 36 should be monitored constantly and any birds dispersed to prevent a buildup of birds in this area. Although WS has been successful in preventing most gulls from nesting on the ground around NASNI, rooftop nesting continues and will require further intensive management.

INTRODUCTION

Bird strikes to aircraft are a serious safety and economic problem in the United States, annually causing millions of dollars in damage to civilian and military aircraft and occasionally loss of human life (Cleary et al. 1998). Military aircraft are especially susceptible to bird strikes because many exercises involve high speeds at low altitudes where birds are commonly present, and losses of military aircraft have been numerous and costly (Blokpoel 1976). Since 1960, at least 250 military aircraft and 120 military personnel have been lost because of wildlife strikes in the U.S. (Cleary and Dolbeer 1999). The U.S. Navy reported about 620 bird strikes from 1993 through 1995 with 19 of these strikes totaling approximately $104 million in aircraft damage (Bird Strike Committee 1997). The U.S. Air Force reported 13,427 bird/wildlife strikes to aircraft world-wide from 1989 through 1993 with damage estimates exceeding $85 million (Arrington 1994).

At Naval Air Station North Island (NASNI), San Diego, California bird strikes regularly have been reported since the start of record keeping in 1980. The Command Navy Safety Center in Norfolk, Virginia reported 102 bird strikes to aircraft at NASNI between 1980 through 1996 (Cummings and Foley 1997). However, it was only recently that birds have caused severe damage to aircraft. On 24 AUG 1995 an E-2 Hawkeye (carrier-based tactical warning and control system aircraft) on take-off struck a large flock of Western Gulls (*Larus occidentalis*) roosting on the runway, killing more than 100 birds. The take-off was aborted with severe damage to the aircraft but no loss of life. The E-2 was valued at $51 million (U.S. Navy Fact File web page 2000). Another incident at NASNI occurred on 15 AUG 1996, when a departing P-3 Orion (four-engine turboprop anti-submarine and maritime surveillance aircraft) struck Western Gulls on the same runway resulting in damage to the aircraft. The P-3 was valued at $36 million (U.S. Navy Fact

File web page 2000). Both of these incidents occurred during night-time operations. In addition, an F-18 Hornet (fighter and attack aircraft) departing NASNI struck a Great Blue Heron (*Ardea herodias*) on 11 JUNE 1996. The heron was partially ingested into the left engine intake. The F-18 was valued at $24 million (U.S. Navy Fact File web page 2000).

As a result of the Bird/Aircraft Strike Hazard (BASH) program initiated on NASNI, observed Western Gull (*Larus occidentalis*) numbers were reduced by an average of 95% from 1996 through 1999. In addition, a steady decline in bird/aircraft strikes on NASNI from 1996 to 1999 (78%) was documented. Habitat modification (i.e., soil cementing) eliminated approximately 52 acres of bird nesting, loafing and foraging habitat at the approach ends of Runways 11 and 18. This effort greatly reduced the incident of runway crossings by all bird species on NASNI. The objectives of this study were to assess bird populations, to identify and quantify the bird species most threatening to flight operations, and to evaluate the bird/airstrike mitigation efforts initiated in 1996.

STUDY AREA

NASNI is a 2,866-acre naval air station located on Coronado Island, San Diego, California that has a number of natural characteristics that make portions of the site attractive to birds. NASNI is bordered on the north and west by the San Diego Bay, on the south by the Pacific Ocean and on the east by the city of Coronado. On NASNI there are vast areas of vegetative habitat interspersed with intermittent and permanent water sources, and flat open areas that attractant several species of birds.

METHODS

WS Bird Dispersal

WS implemented bird control activities on NASNI beginning 1 FEB 2000.

Prior to initiation of operational bird dispersal, baseline information was recorded on species and numbers of birds utilizing the NASNI airfield. Various dispersal techniques were used depending on the location of birds, species, time of bird activity, and level of threat posed by birds. These criteria were subdivided using the following decision making model: first, if the birds were dispersed, would the problem be solved; second, were they resident birds which would continually return, post-dispersal; and third, were they birds that would not disperse even after harassment.

Multiple tools and techniques were used for bird dispersal including automated propane cannons, hand-held pyrotechnics, spotlight harassment, vehicle harassment, electronic distress calls, and dead gull effigies. All dispersal efforts during airfield operation hours were coordinated with the NASNI Air Traffic Control Tower and Navy Security via radio communications. Numbers of birds harassed and pyrotechnics fired were recorded on Airport Data Sheets (Appendix A). Four propane cannons (Reed Joseph International, model M-8) were placed in locations historically identified as gull loafing, roosting and nesting areas. Hand-held pyrotechnics (Sutton Ag. Enterprises) fired from a specialized, double-barreled pistol were used to disperse birds from the NASNI airfield. To discourage use of gull roosting on the Weapons Pier the WS Specialist, after consultation with Weapons personnel, initiated use of pyrotechnics on the Weapons Pier in late December 2000. Pyrotechnics were only used on the Weapons Pier when the red flag was not flying and ordnance were not present.

Vehicle harassment, spotlight harassment, and electronic distress calls were implemented in areas designated too sensitive for pyrotechnics. These areas included the Fuel Farm and Weapons Magazines. These techniques were also implemented throughout the NASNI airfield to augment the dispersal affect of pyrotechnics. To discourage gull loafing on roof tops the WS Specialist placed dead gulls on buildings that were known loafing locations.

Spotlighting, coupled with pyrotechnics, proved an effective combination for dispersing waterfowl from the golf course ponds to the north of the approach end of Runway 29, although some of these birds always returned, post-dispersal, because use of the golf course prohibited continued harassment throughout the day. American Coots (*Fulica americana*) typically roosted on the golf course ponds, but other waterfowl species including American Wigeons (*Anas americana*) roosted elsewhere, and arrived at ponds around sunrise. Several days a week before sunrise, hand-held pyrotechnics, and spotlights were used to haze the coots from the ponds. Beginning in late January 2001, the WS Specialist began using a trained dog for coot and waterfowl dispersal at the ponds. The dog proved effective in dispersing the wigeons, but not effective in dispersing coots. As golfers arrived to play the holes surrounding the ponds, harassment efforts ceased. This also coincided with the start of Air Operation hours and the arrival of wigeons. Efforts to disperse wigeons from the ponds were deemed too risky to Air Operations since birds could possibly disperse across Runway 29. To further discourage use of the ponds, a grid-wire system was constructed on 18 JAN 1999 over two 1-acre ponds adjacent to Runway 29 that were being used extensively by waterfowl. Waterfowl were counted on all five golf course ponds (grided and ungrided) once a day following monthly Airfield surveys.

WS Bird Removal

Lethal control of birds on the NASNI airfield was implemented when other methods were ineffective in reducing immediate threats to aircraft safety. The objectives for lethal control were to prevent reproduction, to reduce overall population levels of certain bird species, and to reinforce the hazing/harassment program. All weapons used on NASNI were registered with security and used only when conditions were safe and in accordance with the Navy and WS regulations and policy. All shooting events were coordinated with the Tower and Navy Security. When shooting events occurred within the Weapons Compound, all procedures previously set forth were followed. Lethal reduction in numbers of gulls, Rock Doves (*Columba livia*), and waterfowl at the NASNI airfield involved shooting, nest traps, Rock Dove traps, cannon nets, egg-oiling, nest destruction, alpha chloralose (AC) baiting, and hand capture. Tools used for lethal control of gulls, Rock Doves, and waterfowl to lower overall numbers utilizing the Airfield included shooting with 12 gauge shotguns (2 3\4" and 3" shells, utilizing #4 and #6 bird shot), .177 caliber air guns, and .22 caliber rifles using subsonic ammunition (CCI CB Longs). Other methods included bal-chatri traps, pole traps, decoy traps, nest traps, Rock Dove traps, egg-oiling, nest destruction, AC, and hand capture. Captured birds were euthanized by CO^2 inhalation under American Veterinary Medical Association Guidelines (AVMA 1993).

Gull trapping began with intensive foot surveys to mark all nests. Discovered nests were marked with flagging and numbers of eggs were recorded on data sheets. Nest traps were placed over gull nests, which commonly contained three unhatched eggs in a complete clutch. Both sexes of Western Gulls incubated the nest, however success of capturing a second nesting gull was diminished by the other adult witnessing the capture of its mate. Allowing the nest to settle for a few days to let the second adult reclaim it increased second adult capture success.

Prebaiting waterfowl with cracked corn was initiated at the golf course on 12 DEC 00. On 21 JAN 01 AC-treated corn was used to remove waterfowl at this location on NASNI. All large scale removal projects such as the use of AC on the golf course were approved and scheduled in advance with Natural Resources Office (NRO), Public Affairs Office, and golf course personnel. Alpha chloralose is a tranquilizing drug not intended for use as a pesticide and may be administered only by trained USDA/APHIS/WS personnel or FDA-approved and trained pest control operators. Alpha Chloralose was used in accordance with the FDA label and WS policy.

Raptor Relocation

Wildlife Services, with California Department of Fish and Game approval and under the NWRC's banding permit (U.S. Fish and Wildlife Service Bird Banding Laboratory: Permit #8567) and guidance, initiated efforts to relocate resident and migrating raptors that were a threat to aircraft safety. Raptors were captured with bal-chatri traps. The bal-chatri trap is a cage made of wire mesh with a lure inside (e.g., rat or mouse), and nylon nooses on top of the cage to catch the raptor's feet. Injuries during trapping are almost impossible (Bub 1991). Captured raptors were banded, held for 30 days by Project Wildlife in Alpine, CA, and relocated approximately 110 miles east of NASNI. The time held and distance released were based on data from past relocation efforts from NASNI that indicated raptors readily return to NASNI when relocated 55 miles to the east and without a holding period (York et al. 2000).

NWRC Bird Surveys

NWRC conducted monthly bird surveys for 3 consecutive days per month from April 2000 through January 2001. Counts of both live and dead birds were made from stations and transects associated with runways and vantage points in areas which were attractive to birds. The following surveys were conducted:

Station Counts: NWRC established 8 permanent stations that encompassed the NASNI airfield (Fig. 1). A route that connected each station was driven in the morning starting at sunrise. The same route was reversed in the evening. Each day the starting location was alternated between stations 1 and 8 to reduce time bias. Station counts were conducted for 10 minute intervals. Numbers, species and activities (e.g., flying, feeding, loafing, roosting, etc.) of birds within approximately 400 m of the observation station were recorded on NASNI maps (Fig. 2). The location and direction of flight of birds observed crossing runways were also recorded. Individual runways were defined from the approach ends to the intersection at X-Ray.

Station 1 was along the approach of Runway 36 (Fig. 1), allowing observations of birds in the infield and along the taxiways surrounding the approach. This station also included counts of birds utilizing the area surrounding the approach as well as the beach area south of the approach. The primary vegetation surrounding the approach to Runway 36 was ice plant (*Mesembryanthemum* spp.). The vegetation was dense with very limited exposed sand. Immediately to the east of station 1 were multiple buildings and chain link fences which provided loafing and roosting sites for numerous bird species.

This area was used by Caspian Terns (*Sterna caspia*) for loafing. It was used on a limited basis by Common Ravens (*Corvus corax*), Great Blue Herons, Red-tailed Hawks (*Buteo jamaicensis*), Burrowing Owls (*Athene cunicularia*), and European Starlings (*Sturnus vulgaris*) for foraging. However, the beach was within 300 ft of Runway 36 and attracted several species of gulls, shorebirds, Brown Pelicans (*Pelecanus occidentalis*) and Double-crested Cormorants (*Phalacrocorax penicillatus*) in large numbers. Also, Western Gulls were observed towering up from the beach to altitudes of 1,000 ft over this area.

Station 2 was located to observe birds crossing on Runway 29, bird movement in route to the heli-wash on the taxi-way to the east of the station, and birds foraging in the grassy area immediately to the south of station. The northern extension of the buildings and fences adjacent to Station 1 were observed from Station 2 to detect loafing and roosting birds.

Station 3 was located at the approach of Runway 29. This area was composed of several diverse habitats. On either side of the approach end of Runway 29 was a golf course consisting of dense stands of trees, fresh water ponds, and a large tract of mixed grasses and ice plant. Along the north and south sides of the runway near Station 3 were hangars, housing and miscellaneous other buildings. A variety of birds used this area primarily for foraging and loafing. The greatest attractions included the ponds and golf course. Waterfowl, gulls and American Coots frequently loafed and foraged on or near the ponds. Past observations found peak use of these ponds occurred December through January.

Station 4 was located near the intersection of the runways, providing a vantage point to observe runway crossings near the center of the Airfield. Birds loafing along the infields were also observed, as well as loafing and roosting birds on the buildings and hangars to the east of Station 4.

Station 5 was located at the north end of the approach to Runway 18 near the shoreline. This observation area included the coast and a narrow strip of ice plant/sand along a road. This station was established primarily to monitor bird movements along the shore and crossings of Runway 18 by birds in route to the heli-wash and/or to the buildings and hangars to the east of the approach. In addition, piers located in San Diego Bay could be observed for gulls, terns, and pelicans.

Station 6 was in an area where numerous buildings and fences could be observed as well as crossings along the length of Runway 18. This station was surrounded by tarmac and pavement with no vegetated habitat, although there were numerous locations for loafing and roosting birds.

Adjacent to Stations 5 and 6 was a 27-acre area which was modified by soil cementing in 1999. Prior to this habitat modification, this area was a mix of low vegetation consisting primarily of ice plant. The vegetative pattern was intermittent in several areas due to the substrate being covered with a layer of soil cement several years earlier. The open area among ice plant was generally sand and was very attractive to Western Gulls for nesting and roosting because it protected against prevailing winds, had good ground cover for nesting, and allowed good visual detection against intruders. Great Blue Herons and raptors, specifically Red-tailed Hawks, were also attracted to this area primarily to prey on California Ground Squirrels (*Spermophilus beecheyi*). Burrowing Owls used abandoned squirrel holes in this area for nesting and roosting. Rock Doves and Mourning Doves (*Zenaida macroura*) were attracted to this area because of the seed-producing plants and grit (e.g., sand), and occasionally people fed Rock Doves in this area.

Station 7, located at the approach end of Runway 11, gave an overview of birds moving along the coast west of the Approach and of birds crossing Runway 11. The area to the north and west of the approach to Runway 11 consisted of a large open tract of sand with areas dominated by ice plant. The density and growth patterns of ice plant made this area attractive to Western Gulls for nesting and loafing. It also attracted Great Blue Herons, Red-tailed Hawks and Burrowing Owls which used the area for foraging. In 1999, approximately 25 acres of this area was modified by soil cementing, which eliminated most, if not all, of the bird foraging, nesting and loafing habitat. The beach area adjacent to the approach attracted large numbers of gulls, waterfowl, shorebirds and pelicans. To the south of the approach to Runway 11 was an area designated as nesting habitat for California Least Terns (*Sterna antillarum browni*).

Station 8 near the intersection of all runways allowed observations of birds crossing Runways 11 and 36, and birds perching on the numerous light poles in the Weapons Compound to the south of Station 8.

Bird/Aircraft Strikes

Following station counts, we drove and/or walked each runway and approach area to search for dead or injured birds. All remains (e.g., feathers, bones and carcasses) were collected, labeled, recorded and frozen. The location of each item was marked on a NASNI map. Bird carcasses found by NASNI airfield personnel were also collected, labeled, recorded, frozen and mapped. Injured birds were collected and euthanized. NWRC personnel recorded the number of bird/aircraft strikes which occurred on all runways and approaches during the study. A strike was defined as one or more birds found intact, and/or remains found at a location on the airfield. If possible, the type of aircraft was identified from records of flight operations.

RESULTS

WS Bird Dispersal and Removal

The total number of birds dispersed via pyrotechnics was not reflective of the total population of birds on NASNI. This was due, in part, to repeat harassment of the same birds resulting in over counts. Conversely, birds repeatedly harassed often disperse when a vehicle or person approaches, resulting in undercounts. Also, propane cannons were instrumental in removing night roosting birds from NASNI, but these numbers could not be quantified.

The number of birds dispersed by WS on NASNI increased approximately 4% from 1999 (Table 1). Table 1 included only those species most commonly dispersed and those that presented the greatest hazard to aircraft safety. The total number of birds, chicks, and eggs removed and/or destroyed decreased by approximately 7% from 1999 levels when a total of 620 were removed and/or destroyed (Table 2). Of these, 80 American Coots were removed as a part of an AC project on the golf course in January 2001. Birds captured using AC bait were euthanized using $CO^{2.}$ Western Gulls, Rock Doves, and American Coots comprised 61%, 22%, and 14%, respectively of all the birds lethally controlled on NASNI in 2000.

WS personnel expended a total of 2,249.5 staff-hours on direct bird control activities on the NASNI Airfield for this project. This total was representative only of hours spent in the field and did not include hours spent repairing and maintaining equipment, writing reports, attending meetings, or providing supervisory oversight.

Table 1. Birds dispersed by WS personnel on NASNI.

SPECIES	Dispersed in 1999	Dispersed in 2000
American Coots	1,295	1,386
Caspian Terns	246	2,815
California Gulls	unk[a]	407
Heermann's Gulls	6,359	1,489
Mallards	47	unk[a]
Western Gulls	2,927	5,821
American Wigeons	121	0
TOTAL	**10,995**	**11,918**

[a]Total number of birds dispersed not recorded for this species

Table 2. Total number of birds, eggs and nests taken or destroyed, by species, and methods on NASNI, 2000.

SPECIES	SHOOTING	TRAPPING	HAND CAUGHT[a]	EGG/NEST REMOVAL	TOTAL
Western Gulls	346	7	3	0	**356**
Heermann's Gulls	2	0	0	0	**2**
Rock Doves	0	126	0	0	**126**
American Coots	0	0	80	0	**80**
Mallards	0	0	4	0	**4**
Red-tailed Hawks	6	5	0	0	**11**[b]
TOTAL	**348**	**138**	**87**	**0**	**579**

[a]Includes birds captured using AC bait.
[b]Includes five relocated hawks which, to date, have not returned to NASNI from relocation sites.

Waterfowl on Golf Course Ponds

Observations from October 2000 through January 2001 detected an average of 157 coots using the two ponds closet to the approach at Runway 29. In 1999 the average number of coots using these ponds during the same months was 261, for a reduction of 40%. This reduction was a result of hazing with pyrotechnics and dogs, the AC removal project, and installation of the grid-wire systems over the two ponds.

Raptor Relocation

Five Red-tailed Hawks were captured, banded, and relocated approximately 110 miles to the east in Imperial County near El Centro, California (Table 3). None of these hawks has returned to NASNI. In addition, five Red-tailed Hawks and one American Kestrel that could not be live trapped were lethally removed.

Table 3. Raptor relocated from NASNI in 2000.

SPECIES AND AGE	CAPTURE DATE	CAPTURE LOCATION	RELEASE DATE	RELEASE LOCATION[a]
Red-Tailed Hawk, Juvenile	20 DEC 00	Radar Field	26 JAN 01	Imperial Valley, CA
Red-Tailed Hawk, Adult	21 DEC 00	Weapons	26 JAN 01	Imperial Valley, CA
Red-tailed Hawk, adult	2 JAN 01	Radar Field	27 FEB 01	Imperial Valley, CA
Red-Tailed Hawk, Juvenile	16 JAN 01	Radar Field	27 FEB 01	Imperial Valley, CA
Red-Tailed Hawk, Juvenile	30 JAN 01	Weapons	27 FEB 01	Imperial Valley, CA

[a]To date no relocated raptors have returned to NASNI.

NWRC Bird Survey Data

Sixty-one bird species were observed on NASNI during the 2000 study period (Appendix B). Twelve of 61 species were shorebirds observed on the periphery of the study area (e.g., along the beaches). Bird numbers continued to decrease throughout the Airfield for since 1999 (Fig. 3). However, bird numbers increased by approximately 50% in July and August 2000 compared to 1999 survey data. These increases were related to the greater number of Mourning Doves and Western Gulls observed on NASNI during these months (Table 4).

There were ten bird species that posed the most serious threat to aircraft safety on NASNI in 2000 (Table 4). This rating was based on numbers, size, and weight of different species. Great Blue Heron numbers decreased on NASNI, but the number of runway crossings have increased 50% over 1999. Double-crested Cormorant numbers decreased by 40% from last year, but with no overall change in runway crossings. Common Raven numbers increased by 50%, but mean daily observations were one raven sighting per day, or less. There was no change in runway crossings of ravens on NASNI. Mallard numbers increased by 15% with only one mallard observed crossing a runway for the year. Red-tailed Hawk numbers and runway crossings remained relatively stable compared to 1999 (Table 4).

Western Gull numbers and runway crossings increased by 21% and 20%, respectively (Table 4), that peaked in July and August (Fig. 4). Numbers of American Coots decreased by 42% with no overall change in runway crossings. Rock Dove numbers and runway crossings decreased by 17% and 100%, respectively since 1999. However, numbers of the other Columbid species (i.e., Mourning Doves) on NASNI increased by

68% with a 67% increase in runway crossings. European starling numbers decreased by 16% and runway crossings declined by 100% (Table 4).

Runway Crossings

Crossings of Runways 36, 29, 18, and 11 have continued to vary over time in 2000 (Figures 5 and 6) with Runway 29 continuing to experience the most crossings. Crossings of all runways peaked June through August (Fig. 5). These peaks have been reported in the past and were related to pre-and post-nesting periods when bird movements were most numerous. Of note was the large number of crossings observed at Runway 29 in June (Fig. 7). The major factors that contributed to runway crossings at Runway 29 were gulls and waterfowl crossing the runway to utilize the golf course ponds. Runway 36 also had multiple runway crossings, but these were attributed to smaller flocking birds continuing to forage and loaf in the grassy areas surrounding the approach. Crossings at Runway 11 peaked in August and were also the result of small flocking birds foraging on the abundant weed seeds at Compass Rose and crossing over to the open areas north of the approach to Runway 11.

Roosting Bird Surveys

Persistent WS bird dispersal efforts resulted in almost total elimination of large numbers of gulls roosting on NASNI. Only the Weapons Pier remained as an occasional roosting location for gulls on NASNI, and since the initiation of pyrotechnic use on the Pier number of roosting birds has dropped dramatically. The peak of roosting activity on the Weapons Pier occurred in August, which is the historical pattern. During the peak of roosting activity in 1999 over 450 gulls and pelicans were observed using the Pier. During 2000, the largest number of roosting gulls observed was 65. This was a reduction in use of the Pier of approximately 85%.

The use of dead gull effigies on roof tops was especially effective in discouraging gulls from loafing and roosting on buildings adjacent to the Airfield. The WS Specialist placed an effigy on Building 805 on Moffett Road and totally eliminated gull use of this roof top.

Bird/Aircraft Strikes

Four dead birds were found on NASNI during the study period (Table 5). Due to location and type of injuries, all deaths were attributed to collisions with aircraft. An additional bird/aircraft strike was reported to NASNI personnel during the study period. This strike involved a helicopter flying over San Diego Bay and striking a shorebird (*Calidris* spp.).

These five strikes were a slight increase from 1999 when 4 strikes were recorded. Three of the five strikes occurred on the approach to Runway 29 which also had the largest number of observed runway crossings by various bird species.

Table 5. Bird/aircraft strikes on NASNI, 2000 including all remains from dead bird searches.

Date	Time	Species	No.	Location	Aircraft	Alt.
22 MAY 00	18:50	House Finch	1	Runway 29 east of Charlie	S-3	–50'
JULY 00	unk	Sandpiper spp.	1	Over San Diego Bay	Helicopter	unk
1 AUG 00	14:10	Caspian Tern	1	Approach to Runway 36	unk	unk
AUG 00	unk	American Kestrel	1	Runway 29 at Echo	unk	unk
21 NOV 00	06:40	Mourning Dove	1	Runway 29 near Alpha Gear	unk	unk

DISCUSSION

Overall, numbers of birds continued to decline on NASNI, with some notable exceptions. We believe much of this reduction in aircraft strike hazards can be attributed to early initiation of the 2000 BASH program. The WS Specialist eliminated gull nesting in the recognized problem areas and thereby reduced gull recruitment into the local population. However, Western Gulls nesting on roof-tops still maintained a presence on NASNI. WS had much greater success in controlling the gulls which nested on the ground. Rooftop exclusion devices (e.g., grid-wires) and dead gull effigies may prevent this rooftop nesting. Effigies were very successful in discouraging roof top loafing and roosting on NASNI. Due to the success of this technique, WS is currently in the process of having some gulls mounted to reduce the chances of attracting scavengers (e.g., ravens). These mounts will be tagged Government property and used year after year.

Many of the hangars and buildings surrounding the Airfield harbored reservoirs of Rock Doves. Personnel at several of the hangars, mainly VR-57, requested assistance from WS concerning Rock Doves inside the buildings. Since the hangars were adjacent to several taxiways, resolving their issues would benefit the BASH program. Technical assistance was provided to NASNI Maintenance concerning improving their exclusion netting in the hangars. In addition, several Rock Dove traps were placed, and Rock Doves were removed from the hangars. After the exclusion netting was repaired and the Rock Doves removed, damage to the interior of the hangar was greatly reduced. We consider this effort to be the reason Rock Dove numbers and runway crossings were observed to drop on NASNI by 17% and 100%, respectively.

The approach to Runway 29 continues to have large numbers of runway crossings. This area presented a unique hazard on NASNI because of the number of aircraft using Runway 29 for training, and the altitude (–60 to 80 ft AGL) at which aircraft approach when they were adjacent to the golf course ponds. Waterfowl flying to and from these ponds crossed the flight path of aircraft landing on Runway 29. However, significant progress has been made in reducing this hazard. The placement of grid-wires over two of the most commonly used ponds, and intense, consistent harassment reduced numbers of coots and waterfowl in this area by 40% in 2000. The efficiency of grid wires for excluding birds such as gulls, waterfowl (mainly dabblers), and geese is well documented (Steuber et al.1994; Pochop et al. 1990). However, additional efforts still need to be made to continue to lower numbers of coots and waterfowl on NASNI. A few coots and/or ducks remaining near the approach to Runway 29 will eventually decoy in greater numbers of birds, creating an aircraft safety hazard. Draining and filling the three ponds closest to the approach will provide the most cost effective method in significantly reducing a major bird/aircraft safety issue on NASNI. Until this objective is achieved, we recommend 1) leaving the grid-wire systems in place year-round to discourage early colonization by migrating coots and waterfowl, 2) continued maintenance on the system so as water levels fluctuate it retains it effectiveness, and 3) continuous harassment by the WS Specialist which will encourage the birds to feed and loaf away from NASNI. The grid-wire system was installed in such a manner as to facilitate seasonal removal. This was to insure that the system would not interfere with California Least Terns foraging in the ponds. However, Least Tern foraging on these ponds is so infrequent that keeping the grids in place year round should not negatively impact this species. Birds, specifically Western Gulls, continued to frequent the beach areas near the approach to Runway 18, as well as the unmodified habitat around the approach to Runway 36. These beach areas offered foraging opportunities at low tide. At the approach to Runway 18, gulls retrieving clams from the beach area at low tide and dropping them in the helicopter parking area created both a nuisance and hazard for helicopters and personnel.

The reservoir of birds on the nearby beaches could negatively impact aircraft operations on NASNI at any given time, as demonstrated by the documented shorebird/helicopter strike in July, 2000. Periodic bird monitoring in this area is recommended to document build-ups of various species (e.g., Heermann's Gulls in late summer). When build-ups are detected, the WS Specialist should initiate various harassment techniques to discourage loafing and feeding.

Mourning Doves, Great Blue Herons, small flocking birds, and raptors foraged and loafed on the grassy areas surrounding the approach to Runway 36 and frequently crossed runways. Stabilizing the soil at the approach to Runway 36 would alleviate much of this bird activity, but would conflict with other environmental priorities on NASNI. Consequently, birds in this area should be monitored constantly and hazed when necessary. An example of the potential problems in this area occurred in July and August 2000 when approximately 200 Caspian Terns used this approach for loafing. We believe the terns moved onto the approach tarmac after pedestrians walking illegally on the beach pushed the terns from their normal loafing areas. This situation resulted in a reported aircraft/Caspian Tern strike. WS placed three propane cannons on the approach and also increased use of hand-held pyrotechnics until the Caspian Terns dispersed. Also, increased Navy Security patrols intensified and kept illegal foot traffic from disturbing the birds from the beach areas. Close monitoring of this area will be required to detect any future buildups.

Gulls have historically used NASNI as a staging area prior to migration in late summer and early fall. An unusually large number of Western Gulls were observed on NASNI during this period, together with an increase in runway crossings. This spike might have been an anomaly, as we believe active WS dispersal and removal efforts greatly reduced the Western Gull population on NASNI since the inception of the BASH program in 1996.

The 17% decline in Rock Dove observations was an encouraging sign that indicated the WS trapping and shooting program lowered the Rock Dove population on NASNI, and subsequently decreased observed runway crossings by 100% for this species. However, the large increase in observed Mourning Dove numbers and runway crossings needs to be addressed. Flocks of Mourning Doves were observed feeding on seeds of the numerous weeds on runway edges and infield areas throughout the Airfield. This problem of weeds attracting seed-eating birds (e.g., doves, finches, starlings, horned larks, etc) was especially pronounced in the Compass Rose area where large flocks of 50 or more birds were commonly observed. We recommend cutting weeds to remove food sources, as well as trapping and shooting doves before their numbers increase further. In addition, we recommend that the weed control on the Airfield be initiated early enough in the season to prevent the plants from producing seeds and subsequently attracting birds. Individual small birds did not present a substantial hazard, but large flocks moving across runways presented a serious risk to aircraft safety. Linnell et al. (1996) described serious damage to aircraft caused by solitary zebra doves (*Geopelia striata*) on Kauai, Hawaii and cautioned against ignoring risks posed by small birds.

The Great Blue Herons on NASNI continued to pose a serious threat to aircraft. These large birds (–5.5 lbs) often crossed runways at dawn as they departed from their roosts in the Eucalyptus trees (*Eucalyptus* spp.) at the corner of Moffett Road and Roe Street. The herons flew across runways on their way to various foraging locations throughout NASNI (e.g., approach end of Runways 29 and 36, and the open fields west of Compass Rose). At dusk the route was reversed as the herons returned to their roosts. This species does not respond well to standard hazing techniques and removal of this possibly unique population in southern California has been discouraged. We suggest capturing and relocating these herons to a more suitable location away from NASNI.

Previous habitat modification efforts have successfully deterred birds from nesting and roosting near runways. However, as soil cementing that has been in place for less than two years deteriorates, continual monitoring will be essential for early detection of birds that reoccupy the modified areas.

MANAGEMENT RECOMMENDATIONS

1. The soil stabilization efforts on NASNI have been extremely successful in reducing nesting habitat for Western Gulls and hunting opportunities for raptors. This trend needs to continue. The sandy short-grass areas on the approach end of Runway 29, the Radar Fields south of 29, and the areas surrounding the approach end of Runway 36 all should be treated and stabilized. This is prime habitat for rodentia and lagomorphs that attract raptors and provide nesting habitat for gulls and other species of birds.

2. Devices to exclude gulls from nesting on building rooftops around NASNI need to be implemented. Grid-wires, anti-perch devices, and other techniques should be implemented to deter nesting, loafing, and roosting activities.

3. Remove Ramp 10. Gulls, cormorants, and pelicans regularly use this as a loafing area and can be seen flying over the helo pads to roost and nest on adjacent buildings. If removal is not possible other options should be explored to exclude bird use (e.g., grid-wire).

4. Remove the concrete docks in the bay. Each dock provides a safe haven for multiple gull nests during the breeding season. It is also a refuge for gulls escaping the pyrotechnics fired at them. If removal is not possible, explore options to exclude bird use and nesting (e.g., gird-wire, predator and/or dead gull effigies).

5. Have all building managers report nesting of any species to the Natural Resources Office so the WS Specialist can be informed and address the issue.

6. Habitat alterations should be made to the areas north of the Weapons Compound to deter Great Blue Heron use. Consider a capture/relocation program to remove these birds from NASNI. Also, trees in the rookery should be thinned or removed to prevent roosting and nesting.

7. Enforce the ADo Not Feed The Wildlife@ base policy. All along the San Diego Bay side of Moffett Road, people intentionally leave food that attracts gulls and other wildlife. Signs stating the aforementioned should be posted. To prevent unintentional bird feeding, all dumpsters and trash cans should remained covered.

8. Early initiation and continuous application of the program is key to success for the BASH program at NASNI. Set forth a protocol to insure budget and contract negotiations do not jeopardize the success of the program. A multi-year contract would be ideal.

9. Implement long-term dispersal techniques on the Weapons Pier. This could include use of distress tapes, sprinkler system, or noise makers.

10. Leave grid-wire systems on golf course ponds year around. Fill ponds where grid-wire systems are difficult and/or impossible to install.

11. Initiate a large-scale removal project of European Starlings on NASNI. These birds can be observed in large numbers at certain times of the year. Trapping or the use of avicides are very effective control techniques for this species.

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APPENDIX 3: York et al. 2001

BIRD AIR STRIKE HAZARD (BASH) MANAGEMENT AND MONITORING AT NAVAL AIR STATION NORTH ISLAND
2000

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BIRD AIR STRIKE HAZARD (BASH) MANAGEMENT AND MONITORING AT NAVAL AIR STATION NORTH ISLAND 2000

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EXECUTIVE SUMMARY

Biologists from the National Wildlife Research Center (NWRC) have worked with North Island Naval Air Station (NASNI) and the U.S. Department of Agriculture's Wildlife Services (WS) since 1996 to evaluate and reduce the hazards birds pose to aircraft on NASNI. In a continuing effort NWRC conducted a bird/aircraft strike hazard (BASH) assessment from April 2000 through January 2001 to assess bird populations, to identify and quantify the bird species most threatening to flight operations, and to evaluate the bird/airstrike mitigation efforts initiated in 1996.

Data from NWRC bird observations in 2000 indicated overall bird numbers on NASNI decreased throughout the Airfield for the second straight year since 1999. However, bird numbers increased by approximately 50% in July and August 2000 compared to 1999 survey data. These increases were related to the large numbers of Mourning Doves and Western Gulls migrating through NASNI during these months. Numbers of Great Blue Herons, Double-crested Cormorants, American Coots, Rock Doves, and European Starlings all declined on NASNI during 2000.

Crossings of Runways 36, 29, 18, and 11 continued to vary from month to month in 2000. The approach to Runway 29 continued to experience the most crossings. Crossings of all runways peaked May through August. These peaks have been reported in the past and were related to pre-and post-nesting periods when bird movements were most numerous. Of note were the greater number of crossings observed at Runway 29 in June. Four dead birds were found on NASNI during the study period. Due to location

and type of injuries, all deaths were attributed to collisions with aircraft. An additional bird/aircraft strike involving a helicopter flying over San Diego Bay and striking a shorebird species (*Calidris* spp.) was reported during the study period. These five strikes were a slight increase from 1999 when 4 strikes occurred. The approach to Runway 29 sustained the most bird/aircraft collisions, as well as the largest number of observed runway crossings by birds.

This reduction in aircraft strike hazards can be attributed to early initiation of the 2000 BASH program. WS personnel eliminated gull nesting in problem areas, and thereby reducing gull recruitment into the local population. Total birds dispersed by WS personnel on NASNI increased by approximately 4% from 1999 dispersals. The total number of birds, chicks, and eggs removed and/or destroyed increased by approximately 7% from 1999 levels. Western Gulls, Rock Doves, and American Coots comprised 66%, 19%, and 12%, respectively, of all the birds taken by lethal methods on NASNI in 2000. Of these, eighty American Coots were removed with alpha-chloralose (AC) bait from the NASNI golf course. Consistent hazing, installation of grid-wire systems over two of the golf course ponds, and the AC bait project were successful in reducing coot numbers on NASNI by 40% when compared to coot numbers in 1999.

The raptor relocation effort initiated in 1999 continued through 2000 with favorable results. In 2000, WS relocated five Red-tailed Hawks approximately 110 miles to the east to Imperial County near El Centro, California. None of these hawks have returned to NASNI.

WS bird dispersal have almost eliminated gulls roosting on NASNI, however the Weapons Pier remained as an occasional roosting location for gulls and pelicans on NASNI. The peak of roosting activity on the Weapons Pier occurred in August, which is the historical pattern. However, there was an 85% reduction in gull numbers using the Pier in 2000 compared to 1999 roosting observations.

The past soil stabilization efforts have deterred birds from nesting and roosting near runways. However, at this writing soil cementing was in place for less than two years. As it deteriorates, continual monitoring will be essential for early detection of reoccupation by various bird species. The sandy, short-grass areas on the approach end of Runway 29 remains an area of concern, and we recommend soil stabilization in this area to eliminate foraging opportunities for birds. In July 2000, over 200 European Starlings, three Great Blue Herons, and three Western Gulls were observed foraging and/or loafing in this area. We also recommend filling the golf course ponds adjacent to the approach of Runway 29, and if this is not possible, leaving the grid-wire systems up throughout the year to discourage bird use. In addition, the approach to Runway 36 should be monitored constantly and any birds dispersed to prevent a buildup of birds in this area. Although WS has been successful in preventing most gulls from nesting on the ground around NASNI, rooftop nesting continues and will require further intensive management.

INTRODUCTION

Bird strikes to aircraft are a serious safety and economic problem in the United States, annually causing millions of dollars in damage to civilian and military aircraft and occasionally loss of human life (Cleary et al. 1998). Military aircraft are especially susceptible to bird strikes because many exercises involve high speeds at low altitudes where birds are commonly present, and losses of military aircraft have been numerous and costly (Blokpoel 1976). Since 1960, at least 250 military aircraft and 120 military personnel have been lost because of wildlife strikes in the U.S. (Cleary and Dolbeer 1999). The U.S. Navy reported about 620 bird strikes from 1993 through 1995 with 19 of these strikes totaling approximately $104 million in aircraft damage (Bird Strike Committee 1997). The U.S. Air Force reported 13,427 bird/wildlife strikes to aircraft world-wide from 1989 through 1993 with damage estimates exceeding $85 million (Arrington 1994).

At Naval Air Station North Island (NASNI), San Diego, California bird strikes regularly have been reported since the start of record keeping in 1980. The Command Navy Safety Center in Norfolk, Virginia reported 102 bird strikes to aircraft at NASNI between 1980 through 1996 (Cummings and Foley 1997). However, it was only recently that birds have caused severe damage to aircraft. On 24 AUG 1995 an E-2 Hawkeye (carrier-based tactical warning and control system aircraft) on take-off struck a large flock of Western Gulls (*Larus occidentalis*) roosting on the runway, killing more than 100 birds. The take-off was aborted with severe damage to the aircraft but no loss of life. The E-2 was valued at $51 million (U.S. Navy Fact File web page 2000). Another incident at NASNI occurred on 15 AUG 1996, when a departing P-3 Orion (four-engine turboprop anti-submarine and maritime surveillance aircraft) struck Western Gulls on the same runway resulting in damage to the aircraft. The P-3 was valued at $36 million (U.S. Navy Fact

File web page 2000). Both of these incidents occurred during night-time operations. In addition, an F-18 Hornet (fighter and attack aircraft) departing NASNI struck a Great Blue Heron (*Ardea herodias*) on 11 JUNE 1996. The heron was partially ingested into the left engine intake. The F-18 was valued at $24 million (U.S. Navy Fact File web page 2000).

As a result of the Bird/Aircraft Strike Hazard (BASH) program initiated on NASNI, observed Western Gull (*Larus occidentalis*) numbers were reduced by an average of 95% from 1996 through 1999. In addition, a steady decline in bird/aircraft strikes on NASNI from 1996 to 1999 (78%) was documented. Habitat modification (i.e., soil cementing) eliminated approximately 52 acres of bird nesting, loafing and foraging habitat at the approach ends of Runways 11 and 18. This effort greatly reduced the incident of runway crossings by all bird species on NASNI. The objectives of this study were to assess bird populations, to identify and quantify the bird species most threatening to flight operations, and to evaluate the bird/airstrike mitigation efforts initiated in 1996.

STUDY AREA

NASNI is a 2,866-acre naval air station located on Coronado Island, San Diego, California that has a number of natural characteristics that make portions of the site attractive to birds. NASNI is bordered on the north and west by the San Diego Bay, on the south by the Pacific Ocean and on the east by the city of Coronado. On NASNI there are vast areas of vegetative habitat interspersed with intermittent and permanent water sources, and flat open areas that attractant several species of birds.

METHODS

WS Bird Dispersal

WS implemented bird control activities on NASNI beginning 1 FEB 2000.
Prior to initiation of operational bird dispersal, baseline information was recorded on species and numbers of birds utilizing the NASNI airfield. Various dispersal techniques were used depending on the location of birds, species, time of bird activity, and level of threat posed by birds. These criteria were subdivided using the following decision making model: first, if the birds were dispersed, would the problem be solved; second, were they resident birds which would continually return, post-dispersal; and third, were they birds that would not disperse even after harassment.
Multiple tools and techniques were used for bird dispersal including automated propane cannons, hand-held pyrotechnics, spotlight harassment, vehicle harassment, electronic distress calls, and dead gull effigies. All dispersal efforts during airfield operation hours were coordinated with the NASNI Air Traffic Control Tower and Navy Security via radio communications. Numbers of birds harassed and pyrotechnics fired were recorded on Airport Data Sheets (Appendix A). Four propane cannons (Reed Joseph International, model M-8) were placed in locations historically identified as gull loafing, roosting and

nesting areas. Hand-held pyrotechnics (Sutton Ag. Enterprises) fired from a specialized, double-barreled pistol were used to disperse birds from the NASNI airfield. To discourage use of gull roosting on the Weapons Pier the WS Specialist, after consultation with Weapons personnel, initiated use of pyrotechnics on the Weapons Pier in late December 2000. Pyrotechnics were only used on the Weapons Pier when the red flag was not flying and ordnance were not present.

Vehicle harassment, spotlight harassment, and electronic distress calls were implemented in areas designated too sensitive for pyrotechnics. These areas included the Fuel Farm and Weapons Magazines. These techniques were also implemented throughout the NASNI airfield to augment the dispersal affect of pyrotechnics. To discourage gull loafing on roof tops the WS Specialist placed dead gulls on buildings that were known loafing locations.

Spotlighting, coupled with pyrotechnics, proved an effective combination for dispersing waterfowl from the golf course ponds to the north of the approach end of Runway 29, although some of these birds always returned, post-dispersal, because use of the golf course prohibited continued harassment throughout the day. American Coots (*Fulica americana*) typically roosted on the golf course ponds, but other waterfowl species including American Wigeons (*Anas americana*) roosted elsewhere, and arrived at ponds around sunrise. Several days a week before sunrise, hand-held pyrotechnics, and spotlights were used to haze the coots from the ponds. Beginning in late January 2001, the WS Specialist began using a trained dog for coot and waterfowl dispersal at the ponds. The dog proved effective in dispersing the wigeons, but not effective in dispersing coots. As golfers arrived to play the holes surrounding the ponds, harassment efforts ceased. This also coincided with the start of Air Operation hours and the arrival of wigeons. Efforts to disperse wigeons from the ponds were deemed too risky to Air Operations since birds could possibly disperse across Runway 29. To further discourage use of the ponds, a grid-wire system was constructed on 18 JAN 1999 over two 1-acre ponds adjacent to Runway 29 that were being used extensively by waterfowl. Waterfowl were counted on all five golf course ponds (grided and ungrided) once a day following monthly Airfield surveys.

WS Bird Removal

Lethal control of birds on the NASNI airfield was implemented when other methods were ineffective in reducing immediate threats to aircraft safety. The objectives for lethal control were to prevent reproduction, to reduce overall population levels of certain bird species, and to reinforce the hazing/harassment program. All weapons used on NASNI were registered with security and used only when conditions were safe and in accordance with the Navy and WS regulations and policy. All shooting events were coordinated with the Tower and Navy Security. When shooting events occurred within the Weapons Compound, all procedures previously set forth were followed. Lethal reduction in numbers of gulls, Rock Doves (*Columba livia*), and waterfowl at the NASNI airfield involved shooting, nest traps, Rock Dove traps, cannon nets, egg-oiling, nest destruction, alpha chloralose (AC) baiting, and hand capture. Tools used for lethal control of gulls, Rock Doves, and waterfowl to lower overall numbers utilizing the Airfield included shooting with 12 gauge shotguns (2 3\4" and 3" shells, utilizing #4 and #6 bird shot), .177 caliber air guns, and .22 caliber rifles using subsonic ammunition (CCI CB Longs). Other methods included bal-chatri traps, pole traps, decoy traps, nest traps, Rock Dove traps, egg-oiling, nest destruction, AC, and hand capture. Captured birds were euthanized by CO^2 inhalation under American Veterinary Medical Association Guidelines (AVMA 1993).

Gull trapping began with intensive foot surveys to mark all nests. Discovered nests were marked with flagging and numbers of eggs were recorded on data sheets. Nest traps were placed over gull nests, which commonly contained three unhatched eggs in a complete clutch. Both sexes of Western Gulls incubated the nest, however success of capturing a second nesting gull was diminished by the other adult witnessing the capture of its mate. Allowing the nest to settle for a few days to let the second adult reclaim it increased second adult capture success.

Prebaiting waterfowl with cracked corn was initiated at the golf course on 12 DEC 00. On 21 JAN 01 AC-treated corn was used to remove waterfowl at this location on NASNI. All large scale removal projects such as the use of AC on the golf course were approved and scheduled in advance with Natural Resources Office (NRO), Public Affairs Office, and golf course personnel. Alpha chloralose is a tranquilizing drug not intended for use as a pesticide and may be administered only by trained USDA/APHIS/WS personnel or FDA-approved and trained pest control operators. Alpha Chloralose was used in accordance with the FDA label and WS policy.

Raptor Relocation

Wildlife Services, with California Department of Fish and Game approval and under the NWRC's banding permit (U.S. Fish and Wildlife Service Bird Banding Laboratory: Permit #8567) and guidance, initiated efforts to relocate resident and migrating raptors that were a threat to aircraft safety. Raptors were captured with bal-chatri traps. The bal-chatri trap is a cage made of wire mesh with a lure inside (e.g., rat or mouse), and nylon nooses on top of the cage to catch the raptor's feet. Injuries during trapping are almost impossible (Bub 1991). Captured raptors were banded, held for 30 days by Project Wildlife in Alpine, CA, and relocated approximately 110 miles east of NASNI. The time held and distance released were based on data from past relocation efforts from NASNI that indicated raptors readily return to NASNI when relocated 55 miles to the east and without a holding period (York et al. 2000).

NWRC Bird Surveys

NWRC conducted monthly bird surveys for 3 consecutive days per month from April 2000 through January 2001. Counts of both live and dead birds were made from stations and transects associated with runways and vantage points in areas which were attractive to birds. The following surveys were conducted:

Station Counts: NWRC established 8 permanent stations that encompassed the NASNI airfield (Fig. 1). A route that connected each station was driven in the morning starting at sunrise. The same route was reversed in the evening. Each day the starting location was alternated between stations 1 and 8 to reduce time bias. Station counts were conducted for 10 minute intervals. Numbers, species and activities (e.g., flying, feeding, loafing, roosting, etc.) of birds within approximately 400 m of the observation station were recorded on NASNI maps (Fig. 2). The location and direction of flight of birds observed crossing runways were also recorded. Individual runways were defined from the approach ends to the intersection at X-Ray.

Station 1 was along the approach of Runway 36 (Fig. 1), allowing observations of birds in the infield and along the taxiways surrounding the approach. This station also included counts of birds utilizing the area surrounding the approach as well as the beach area south of the approach. The primary vegetation surrounding the approach to Runway 36 was ice plant (*Mesembryanthemum* spp.). The vegetation was dense with very limited exposed sand. Immediately to the east of station 1 were multiple buildings and chain link fences which provided loafing and roosting sites for numerous bird species.

This area was used by Caspian Terns (*Sterna caspia*) for loafing. It was used on a limited basis by Common Ravens (*Corvus corax*), Great Blue Herons, Red-tailed Hawks (*Buteo jamaicensis*), Burrowing Owls (*Athene cunicularia*), and European Starlings (*Sturnus vulgaris*) for foraging. However, the beach was within 300 ft of Runway 36 and attracted several species of gulls, shorebirds, Brown Pelicans (*Pelecanus occidentalis*) and Double-crested Cormorants (*Phalacrocorax penicillatus*) in large numbers. Also, Western Gulls were observed towering up from the beach to altitudes of 1,000 ft over this area.

Station 2 was located to observe birds crossing on Runway 29, bird movement in route to the heli-wash on the taxi-way to the east of the station, and birds foraging in the grassy area immediately to the south of station. The northern extension of the buildings and fences adjacent to Station 1 were observed from Station 2 to detect loafing and roosting birds.

Station 3 was located at the approach of Runway 29. This area was composed of several diverse habitats. On either side of the approach end of Runway 29 was a golf course consisting of dense stands of trees, fresh water ponds, and a large tract of mixed grasses and ice plant. Along the north and south sides of the runway near Station 3 were hangars, housing and miscellaneous other buildings. A variety of birds used this area primarily for foraging and loafing. The greatest attractions included the ponds and golf course. Waterfowl, gulls and American Coots frequently loafed and foraged on or near the ponds. Past observations found peak use of these ponds occurred December through January.

Station 4 was located near the intersection of the runways, providing a vantage point to observe runway crossings near the center of the Airfield. Birds loafing along the infields were also observed, as well as loafing and roosting birds on the buildings and hangars to the east of Station 4.

Station 5 was located at the north end of the approach to Runway 18 near the shoreline. This observation area included the coast and a narrow strip of ice plant/sand along a road. This station was established primarily to monitor bird movements along the shore and crossings of Runway 18 by birds in route to the heli-wash and/or to the buildings and hangars to the east of the approach. In addition, piers located in San Diego Bay could be observed for gulls, terns, and pelicans.

Station 6 was in an area where numerous buildings and fences could be observed as well as crossings along the length of Runway 18. This station was surrounded by tarmac and pavement with no vegetated habitat, although there were numerous locations for loafing and roosting birds.

Adjacent to Stations 5 and 6 was an 27-acre area which was modified by soil cementing in 1999. Prior to this habitat modification, this area was a mix of low vegetation consisting primarily of ice plant. The vegetative pattern was intermittent in several areas due to the substrate being covered with a layer of soil cement several years earlier. The open area among ice plant was generally sand and was very attractive to Western Gulls for nesting and roosting because it protected against prevailing winds, had good ground cover for nesting, and allowed good visual detection against intruders. Great Blue Herons and raptors, specifically Red-tailed Hawks, were also attracted to this area primarily to prey on California Ground Squirrels (*Spermophilus beecheyi*). Burrowing Owls used abandoned squirrel holes in this area for nesting and roosting. Rock Doves and Mourning Doves (*Zenaida macroura*) were attracted to this area because of the seed-producing plants and grit (e.g., sand), and occasionally people fed Rock Doves in this area.

Station 7, located at the approach end of Runway 11, gave an overview of birds moving along the coast west of the Approach and of birds crossing Runway 11. The area to the north and west of the approach to Runway 11 consisted of a large open tract of sand with areas dominated by ice plant. The density and growth patterns of ice plant made this area attractive to Western Gulls for nesting and loafing. It also attracted Great Blue Herons, Red-tailed Hawks and Burrowing Owls which used the area for foraging. In 1999, approximately 25 acres of this area was modified by soil cementing, which eliminated most, if not all, of the bird foraging, nesting and loafing habitat. The beach area adjacent to the approach attracted large numbers of gulls, waterfowl, shorebirds and pelicans. To the south of the approach to Runway 11 was an area designated as nesting habitat for California Least Terns (*Sterna antillarum browni*).

Station 8 near the intersection of all runways allowed observations of birds crossing Runways 11 and 36, and birds perching on the numerous light poles in the Weapons Compound to the south of Station 8.

Bird/Aircraft Strikes

Following station counts, we drove and/or walked each runway and approach area to search for dead or injured birds. All remains (e.g., feathers, bones and carcasses) were collected, labeled, recorded and frozen. The location of each item was marked on a NASNI map. Bird carcasses found by NASNI airfield personnel were also collected, labeled, recorded, frozen and mapped. Injured birds were collected and euthanized. NWRC personnel recorded the number of bird/aircraft strikes which occurred on all runways and approaches during the study. A strike was defined as one or more birds found intact, and/or remains found at a location on the airfield. If possible, the type of aircraft was identified from records of flight operations.

RESULTS

WS Bird Dispersal and Removal

The total number of birds dispersed via pyrotechnics was not reflective of the total population of birds on NASNI. This was due, in part, to repeat harassment of the same birds resulting in over counts. Conversely, birds repeatedly harassed often disperse when a vehicle or person approaches, resulting in undercounts. Also, propane cannons were instrumental in removing night roosting birds from NASNI, but these numbers could not be quantified.

The number of birds dispersed by WS on NASNI increased approximately 4% from 1999 (Table 1). Table 1 included only those species most commonly dispersed and those that presented the greatest hazard to aircraft safety. The total number of birds, chicks, and eggs removed and/or destroyed decreased by approximately 7% from 1999 levels when a total of 620 were removed and/or destroyed (Table 2). Of these, 80 American Coots were removed as a part of an AC project on the golf course in January 2001. Birds captured using AC bait were euthanized using $CO^{2.}$ Western Gulls, Rock Doves, and

American Coots comprised 61%, 22%, and 14%, respectively of all the birds lethally controlled on NASNI in 2000.

WS personnel expended a total of 2,249.5 staff-hours on direct bird control activities on the NASNI Airfield for this project. This total was representative only of hours spent in the field and did not include hours spent repairing and maintaining equipment, writing reports, attending meetings, or providing supervisory oversight.

Table 1. Birds dispersed by WS personnel on NASNI.

SPECIES	Dispersed in 1999	Dispersed in 2000
American Coots	1,295	1,386
Caspian Terns	246	2,815
California Gulls	unk[a]	407
Heermann's Gulls	6,359	1,489
Mallards	47	unk[a]
Western Gulls	2,927	5,821
American Wigeons	121	0
TOTAL	**10,995**	**11,918**

[a]Total number of birds dispersed not recorded for this species

Table 2. Total number of birds, eggs and nests taken or destroyed, by species, and methods on NASNI, 2000.

SPECIES	SHOOTING	TRAPPING	HAND CAUGHT[a]	EGG/NEST REMOVAL	TOTAL
Western Gulls	346	7	3	0	**356**
Heermann's Gulls	2	0	0	0	**2**
Rock Doves	0	126	0	0	**126**
American Coots	0	0	80	0	**80**
Mallards	0	0	4	0	**4**
Red-tailed Hawks	6	5	0	0	**11[b]**
TOTAL	**348**	**138**	**87**	**0**	**579**

[a]Includes birds captured using AC bait.
[b]Includes five relocated hawks which, to date, have not returned to NASNI from relocation sites.

Waterfowl on Golf Course Ponds

Observations from October 2000 through January 2001 detected an average of 157 coots using the two ponds closet to the approach at Runway 29. In 1999 the average number of coots using these ponds during the same months was 261, for a reduction of 40%. This reduction was a result of hazing with pyrotechnics and dogs, the AC removal project, and installation of the grid-wire systems over the two ponds.

Raptor Relocation

Five Red-tailed Hawks were captured, banded, and relocated approximately 110 miles to the east in Imperial County near El Centro, California (Table 3). None of these hawks has returned to NASNI. In addition, five Red-tailed Hawks and one American Kestrel that could not be live trapped were lethally removed.

Table 3. Raptor relocated from NASNI in 2000.

SPECIES AND AGE	CAPTURE DATE	CAPTURE LOCATION	RELEASE DATE	RELEASE LOCATION[a]
Red-Tailed Hawk, Juvenile	20 DEC 00	Radar Field	26 JAN 01	Imperial Valley, CA
Red-Tailed Hawk, Adult	21 DEC 00	Weapons	26 JAN 01	Imperial Valley, CA
Red-tailed Hawk, adult	2 JAN 01	Radar Field	27 FEB 01	Imperial Valley, CA
Red-Tailed Hawk, Juvenile	16 JAN 01	Radar Field	27 FEB 01	Imperial Valley, CA
Red-Tailed Hawk, Juvenile	30 JAN 01	Weapons	27 FEB 01	Imperial Valley, CA

[a]To date no relocated raptors have returned to NASNI.

NWRC Bird Survey Data

Sixty-one bird species were observed on NASNI during the 2000 study period (Appendix B). Twelve of 61 species were shorebirds observed on the periphery of the study area (e.g., along the beaches). Bird numbers continued to decrease throughout the Airfield for since 1999 (Fig. 3). However, bird numbers increased by approximately 50% in July and August 2000 compared to 1999 survey data. These increases were related to the greater number of Mourning Doves and Western Gulls observed on NASNI during these months (Table 4).

There were ten bird species that posed the most serious threat to aircraft safety on NASNI in 2000 (Table 4). This rating was based on numbers, size, and weight of different species. Great Blue Heron numbers decreased on NASNI, but the number of runway crossings have increased 50% over 1999. Double-crested Cormorant numbers decreased by 40% from last year, but with no overall change in runway crossings. Common Raven numbers increased by 50%, but mean daily observations were one raven sighting per day, or less. There was no change in runway crossings of ravens on NASNI. Mallard numbers increased by 15% with only one mallard observed crossing a runway for the year. Red-tailed Hawk numbers and runway crossings remained relatively stable compared to 1999 (Table 4).

Western Gull numbers and runway crossings increased by 21% and 20%, respectively (Table 4), that peaked in July and August (Fig. 4). Numbers of American Coots decreased by 42% with no overall change in runway crossings. Rock Dove numbers and runway crossings decreased by 17% and 100%, respectively since 1999. However, numbers of the other Columbid species (i.e., Mourning Doves) on NASNI increased by 68% with a 67% increase in runway crossings. European starling numbers decreased by 16% and runway crossings declined by 100% (Table 4).

Runway Crossings

Crossings of Runways 36, 29, 18, and 11 have continued to vary over time in 2000 (Figures 5 and 6) with Runway 29 continuing to experience the most crossings. Crossings of all runways peaked June through August (Fig. 5). These peaks have been reported in the past and were related to pre-and post-nesting periods when bird movements were most numerous. Of note was the large number of crossings observed at Runway 29 in June (Fig. 7). The major factors that contributed to runway crossings at Runway 29 were gulls and waterfowl crossing the runway to utilize the golf course ponds. Runway 36 also had multiple runway crossings, but these were attributed to smaller flocking birds continuing to forage and loaf in the grassy areas surrounding the approach. Crossings at Runway 11 peaked in August and were also the result of small flocking birds foraging on the abundant weed seeds at Compass Rose and crossing over to the open areas north of the approach to Runway 11.

Roosting Bird Surveys

Persistent WS bird dispersal efforts resulted in almost total elimination of large numbers of gulls roosting on NASNI. Only the Weapons Pier remained as an occasional roosting location for gulls on NASNI, and since the initiation of pyrotechnic use on the Pier number of roosting birds has dropped dramatically. The peak of roosting activity on the Weapons Pier occurred in August, which is the historical pattern. During the peak of roosting activity in 1999 over 450 gulls and pelicans were observed using the Pier. During 2000, the largest number of roosting gulls observed was 65. This was a reduction in use of the Pier of approximately 85%.

The use of dead gull effigies on roof tops was especially effective in discouraging gulls from loafing and roosting on buildings adjacent to the Airfield. The WS Specialist placed an effigy on Building 805 on Moffett Road and totally eliminated gull use of this roof top.

Bird/Aircraft Strikes

Four dead birds were found on NASNI during the study period (Table 5). Due to location and type of injuries, all deaths were attributed to collisions with aircraft. An additional bird/aircraft strike was reported to NASNI personnel during the study period. This strike involved a helicopter flying over San Diego Bay and striking a shorebird (*Calidris* spp.).

These five strikes were a slight increase from 1999 when 4 strikes were recorded. Three of the five strikes occurred on the approach to Runway 29 which also had the largest number of observed runway crossings by various bird species.

Table 5. Bird/aircraft strikes on NASNI, 2000 including all remains from dead bird searches.

Date	Time	Species	No.	Location	Aircraft	Alt.
22 MAY 00	18:50	House Finch	1	Runway 29 east of Charlie	S-3	–50'
JULY 00	unk	Sandpiper spp.	1	Over San Diego Bay	Helicopter	unk
1 AUG 00	14:10	Caspian Tern	1	Approach to Runway 36	unk	unk
AUG 00	unk	American Kestrel	1	Runway 29 at Echo	unk	unk
21 NOV 00	06:40	Mourning Dove	1	Runway 29 near Alpha Gear	unk	unk

DISCUSSION

Overall, numbers of birds continued to decline on NASNI, with some notable exceptions. We believe much of this reduction in aircraft strike hazards can be attributed to early initiation of the 2000 BASH program. The WS Specialist eliminated gull nesting in the recognized problem areas and thereby reduced gull recruitment into the local population. However, Western Gulls nesting on roof-tops still maintained a presence on NASNI. WS had much greater success in controlling the gulls which nested on the ground. Rooftop exclusion devices (e.g., grid-wires) and dead gull effigies may prevent this rooftop nesting. Effigies were very successful in discouraging roof top loafing and roosting on NASNI. Due to the success of this technique, WS is currently in the process of having some gulls mounted to reduce the chances of attracting scavengers (e.g., ravens). These mounts will be tagged Government property and used year after year. Many of the hangars and buildings surrounding the Airfield harbored reservoirs of Rock Doves. Personnel at several of the hangars, mainly VR-57, requested assistance from WS concerning Rock Doves inside the buildings. Since the hangars were adjacent to several taxiways, resolving their issues would benefit the BASH program. Technical assistance was provided to NASNI Maintenance concerning improving their exclusion netting in the hangars. In addition, several Rock Dove traps were placed, and Rock Doves were removed from the hangars. After the exclusion netting was repaired and the Rock Doves removed, damage to the interior of the hangar was greatly reduced. We consider this effort to be the reason Rock Dove numbers and runway crossings were observed to drop on NASNI by 17% and 100%, respectively.

The approach to Runway 29 continues to have large numbers of runway crossings. This area presented a unique hazard on NASNI because of the number of aircraft using Runway 29 for training, and the altitude (–60 to 80 ft AGL) at which aircraft approach when they were adjacent to the golf course ponds. Waterfowl flying to and from these ponds crossed the flight path of aircraft landing on Runway 29. However, significant progress has been made in reducing this hazard. The placement of grid-wires over two of the most commonly used ponds, and intense, consistent harassment reduced numbers of coots and waterfowl in this area by 40% in 2000. The efficiency of grid wires for excluding birds such as gulls, waterfowl (mainly dabblers), and geese is well documented (Steuber et al.1994; Pochop et al. 1990). However, additional efforts still need to be made to continue to lower numbers of coots and waterfowl on NASNI. A few coots and/or ducks remaining near the approach to Runway 29 will eventually decoy in greater numbers of birds, creating an aircraft safety hazard. Draining and filling the three ponds closest to the approach will provide the most cost effective method in significantly reducing a major bird/aircraft safety issue on NASNI. Until this objective is achieved, we recommend 1) leaving the grid-wire systems in place year-round to discourage early colonization by migrating coots and waterfowl, 2) continued maintenance on the system so as water levels fluctuate it retains it effectiveness, and 3) continuous harassment by the WS Specialist which will encourage the birds to feed and loaf away from NASNI. The grid-wire system was installed in such a manner as to facilitate seasonal removal. This was to insure that the system would not interfere with California Least Terns foraging in the ponds. However, Least Tern foraging on these ponds is so infrequent that keeping the grids in place year round should not negatively impact this species.

Birds, specifically Western Gulls, continued to frequent the beach areas near the approach to Runway 18, as well as the unmodified habitat around the approach to Runway 36. These beach areas offered foraging opportunities at low tide. At the approach to Runway 18, gulls retrieving clams from the beach area at low tide and dropping them in the helicopter parking area created both a nuisance and hazard for helicopters and personnel.

The reservoir of birds on the nearby beaches could negatively impact aircraft operations on NASNI at any given time, as demonstrated by the documented shorebird/helicopter strike in July, 2000. Periodic bird monitoring in this area is recommended to document build-ups of various species (e.g., Heermann's Gulls in late summer). When build-ups are detected, the WS Specialist should initiate various harassment techniques to discourage loafing and feeding.

Mourning Doves, Great Blue Herons, small flocking birds, and raptors foraged and loafed on the grassy areas surrounding the approach to Runway 36 and frequently crossed runways. Stabilizing the soil at the approach to Runway 36 would alleviate much of this bird activity, but would conflict with other environmental priorities on NASNI. Consequently, birds in this area should be monitored constantly and hazed when necessary. An example of the potential problems in this area occurred in July and August 2000 when approximately 200 Caspian Terns used this approach for loafing. We believe the terns moved onto the approach tarmac after pedestrians walking illegally on the beach pushed the terns from their normal loafing areas. This situation resulted in a reported aircraft/Caspian Tern strike. WS placed three propane cannons on the approach and also increased use of hand-held pyrotechnics until the Caspian Terns dispersed. Also, increased Navy Security patrols intensified and kept illegal foot traffic from disturbing the birds from the beach areas. Close monitoring of this area will be required to detect any future buildups.

Gulls have historically used NASNI as a staging area prior to migration in late summer and early fall. An unusually large number of Western Gulls were observed on NASNI during this period, together with an increase in runway crossings. This spike might have been an anomaly, as we believe active WS dispersal and removal efforts greatly reduced the Western Gull population on NASNI since the inception of the BASH program in 1996.

The 17% decline in Rock Dove observations was an encouraging sign that indicated the WS trapping and shooting program lowered the Rock Dove population on NASNI, and subsequently decreased observed runway crossings by 100% for this species. However, the large increase in observed Mourning Dove numbers and runway crossings needs to be addressed. Flocks of Mourning Doves were observed feeding on seeds of the numerous weeds on runway edges and infield areas throughout the Airfield. This problem of weeds attracting seed-eating birds (e.g., doves, finches, starlings, horned larks, etc) was especially pronounced in the Compass Rose area where large flocks of 50 or more birds were commonly observed. We recommend cutting weeds to remove food sources, as well as trapping and shooting doves before their numbers increase further. In addition, we recommend that the weed control on the Airfield be initiated early enough in the season to prevent the plants from producing seeds and subsequently attracting birds. Individual small birds did not present a substantial hazard, but large flocks moving across runways presented a serious risk to aircraft safety. Linnell et al. (1996) described serious damage to aircraft caused by solitary zebra doves (*Geopelia striata*) on Kauai, Hawaii and cautioned against ignoring risks posed by small birds.

The Great Blue Herons on NASNI continued to pose a serious threat to aircraft. These large birds (–5.5 lbs) often crossed runways at dawn as they departed from their roosts in the Eucalyptus trees (*Eucalyptus* spp.) at the corner of Moffett Road and Roe Street. The herons flew across runways on their way to various foraging locations throughout NASNI (e.g., approach end of Runways 29 and 36, and the open fields west of Compass Rose). At dusk the route was reversed as the herons returned to their roosts. This species does not respond well to standard hazing techniques and removal of this possibly unique population in southern California has been discouraged. We suggest capturing and relocating these herons to a more suitable location away from NASNI.

Previous habitat modification efforts have successfully deterred birds from nesting and roosting near runways. However, as soil cementing that has been in place for less than two years deteriorates, continual monitoring will be essential for early detection of birds that reoccupy the modified areas.

MANAGEMENT RECOMMENDATIONS

1. The soil stabilization efforts on NASNI have been extremely successful in reducing nesting habitat for Western Gulls and hunting opportunities for raptors. This trend needs to continue. The sandy short-grass areas on the approach end of Runway 29, the Radar Fields south of 29, and the areas surrounding the approach end of Runway 36 all should be treated and stabilized. This is prime habitat for rodentia and lagomorphs that attract raptors and provide nesting habitat for gulls and other species of birds.

2. Devices to exclude gulls from nesting on building rooftops around NASNI need to be implemented. Grid-wires, anti-perch devices, and other techniques should be implemented to deter nesting, loafing, and roosting activities.

3. Remove Ramp 10. Gulls, cormorants, and pelicans regularly use this as a loafing area and can be seen flying over the helo pads to roost and nest on adjacent buildings. If removal is not possible other options should be explored to exclude bird use (e.g., grid-wire).

4. Remove the concrete docks in the bay. Each dock provides a safe haven for multiple gull nests during the breeding season. It is also a refuge for gulls escaping the pyrotechnics fired at them. If removal is not possible, explore options to exclude bird use and nesting (e.g., gird-wire, predator and/or dead gull effigies).

5. Have all building managers report nesting of any species to the Natural Resources Office so the WS Specialist can be informed and address the issue.

6. Habitat alterations should be made to the areas north of the Weapons Compound to deter Great Blue Heron use. Consider a capture/relocation program to remove these birds from NASNI. Also, trees in the rookery should be thinned or removed to prevent roosting and nesting.

7. Enforce the ADo Not Feed The Wildlife@ base policy. All along the San Diego Bay side of Moffett Road, people intentionally leave food that attracts gulls and other wildlife. Signs stating the aforementioned should be posted. To prevent unintentional bird feeding, all dumpsters and trash cans should remained covered.

8. Early initiation and continuous application of the program is key to success for the BASH program at NASNI. Set forth a protocol to insure budget and contract negotiations do not jeopardize the success of the program. A multi-year contract would be ideal.

9. Implement long-term dispersal techniques on the Weapons Pier. This could include use of distress tapes, sprinkler system, or noise makers.

10. Leave grid-wire systems on golf course ponds year around. Fill ponds where grid-wire systems are difficult and/or impossible to install.

11. Initiate a large-scale removal project of European Starlings on NASNI. These birds can be observed in large numbers at certain times of the year. Trapping or the use of avicides are very effective control techniques for this species.

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APPENDIX 4: Sheffer and Cummings 2001

FINAL REPORT

BIRD AIR STRIKE HAZARD (BASH) MANAGEMENT AND MONITORING AT NAVAL AIR STATION NORTH ISLAND

2001

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FINAL REPORT
BIRD AIR STRIKE HAZARD (BASH) MANAGEMENT AND MONITORING AT NAVAL AIR STATION NORTH ISLAND
2001

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EXECUTIVE SUMMARY

The National Wildlife Research Center (NWRC) has worked with Naval Air Station North Island (NASNI) and the U.S. Department of Agriculture's California Wildlife Services (WS) since 1996 to evaluate and reduce the hazards birds pose to aircraft on NASNI. In a continuing effort NWRC conducted monthly monitoring surveys to assess the bird/aircraft strike hazard (BASH) at NASNI from February 2001 through January 2002 and evaluated the bird/aircraft strike hazard mitigation efforts initiated in 1996 by Wildlife Services.

NWRC bird observations in 2001 indicated overall bird numbers on NASNI decreased throughout the airfield for the third straight year since 1999. In June 2001 and January 2002, bird numbers increased slightly over the previous year's numbers. Numbers of great blue herons, double-crested cormorants, American coots, and rock doves all declined on NASNI during 2001, whereas European starlings, brown pelicans, red-tailed hawks, Heermann's Gulls, Forster's gulls and house finches all increased during 2001. Crossings of Runways 18-36 and 11-29 varied from month to month in 2001. The approach to Runway 29 continued to have the most crossings. Crossings of all runways peaked May through July 2001 and January 2002. These peaks have been reported in the past and were related to pre-and post-nesting periods when bird movements were most numerous. Eighteen dead birds were found on NASNI during the study period. Due to location and type of injuries, fourteen deaths were attributed to bird/aircraft strikes. Four of these fourteen bird/aircraft strikes were reported to Lieutenant Max Wettstein,

Aviation Safety Officer, during the study period. Ten of the ten strikes occurred on or near Runway 29-11. Four strikes occurred on or near Runway 18-36. Three of the strikes were the same bird species that were struck in 2000 (house finch, mourning dove, and American kestrel). The increase in bird/aircraft strikes may be attributed to an increase in the number of operations, changes in bird populations, changes in habitat or awareness by pilots and operation personnel.

WS personnel eliminated gull nesting in problem areas, and thereby reducing gull recruitment into the local population. The number of birds dispersed in 2001 by WS on NASNI was 6,576, a decrease of 45% over 2000. The total number of birds, chicks, and eggs removed and/or destroyed in 2001 was 98, as compared to 579 in 2000. This is an 83% reduction in the number of the number removed or destroyed. Of the 98, western gulls, rock doves, and mallards comprised 37%, 36%, and 21%, respectively of all the birds lethally removed on NASNI in 2001.

The raptor translocation effort initiated in 1999 continued through 2001. In 2001, WS translocated two red-tailed hawks approximately 110 miles east to Imperial County near El Centro, California. These hawks have not returned to NASNI.

WS bird dispersal efforts reduced gulls roosting on NASNI. Only the Weapons Pier remained as an occasional roosting site for gulls on NASNI. Use of pyrotechnics at this site has been effective in minimizing bird use. Hazing and use of gull effigies on rooftops, such as building 805 (a heavily used gull roost prior to control efforts), has significantly reduced or eliminated gull use of these sites.

The past soil stabilization efforts have deterred birds from nesting and roosting near runways. Continual monitoring of these areas will be essential for early detection of reoccupation by various bird species. The sandy, short-grass areas in the over-run areas on the approach to Runway 29-11 remains an area of concern, and we recommend soil stabilization in this area to eliminate foraging opportunities for birds. We also recommend draining and filling the golf course ponds adjacent to the approach to Runway 29-11, and if this is not possible, leaving the grid-wire systems up throughout the year to discourage bird use. In addition, the approach to Runway 18-36 should be monitored constantly and any birds dispersed to prevent a buildup of birds in this area. Although WS has been successful in preventing most gulls from nesting on the ground around NASNI, rooftop nesting continues and will require further intensive management.

INTRODUCTION

Bird strikes to aircraft are a serious safety and economic problem in the United States, annually causing millions of dollars in damage to civilian and military aircraft and occasionally loss of human life (Cleary et al. 1998). Military aircraft are especially susceptible to bird strikes because many exercises involve high speeds at low altitudes where birds are commonly present, and losses of military aircraft have been numerous and costly (Blokpoel 1976). Since 1960, at least 250 military aircraft and 120 military personnel have been lost because of wildlife strikes in the U.S. (Cleary and Dolbeer 1999). The U.S. Navy reported about 620 bird strikes from 1993 through 1995 with 19 of these strikes totaling approximately $104 million in aircraft damage (Bird Strike

Committee 1997). The U.S. Air Force reported 13,427 bird/wildlife strikes to aircraft world-wide from 1989 through 1993 with damage estimates exceeding $85 million (Arrington 1994).

At Naval Air Station North Island (NASNI), San Diego, California bird strikes regularly have been reported since the start of record keeping in 1980. The Command Navy Safety Center in Norfolk, Virginia reported 102 bird strikes to aircraft at NASNI between 1980 through 1996 (Cummings and Foley 1997). On 24 August 1995 an E-2 Hawkeye (carrier-based tactical warning and control system aircraft) on take-off struck a large flock of western gulls (*Larus occidentalis*) roosting on the runway, killing more than 100 birds. The take-off was aborted with severe damage to the aircraft and no loss of life. Another incident at NASNI occurred on 15 August 1996, when a departing P-3 Orion (four-engine turboprop anti-submarine and maritime surveillance aircraft) struck western gulls on the same runway resulting in damage to the aircraft. Both of these incidents occurred during night-time operations. In addition, an F-18 Hornet departing NASNI struck a great blue heron (*Ardea herodias*) on 11 June 1996. The heron was partially ingested into the left engine intake.

During 1996/1997 the National Wildlife Research Center conducted a Wildlife Hazard Assessment for NASNI and made recommendations to reduce the bird/aircraft hazard. NASNI acted on most recommendations that included habitat modification of high bird use areas by soil cementing about 52 acres of bird habitats, translocated raptors that used the airfield, put in place a BASH working group, started bird patrols to haze or remove birds that were a potential hazard to aircraft and initiated a monthly BASH monitoring program.

Following the initial Wildlife Hazard Assessment in 1996/1997 and the development of a BASH program, monitoring surveys have shown that the number of birds using NASNI between 1996 and 2001 has significantly decreased. Numbers of western gulls observed on the airfield as compared to 1996/1997 decreased 95% in 1999, increased 21% in 2000, then decreased 75% in 2001 (average daily mean of 19, 127, 32, respectively). This can be directly attributed to habitat management and Wildlife Services BASH management program.

In 2001, overall bird numbers decreased throughout the airfield on NASNI. Runway 29-11 had the most crossings and they peaked May through August, which are attributed to pre- and post-nesting periods when bird movements are most numerous. Five bird strikes were reported during 2000 and the field east of Runway 29-11 sustained the most bird/aircraft collisions. WS personnel dispersed 11,918 birds (an increase of 4% from 1999), lethally removed 579 birds (an increase of 7% from 1999), reduced American coot numbers by 40% from 1999 and relocated five red-tailed hawks during 2000. WS personnel reduced gull numbers on the Weapons Pier by 85% from 1999 numbers to a maximum of 65 birds observed roosting on the pier.

In 2001, NWRC continued to conduct a monthly monitoring survey to assess changes in bird numbers, locations and behavior resulting for WS BASH management activities, and to determine any additional measures that should be taken to reduce bird hazards at NASNI.

STUDY AREA

NASNI is a 2,866-acre naval air station located on Coronado Island, San Diego, California that has a number of natural characteristics that make portions of the site attractive to birds. NASNI is bordered on the north and west by the San Diego Bay, on the south by the Pacific Ocean and on the east by the city of Coronado. On NASNI there are vast areas of vegetative habitat interspersed with intermittent and permanent water sources, and flat open areas that attractant several species of birds.

METHODS

WS Bird Dispersal

WS implemented bird management activities on NASNI beginning February 1, 2001. Prior to initiation of operational bird dispersal, baseline information was recorded on species and numbers of birds using the NASNI airfield. Various dispersal techniques were used depending on the location of birds, species, time of bird activity, and level of threat posed by birds. These criteria were subdivided using the following decision making model: first, if the birds were dispersed, would the problem be solved; second, were they resident birds which would continually return, post-dispersal; and third, were they birds that would not disperse even after harassment.

Multiple tools and techniques were used for bird dispersal including hand-held pyrotechnics, spotlight harassment, vehicle harassment, electronic distress calls, and dead gull effigies. All dispersal efforts during airfield operation hours were coordinated with the NASNI Air Traffic Control Tower and Navy Security via radio communications. Numbers of birds harassed and pyrotechnics fired were recorded on Airport Data Sheets (Appendix A). During 2001, propane cannons (Reed Joseph International, model M-8) were not used in locations historically identified as gull loafing, roosting and nesting areas. The need for propane cannons was not warranted at NASNI during 2001, but the cannons were available if the need arose. Hand-held pyrotechnics (Sutton Ag. Enterprises) fired from a specialized, double-barreled pistol were used to disperse birds from the NASNI airfield. Pyrotechnics were specifically used to disperse birds from loafing on ramp 10, and areas along Moffet Road. To discourage gull roosting in the Weapons Complex (pier and perimeter road) the WS Specialist, after consultation with Weapons personnel, initiated use of pyrotechnics on the Weapons Pier in February 2001. Pyrotechnics were only used on the Weapons Pier when the red flag was not flying and ordnance were not present.

Vehicle and spotlight harassment were implemented in areas designated too sensitive for pyrotechnics. These areas included the Fuel Farm and Weapons Magazines. These techniques were also implemented throughout the NASNI airfield to augment the dispersal affect of pyrotechnics. To discourage gull loafing on roof tops the WS

Specialist placed dead gulls effigies on buildings that were known loafing locations, which kept numbers on Building 805 throughout the year close to zero.

Pyrotechnics, although an effective tool, were not used to disperse waterfowl from the golf course ponds to the north of the approach end of Runway 29. Wildlife Services received several noise complaints from the BOQ and surrounding residential areas when pyrotechnics were used. This was a result of the need to disperse waterfowl prior to the daily opening of Runway 29. Also the use of the golf course prohibited continued harassment throughout the day. American coots (*Fulica americana*) typically roosted on the golf course ponds, but other waterfowl species including American wigeons (*Anas americana*) roosted elsewhere, and arrived at ponds around sunrise. Beginning in January 22, 2001, the WS Specialist began using a trained dog for coot and waterfowl dispersal at golf course ponds. The dog was brought to the ponds an average of two times per week at approximately 0700 and dispersed approximately 120 mallards, 260 American wigeons and 445 American coots. Initial efforts were successful in dispersing the coots, however they soon began to hide in cattails growing in one of the ponds when the dog arrived, which made dispersal impossible for the dog. No lethal control was used during this time due to the effectiveness of the dog. Harassment efforts ceased at 0730 due to the start of normal Air Operations hours, the arrival of golfers on the course, and the arrival of American wigeons on the golf course ponds. Efforts to disperse wigeons from the ponds were deemed too risky to Air Operations since birds could possibly disperse across Runway 29 and the approach. To further discourage use of the ponds, a grid-wire system was constructed on January 18, 1999 over two 1-acre ponds adjacent to

Runway 29 that were being used extensively by waterfowl. During May and June 2001, the grids were removed from the golf course ponds; they were put back up September 5, 2001 and kept up for three weeks. They were taken down because the water levels were not kept constant, making the grids ineffective by either being submerged in water or too far above the water so that birds could swim right under them. Waterfowl were counted on all five golf course ponds (gridded and ungridded) once a day following monthly Airfield surveys. Results indicated that wire grids significantly decrease use of the ponds when properly maintained. Over the past three years it has also been recommended that a grid-wire system be installed over another pond southeast of Runway 29. This recommendation was considered, but due to the mismanagement of the grid wire system it was recommended that all three ponds adjacent to Runway 29 be drained and filled. On January 1, 2002 it was decided by the golf course advisory committee that the three ponds would be drained and filled and turned into waste bunkers. Wildlife Services believes this action will reduce the number of birds using this area of the airfield and the number of birds crossing at the approach to Runway 29.

WS Bird Removal

Lethal control of birds on the NASNI airfield was implemented when other methods were ineffective or there was a perceived threat to aircraft safety. The objectives for lethal control were to reduce overall population levels of certain bird species causing a potential bird/aircraft hazard, and to reinforce the bird hazing/harassment program. All weapons used for bird control activities on NASNI were registered with security and used only when conditions were safe and in accordance with the Navy and WS regulations and policy. All shooting events were coordinated with the Tower and Navy Security. When shooting events occurred within the Weapons Compound, all procedures previously set forth were followed. Several methods were used to lethally manage gulls, rock doves (*Columba livia*), and waterfowl on or around NASNI airfield which included shooting with 12 gauge shotguns (2 3/4" and 3" shells, utilizing #4 and #6 bird shot), .177 caliber air guns, and .22 caliber rifles using subsonic ammunition (CCI CB Longs)., with rock dove traps, nest destruction, alpha chloralose (AC) baiting, bal-chatri traps, pole traps, decoy traps and hand capture. Captured birds were euthanized by CO_2 inhalation under American Veterinary Medical Association Guidelines (AVMA 1993).

All large scale removal projects such as the use of AC on the golf course were approved and scheduled in advance with Natural Resources Office (NRO), Public Affairs Office, and golf course personnel. Alpha chloralose is a tranquilizing drug not intended for use as a pesticide and may be administered only by trained USDA/APHIS/WS personnel or FDA-approved and trained pest control operators. Alpha chloralose was used in accordance with the FDA label and WS policy. On September 19, 2001, waterfowl on the golf course were pre-baited with cracked-corn adjacent to pond areas. On October 1, 2001, AC-treated corn was used to capture waterfowl using golf course ponds.

Raptor Translocation

Translocation of live-captured raptors on NASNI was allowed under a U.S. Navy depredation permit issued to Tammy Conkle (permit # MB746332-0), and banding was allowed under NWRC's banding permit (U.S. Fish and Wildlife Service Bird Banding Laboratory: Permit #8567). WS, under NWRC's guidance, initiated efforts to relocated resident and migrating raptors that were a threat to aircraft safety. Raptors were caught with Bal-chatri traps, banded, held in captivity until conditions were appropriate for release, and translocated 110 miles east of NASNI. The time held and distance released were based on data from past translocation efforts from NASNI where three out of eleven raptors returned to NASNI (27% return rate) when translocated 55 miles to the east and without a holding period (York et al. 2000).

NWRC Bird Monitoring Surveys

NWRC conducted bird monitoring surveys from February 2001 through January 2002. Surveys were conducted each month for 3 consecutive days and in the same manner that was established in 1996. Counts of both live and dead birds were made from stations and transects associated with NASNI runways. The following surveys were conducted:

<u>Station Counts:</u> NWRC personnel used 8 permanent stations, set up for previous years' surveys that encompassed the NASNI airfield (Fig. 1). A route that connected each station was driven in the morning starting at sunrise (approximately 0515-0630). The same route was reversed in the evening starting at approximately 1530-1830. Each day the starting location was alternated between stations 1 and 8 to reduce time bias. Station

counts were conducted for 10 minute intervals. Numbers, species and activities (e.g., flying, feeding, loafing, roosting, etc.) of birds within approximately 1,000-1,200 ft of the observation station were recorded on NASNI maps (Fig. 2). The location and direction of flight of birds observed crossing runways were also recorded. Individual runways were defined from the approach ends to the intersection at X-Ray.

Station 1 is near the approach of Runway 36 (Fig. 1), allowing observations of birds in the infield and along the taxiways surrounding the approach. This station also included counts of birds utilizing the area surrounding the approach as well as the beach area south of the approach. The habitat type surrounding the approach to Runway 36 was primarily composed of ice plant (*Mesembryanthemum spp*.), but does not include seed producing plants. This area supports a prey base for owls, raptors and herons. On either side of station 1 are multiple buildings, power lines, and chain link fences which provided loafing and roosting sites for numerous bird species.

This area is used by red-tailed hawks (*Buteo jamaicensis*) hunting California ground squirrels (*Spermophilus beecheyi*) and black-tailed jackrabbits (*Lepus californicus*). Caspian terns (*Sterna caspia*) have been observed in the area. It is used on a limited basis by common ravens (*Corvus corax*), great blue herons, burrowing owls (*Athene cunicularia*), and European starlings (*Sturnus vulgaris*) for foraging. The beach which is about 500 ft from Runway 36 attracted several species of gulls, shorebirds, brown pelicans (*Pelecanus occidentalis*) and double-crested cormorants (*Phalacrocorax auritus*) in large numbers. The beach area is also used for foraging by a number of snowy plovers (*Charadrius alexandrinus*) and black-bellied plovers (*Pluvialis squatarola*) during winter. At this station, western gulls have been observed towering up from the beach to altitudes more than 1,000 ft over this area.

Station 2 is located to observe birds crossing on Runway 29, bird movement in route to the heli-wash on the taxi-way to the east of the station, and birds foraging in the grassy area immediately to the south of station. The northern extension of the buildings and fences adjacent to Station 1 were observed from Station 2 to detect loafing and roosting birds.

Station 3 is located at the approach of Runway 29. This area is composed of several diverse habitats. On either side of the approach end of Runway 29 is a golf course consisting of dense stands of trees, freshwater ponds, and a large tract of mixed grasses and ice plant. Along the north and south sides of the runway near Station 3 are hangars, housing and miscellaneous other buildings. A variety of birds use this area primarily for foraging and loafing. The greatest attractions include the ponds on the golf course. Waterfowl, gulls and American coots frequently loafed and foraged on or near the ponds. Previous years' observations showed peak use of these ponds occurs December through January.

Station 4 is located near the center of the airfield where runways intersect to observe bird movement generally in the center of the airfield. The federal fire buildings to the southeast of Runway 36 and 29 provide loafing areas for those birds crossing the airfield from the east to the west, or vice versa. There are also several seed producing plants growing in the tarmac around heli-pads which attract birds to the area.

Station 5 is located at the north end of the approach to Runway 18 near the shoreline. This observation area includes the coast and a narrow strip of ice plant/sand along the perimeter road. This station is established primarily to monitor bird movements along the shore and crossings of Runway 18 in route to the heli-wash and/or to the buildings and hangars to the east of the approach. In addition, piers located in San Diego Bay could be observed from this station for gulls, terns, and pelicans. Gulls, ring-billed gulls (*Larus delawarensis*) in particular, foraging for shellfish at low tide will use the tarmac and soil cemented areas at the north end of Runway 18 to aid in breaking the shells.

Station 6 is in an area where numerous buildings and fences could be observed as well as crossings along the length of Runway 18. This station is surrounded by tarmac and pavement with little vegetated habitat, although there are numerous locations for loafing and roosting birds. A narrow strip of sandy soil with a light covering of vegetation, primarily small grasses and low-growing plants, is located along the west edge of Runway 18 adjacent to the fuel farm.

Within Stations 5 and 6 is a 27-acre area that was soil cemented in 1999. Prior to this habitat modification, this area was a mix of low vegetation consisting primarily of ice plant. The vegetative pattern was intermittent in several areas due to the substrate being covered with a layer of soil cement several years earlier. The open area among ice plant was generally sand and was very attractive to western gulls for nesting and roosting because it protected against prevailing winds, had good ground cover for nesting, and allowed good visual detection against intruders. Great blue herons and raptors, specifically red-tailed hawks, were also attracted to this area primarily to prey on

California ground squirrels. Burrowing owls (*Athene cunicularia*) used abandoned squirrel holes in this area for nesting and roosting. Rock doves (*Columba livia*) and mourning doves (*Zenaida macroura*) were attracted to this area because of the seed-producing plants and grit (e.g., sand), and occasionally people fed rock doves in this area. Station 7 is located at the approach end of Runway 11 to observe bird movements along the coast west of the Approach and of birds crossing Runway 11. Prior to 1999, the area to the west and northwest of the approach to Runway 11 consisted of a large open tract of sand with areas dominated by ice plant. The density and growth patterns of ice plant made this area attractive to western gulls for nesting and loafing. It also attracted great blue herons, red-tailed hawks and burrowing owls which used the area for foraging. In 1999, approximately 25 acres of this area was modified by soil cementing, which eliminated most of the bird foraging, nesting and loafing habitat. Red-tailed hawks and American kestrels (*Falco sparvarius*) still used the small amount of remaining area to the west which was not soil cemented for foraging. The beach area adjacent to the approach attracted large numbers of gulls, waterfowl, shorebirds and pelicans. To the southwest of the approach to Runway 11 is an area designated as nesting habitat for California least terns (*Sterna antillarum browni*), which attracts several species for foraging and loafing. Station 8 allows observations of birds crossing Runways 11 and 36, and birds perching on the numerous light poles in the Weapons Compound to the south of Station 8. The habitat type in the field to the northwest of Runway 36 includes both iceplant and seed producing plants, which attracts several species for foraging and loafing and in doing so supports a prey base for owls, raptors and herons.

Bird/Aircraft Strikes

Following station counts, we drove and/or walked each runway and approach area to search for dead or injured birds. All remains (e.g., feathers, bones and carcasses) were collected, labeled, recorded and frozen. The location of each item was recorded with a GPS unit (Garmin 12, Garmin Corporation, Olaphe, Kansas) and marked on a NASNI map. Bird carcasses found by NASNI airfield personnel were also collected, labeled, recorded, frozen and mapped. Injured birds were collected and euthanized.

NWRC personnel recorded the number of bird/aircraft strikes which occurred on all runways and approaches during the study. A strike was defined as one or more birds found intact, and/or remains found at a location on the runway proper, adjacent to the runway, or if it was reported as a strike. If possible, the type of aircraft was identified from records of flight operations.

RESULTS

WS Bird Dispersal and Removal

The total number of birds dispersed via pyrotechnics was not reflective of the total population of birds on NASNI. This was due, in part, to repeat harassment of the same birds resulting in over counts. Conversely, birds repeatedly harassed often disperse when a vehicle or person approaches, resulting in undercounts.

The number of birds dispersed by WS on NASNI decreased approximately 45% from 2000 (Table 1). Table 1 included only those species most commonly dispersed and those that presented the greatest hazard to aircraft safety. The total number of birds, chicks, and eggs removed and/or destroyed decreased from 579 in 2000 to 98 in 2001, an approximate 83% decrease (Table 2). Of these, 21 mallards were removed as a part of an AC project on the golf course in October 2001. Birds captured using AC bait were euthanized using CO_2. Western gulls, rock doves, and American coots comprised 37%, 36%, and 21%, respectively of all the birds lethally controlled on NASNI in 2001.

WS personnel expended a total of 1,775 staff-hours on direct bird control activities on the NASNI Airfield for this project. This total was representative only of hours spent in the field and did not include hours spent repairing and maintaining equipment, writing reports, attending meetings, or providing supervisory oversight.

Table 1. Birds dispersed by WS personnel on NASNI.

SPECIES	Dispersed in 2000	Dispersed in 2001
American Coots	1,386	445
Caspian Terns	2,815	115
California Gulls	407	N/A
Heermann's Gulls	1,489	1710
Mallards	unk[a]	120
Western Gulls	5,821	3,926
American Wigeons	0	260
TOTAL	**11,918**	**6,576**

[a]Total number of birds dispersed not recorded for this species.

Table 2. Total number of birds, eggs and nests taken or destroyed, by species, and methods on NASNI, 2001.

SPECIES	SHOOTING	TRAPPING	HAND CAUGHT[a]	EGG/NEST REMOVAL	TOTAL
Western Gulls	36	0	0	0	**36**
Heermann's Gulls	4	0	0	0	**4**
Rock Doves	34	1	0	0	**35**
American Coots	0	0	0	0	**0**
Mallards	0	0	21	0	**21**
Red-tailed Hawks	0	2	0	0	**2[b]**
TOTAL	**74**	**3**	**21**	**0**	**98**

[a]Includes birds captured using AC bait.
[b]Includes two translocated hawks which, to date, have not returned to NASNI.

Raptor Translocation

Two red-tailed hawks were captured, banded, and translocated approximately 110 miles to the east in Imperial County near El Centro, California (Table 3). None of these hawks have returned to NASNI.

Table 3. Raptors translocated from NASNI in 2001.

SPECIES AND AGE	CAPTURE DATE	CAPTURE LOCATION	RELEASE DATE	RELEASE LOCATION[a]
Red-tailed hawk,	March 26, 01	Radar Field	May 8, 01	Imperial Valley, CA

Juvenile, # 117713327				
Red-tailed hawk, Juvenile # 117713328	April 2, 01	Radar Field	May 8, 01	Imperial Valley, CA

[a]To date no translocated raptors have returned to NASNI.

NWRC Bird Monitoring Survey Data

Sixty-eight bird species were observed on NASNI during the 2001 study period and two species were identified which did not occur during observation periods (Appendix B). Bird numbers on the airfield generally remained as low or were lower than 1999 and 2000 levels (Fig. 3) with the exception of June 2001 and August 2001 and January 2002 when bird numbers were slightly higher than either 2000 or 2001 levels, and December 2001 when bird numbers increased by nearly 50% from 2000 levels. The increase in December 2001 bird numbers was due to 5 species in particular: American coot (*Fulica americana*), European starling (*Sturnus vulgaris*), American wigeon (*Anas americana*), brown pelican (*Pelecanus occidentalis*), and Forster's tern (*Sterna forsteri*). American coot numbers in December increased from a mean of 126 per observation period in 2000 to a mean of 141 per observation period in 2001. European starling numbers increased from a mean of 16 in 2000 to 64 in 2001. American wigeons were not observed in 2000, but an average of 31 per observation period were observed in 2001. Brown pelicans increased from an average of three birds per observation period in December 2000 to an average of 47 birds per observation period in 2001. There were no recorded sightings of

Forster's terns in December 2000. In December 2001, an average of 55 Forster's terns were observed per period.

Runway crossings by birds varied greatly in 2001 (Figure 4). May, June and July 2001 and January 2002 data showed higher mean numbers of runway crossings than in 2000. In all three months, higher 2001 numbers were the result of an increase in the number of house finches (*Carpodacus mexicanus*) crossing runways. In addition, during January 2001, the increase in runway crossings was an artifact of one crossing event of 138 birds (snowy plovers and black-bellied plovers). Runway crossings by birds in April, October, November and December were not different between 2000 and 2001. The number of crossings in August 2001 was much lower than in the corresponding month in 2000.

There were ten bird species that posed the most serious threat to aircraft safety on NASNI in 2000 (Table 4). This rating was based on numbers, size, and weight of different species. In 2001, the list was modified to include additional species.

Brown pelicans, because of their size (x = 7.5 lbs.), pose a serious threat to aircraft. The mean daily number of pelicans observed was 11, an increase of 10% from the 2000, which caused them to be placed on the list of top ten birds on NASNI this year. However, no pelicans have been observed crossing the airfield runways. We consider them to be a threat because they have been observed crossing the approaches to runways 18 and 36 during aircraft operations and at an altitude that potentially puts them in the path of aircraft.

Great blue heron mean daily numbers decreased by 33% (from 3 to 2) on NASNI in 2001, and the number of runway crossings decreased 50% (from 2 to 1) from 2000.

Great blue herons are, however, still observed often around the airfield and due to their large size and flight altitude also pose a threat to aircraft.

In 2001, 39 observations of red-tailed hawks were recorded mainly on structures adjacent to the runway. During the observation periods an average of one red-tailed hawk was observed. There were three runway crossings by red-tailed hawks during the observation periods. These numbers reflect an increase as compared to a similar period in 2000. Most red-tailed hawks were observed during October to January.

Western gull numbers decreased 75% in 2001 to a daily mean of 32 birds (from 127) and runway crossings decreased 80% in 2001 to a daily mean of 1 (from 5). Heermann's gull (*Larus heermanni*) numbers increased by 40% to a daily mean of 13 observed, causing them to be placed on the list this year. However, Heermann's gulls have not been observed crossing the airfield runways.

American coots decreased 47% to a daily mean of 39 in 2001 (from 88). No American coots were observed crossing airfield runways, which was similar to 2000.

Forster's terns (*Sterna forsteri*) were added to the list this year, because at certain times of the year, particularly winter (peak in December), a large number of these birds were observed over San Diego Bay at the approach of runway 18. The number of runway crossings by Forster's terns has increased and their flocking behavior in the approach of 18 is a concern for helicopter operations.

Mourning dove numbers on NASNI decreased by 72% (from 25 to 6) with an 83% decrease in runway crossings (from 6 to 1). European starling numbers increased by 31% to a daily mean of 28 from 26, but runway crossings still are low, less than one per day from zero. House finches represented a large increase over 2000 numbers and thus were added to the list this year. Their numbers increased to 26 mean daily observations (115% increase) with a corresponding increase in runway crossings to a daily mean of 6 (200% increase).

Birds which were replaced on the top 10 hazardous species list include double-crested cormorant (*Phalacrocorax auritus*), common raven **(***Corvus corax*)**,** mallard **(***Anus platyrhynchos*)**,** and rock dove **(***Columba livia*)**.** Those species, although they are large enough to cause damage to aircraft and have previously been present in large numbers on NASNI, were not observed in sufficient numbers in 2001 to warrant inclusion on the list.

Waterfowl on Golf Course Ponds

During the daily morning observation period, an average of 91 American coots were observed using the two ponds closest to the approach of Runway 29 from October 2001 through January 2002. Since 1999, American coot numbers have decreased from an average of 261 to 91 in 2001, which is a 65% decrease. This reduction is due to the Wildlife Service BASH Program which includes hazing with pyrotechnics and dogs, capture/removal with alpha chloralose, and installation of the grid-wire systems over the two ponds. This continuous reduction may be deceiving, however, because the number of American coots in October and November 2001 was much lower than in the same period of 2000. American coot numbers averaged 133 birds per day for February and March 2002. In contrast, February and March American coot numbers for 2001 averaged only 50 birds per day. Therefore, it appears a shift in months of use has occurred rather than an actual decrease in coot numbers.

Runway Crossings

Crossings of Runways 36, 29, 18, and 11 have continued to vary over time in 2001 with Runway 29 continuing to experience the most crossings. Crossings of all runways peaked in June, July 2001 and January 2002 (Fig. 4). The peaks seen in June and July are similar to those reported in the past that were related to pre-and post-nesting periods when bird movements were most numerous. The January peak was due to the unusual crossing of snowy plovers and black-bellied plovers. August crossings declined dramatically in 2001 as compared to 2000. Mourning doves comprised a large part of the total crossings in August 2000 (average of 8 crossings per day, almost 40% of the total number of crossings for August). In contrast, there were no observed crossings by mourning doves in 2001. The major factors that contributed to runway crossings at Runway 29 were gulls and waterfowl crossing the runway to utilize the golf course ponds. Runway 36 also had multiple runway crossings, which were attributed to smaller flocking birds continuing to forage and loaf in the grassy areas surrounding the approach.

Roosting Bird Surveys

As was the case in 2000, persistent WS bird dispersal efforts resulted in almost total elimination of large numbers of gulls roosting on NASNI. Only the Weapons Pier remained an occasional roosting location for gulls on NASNI, and since the initiation of pyrotechnic use on the pier the number of roosting birds has remained very low. During the peak of roosting activity in 1999 over 450 gulls and pelicans were observed using the Weapons Pier. During 2001, only an occasional brown pelican and very rarely a gull were observed roosting on the pier.

The use of dead gull effigies on roof tops was especially effective in discouraging gulls from loafing and roosting on buildings adjacent to the Airfield. In 2000, the WS Specialist placed an effigy on Building 805 on Moffett Road and totally eliminated gull use of this roof top. Gull effigies are placed in a problem area face up with the wings spread. Other gulls have been observed circling around this area for six to eight hours, looking down at the gull and calling, then will leave and not use the area for approximately two weeks. There has only been one case of the gulls being scavenged (a raven that was lethally removed due to its scavenging the gull). Gulls continued to completely avoid loafing and roosting on Building 805 in 2001.

Bird/Aircraft Strikes

Eighteen dead birds were found on NASNI during the study period (Table 5). Due to location and type of injuries, fourteen of these were considered bird/aircraft strikes. Of these, four were reported to Lieutenant Max Wettstein, Aviation Safety Officer, during the study period. Those reported by Lt. Wettstein are indicated in bold in Table 5. One rock dove found with all viscera removed and fed upon was placed in the freezer by Darryl York; this was considered a falcon kill rather than a strike. One western gull was found by Darryl York during a dead bird survey and was reported to be old and cut by a mower; this was determined to be an aircraft strike. One brown pelican was reported sitting on Runway 18, noted by a pilot approaching in an aircraft, who then proceeded to report it to the tower; this was determined to be a sick or disease animal rather than an aircraft strike. One female American kestrel was found by Kirk Shively on the approach to Runway 29; this was determined to be a strike. The remaining three birds were either found by other operational personnel or, in the case of the April 22, 2001 bird strike, no remains were found. Nine of the fourteen strikes occurred either on Runway 29 or the approach to Runway 29, which also had the greatest number of observed runway crossings by various bird species, and one strike occurred on the approach to Runway 11. One strike occurred on Runway 18-36, one strike occurred on the approach to Runway 18, one strike occurred on the departure end of Runway 18, and one strike occurred on the approach to Runway 36 (see Table 5). The number of strikes increased from four in 1999 and five in 2000 to thirteen in 2001. Three of the 2001 strikes were similar to species that were also struck in 2000 (house finch, mourning dove, and American kestrel). This increase in aircraft strike hazards may only be an increase in the number reported as opposed to an actual increase in number of strikes for when airfield personnel are questioned about strikes seen, many admit seeing strikes and not reporting. This may be due to confusion of who to report the strike to or lack of communication of the importance of reporting strikes.

Table 5. Bird/aircraft strikes on NASNI, 2001 including all remains from dead bird searches.

Date	Time	Species	No.	Location	Aircraft	Alt.
APR 22, 2001	**1305**	**Gull spp.**	**1**	**Departure end of RW 18**	**C-9**	**200 ft**
MAR 22, 2001	unk	Western Gull	1	Near light stands on the approach to RW 29	unknown	unk
MAY 17, 2001	unk	Caspian Tern	1	Approach to Runway 36	unknown	unk
AUG 21, 2001	**1830**	**House Finch**	**5**	**On Runway 29-11 near Charlie Taxiway**	**S-3B**	**50 ft**
AUG 30, 2001	unk	House Finch	1	Runway 29-11 near Charlie Taxiway	unknown	unk
AUG 30, 2001 - SEPT 27, 2001	unk	California Least Tern	1	RW 18-36 at 2 marker from approach of RW 18	unknown	unk
SEPT 17, 2001	**0700**	**Mourning Dove Found at 1100 hrs**	**1**	**500 ft from the approach of RW 18**	**H-3 helicopter**	**unk**
OCT 23, 2001	unk	American Coot	1	Alopng light stands on the approach to Runway 29	unknown	unk
NOV 13, 2001	**1245**	**California Brown Pelican**	**1**	**End of channel near RW 11**	**CH-46**	**300 ft**
DEC 20, 2001	0945	American Kestrel	1	Approach to Runway 29	unknown	unk
		Total strikes	14			

* All the above determined as strikes due to location found (on the runway, or in close proximity to it) by either NWRC personnel or operations personnel. **Bold** = Bird strikes reported to the safety officer.

DISCUSSION

Overall, numbers of birds continued to decline on NASNI, with some notable exceptions. We believe much of this reduction in aircraft strike hazards can be attributed to early initiation of the BASH program beginning in 2000. The WS Specialist eliminated gull nesting in the recognized problem areas and thereby reduced gull recruitment into the local population. However, western gulls nesting on roof-tops still maintained a presence on NASNI. WS had much greater success in controlling the gulls which nested on the ground. Rooftop exclusion devices (e.g., grid-wires) and dead gull effigies may prevent this rooftop nesting. Effigies were very successful in discouraging roof top loafing and roosting on NASNI and seem the most beneficial management tool. For example, gulls frequently roosted on Building 805 (off Moffett Road near the Navy Flying Club) which presented a risk to aircraft, but soon after effigies were incorporated into management on the airfield, very few gulls, if any, have been witnessed using this or other nearby buildings. Due to the success of this technique, WS is currently in the process of having some gulls mounted to reduce the chances of attracting scavengers (e.g., ravens). These mounts will be tagged Government property and used year after year.

Many of the hangars and buildings surrounding the airfield attract rock doves. WS continued assistance concerning rock doves inside the VR-57 hangars, as was requested by personnel during the year of 2000. Since the hangars were adjacent to several taxiways, resolving their issues would benefit the BASH program. Technical assistance was provided to NASNI Maintenance concerning improving their exclusion netting in the hangars. In addition, several rock dove traps were placed, and rock doves were removed from the hangars. After the exclusion netting was repaired and the rock doves removed, damage to the interior of the hangar was greatly reduced. Although rock dove numbers increased slightly on NASNI in 2001, we still consider this effort has contributed to the low numbers of rock doves on NASNI.

The approach to Runway 29 as well as Runway 29 itself continues to have a large number of runway crossings. This area presents probably the greatest hazard on NASNI because of the number of aircraft using Runway 29 for training, and the altitude (–60 to 80 ft AGL) at which aircraft approach when they are adjacent to the golf course ponds. Waterfowl flying to and from these ponds crossed the flight path of aircraft landing on Runway 29. However, significant progress has been made in reducing this hazard. The placement of grid-wires over two of the most commonly used ponds, and intense, consistent harassment reduced numbers of coots and waterfowl in this area by 40% in 2001. The efficiency of grid wires for excluding birds such as gulls, waterfowl (mainly dabblers), and geese is well documented (Steuber et al.1994; Pochop et al. 1990). However, additional efforts still need to be made to continue to lower numbers of American coots and waterfowl using this area on NASNI. A few coots and/or ducks remaining near the approach to Runway 29 will eventually decoy in greater numbers of birds. Draining and filling the three ponds closest to the approach is the most cost effective method to eliminate the hazard to aircraft these ponds present. Until this objective is achieved, we recommend 1) leaving the grid-wire systems in place year-round to discourage early use by migrating coots and waterfowl, 2) continued maintenance on the system so as water levels fluctuate it retains it effectiveness, and 3) continuous harassment by the WS Specialist which will encourage the birds to feed and loaf away from NASNI. The grid-wire system was installed in such a manner as to facilitate seasonal removal. This was to insure that the system would not interfere with California least terns foraging in the ponds. However, least tern foraging on these ponds was not observed during the surveys in 2001, so keeping the grids in place year round should not negatively impact this species.

Birds, specifically western gulls, continued to frequent the beach areas near the approach to Runway 18, as well as the unmodified habitat around the approach to Runway 36. These beach areas offered foraging opportunities at low tide. At the approach to Runway 18, gulls retrieving shellfish from the beach area at low tide and dropping them in the helicopter parking area created both a nuisance and hazard for helicopters and personnel. The population of birds on the nearby beaches, such as western gulls, brown pelicans, double-crested cormorants and various species of terns during migration times can occur in the hundreds. For example, the daily average in February 2001 was 60 pelicans, 138 cormorants and 23 gulls. This could negatively impact aircraft operations on NASNI at any given time, as demonstrated by the documented shorebird/helicopter strike in July, 2000. Periodic bird monitoring in these areas is recommended to document build-ups of various species (e.g., Heermann's gulls in late summer). When build-ups are detected, the WS Specialist should initiate various harassment techniques to discourage loafing and feeding.

Great blue herons, shorebirds, other small flocking birds, and raptors forage and loaf in the open grassy areas surrounding the approach to Runway 36 and frequently crossed runways to access these areas. Stabilizing the soil at the approach to Runway 36 would alleviate much of this bird activity, but would conflict with other environmental priorities on NASNI, such as burrowing owl and snowy plover nesting. Consequently, birds in this area should be monitored constantly and hazed when necessary. In addition, Navy Security should continue to patrol this area which keeps illegal foot traffic from disturbing the birds from the beach areas.

Gulls have historically used NASNI as a staging area prior to migration in late summer and early fall. An unusually large number of western gulls were observed on NASNI during this period, together with an increase in runway crossings. This spike might have been an anomaly, as we believe active WS dispersal and removal efforts greatly reduced the western gull population on NASNI since the inception of the BASH program in 1996.

The increase in rock doves is an indication that the population on NASNI is increasing. Rock doves have not been observed crossing runways which indicated they are using areas around the airfield that are not in close proximity to the runways. To insure populations remain low, we recommend strictly enforcing laws prohibiting the feeding of birds around the airfield and keeping populations in check by trapping. A large decrease in observed mourning dove numbers (72%) and runway crossings (83%) indicates that cutting weeds to remove food sources, especially when initiated early enough in the season, prevents the plants from producing seeds and subsequently attracting birds.

Individual small birds did not present a substantial hazard, but large flocks moving across runways presented a serious risk to aircraft safety. Linnell et al. (1996) described serious damage to aircraft caused by solitary zebra doves (*Geopelia striata*) on Kauai, Hawaii and cautioned against ignoring risks posed by small birds.

The great blue herons on NASNI decreased in overall numbers by 33%, and number of runway crossings decreased by 50%. However, these large birds (–5.5 lbs) still crossed runways during early morning and late afternoon as they departed or returned to their roosts in the Eucalyptus trees (*Eucalyptus* spp.) at the corner of Moffett Road and Roe Street. In addition, they move across runways as they forage at various locations throughout NASNI (e.g., approach end of Runways 29 and 36, and the open fields west of Compass Rose). All of the above pose a serious threat to aircraft. This species does not respond well to standard hazing techniques and removal of this possibly unique population in southern California has been discouraged. We suggest capturing and relocating these herons to a more suitable location away from NASNI.

Previous habitat modification efforts have successfully deterred birds from nesting and roosting near runways. However, as soil cementing that has been in place for less than two years deteriorates, continual monitoring will be essential for early detection of birds that reoccupy the modified areas.

MANAGEMENT RECOMMENDATIONS

1. The soil stabilization efforts on NASNI have been extremely successful in reducing nesting habitat for Western Gulls and hunting opportunities for raptors and great blue herons. This effort needs to continue. The sandy short-grass areas on the approach end of Runway 29, the Radar Fields south of 29, and the areas surrounding the approach end of Runway 36 all should be treated and stabilized. This is prime habitat for rodentia and lagomorphs that attract raptors and provide nesting habitat for gulls and other species of birds.

2. Devices to exclude gulls from nesting on building rooftops around NASNI need to be implemented. Effigies should be the most common technique used, as it seems to be very effective and is low in cost. Grid-wires, anti-perch devices, and other techniques could also be implemented to deter nesting, loafing, and roosting activities.

3. Remove Ramp 10. Gulls, cormorants, and pelicans regularly use this as a loafing area and can be seen flying over the helipads to roost and nest on adjacent buildings. If removal is not possible other options should be explored to exclude bird use (e.g., grid-wire).

4. Modify the concrete breakers in the bay adjacent to runway 18. Each breaker provides a safe haven for multiple gull nests during the breeding season. It is also a refuge for gulls escaping the pyrotechnics fired at them. Explore options to exclude bird use and nesting (e.g., grid-wire, predator and/or dead gull effigies).

5. Have all building managers report nesting of any species to the Natural Resources Office so the WS Specialist can be informed and address the issue.

6. Habitat alterations should be made to the areas north of the Weapons Compound to deter Great Blue Heron use. Consider a capture/relocation program to remove these birds from NASNI. Also, trees in the rookery should be thinned or removed to prevent roosting and nesting.

7. Enforce the ADo Not Feed The Wildlife@ base policy. All along the San Diego Bay side of Moffett Road, people intentionally leave food that attracts gulls and other wildlife. Signs stating the aforementioned should be posted and the consequences for the animals mentioned. To prevent unintentional bird feeding, all dumpsters and trash cans should remained covered.

8. Early initiation and continuous application of the program is key to success for the BASH program at NASNI. Set forth a protocol to insure budget and contract negotiations do not jeopardize the success of the program. A multi-year contract would be ideal.

9. Implement long-term dispersal techniques on the Weapons Pier. This could include use of distress tapes, sprinkler system, or noise makers.

10. Leave grid-wire systems on golf course ponds year around. Drain and fill ponds where grid-wire systems are difficult and/or impossible to install.

11. Initiate a large-scale removal project of European Starlings on NASNI. These birds can be observed in large numbers at certain times of the year. Trapping or the use of avicides are very effective control techniques for this species.

ACKNOWLEDGMENTS

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Figure 1. Bird survey stations on NASNI

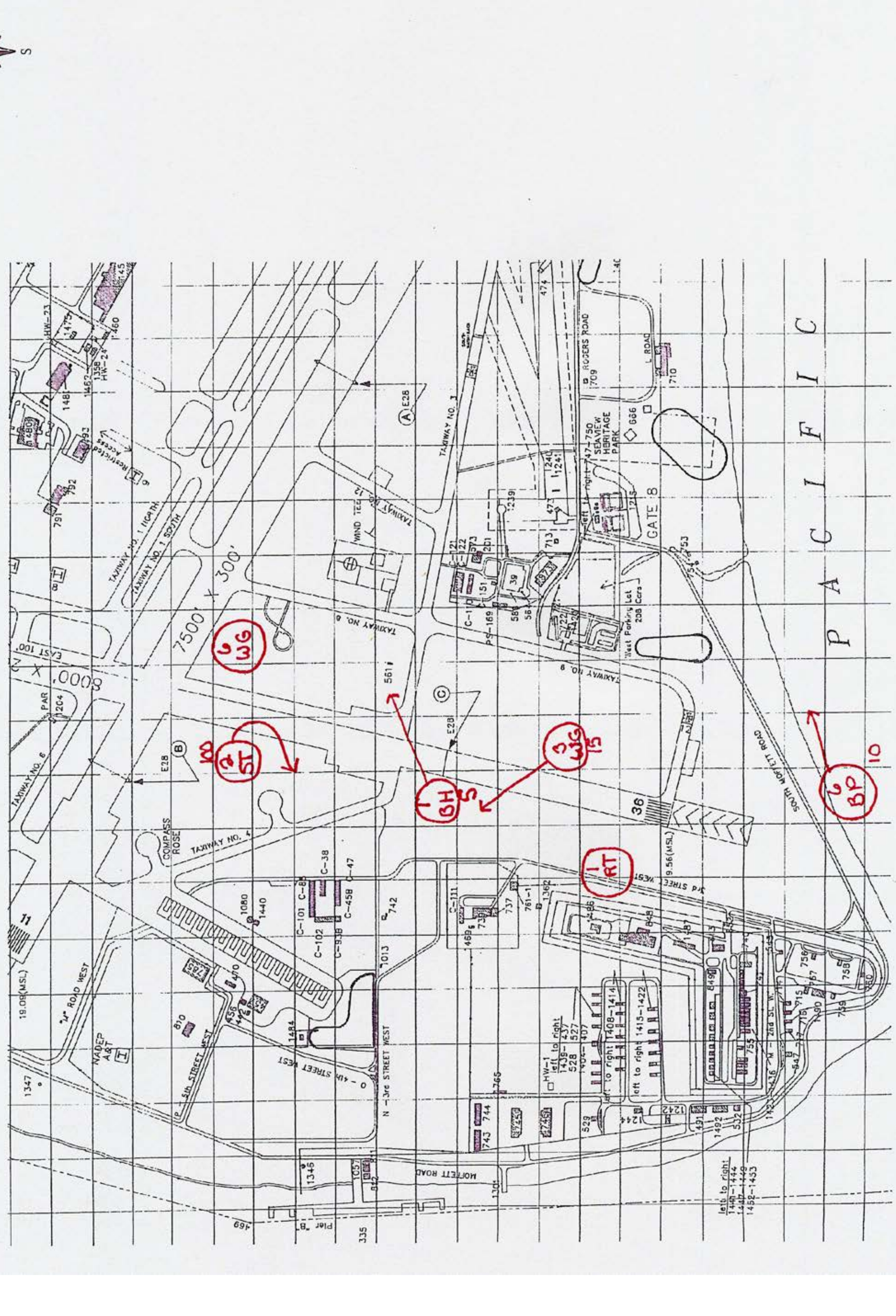
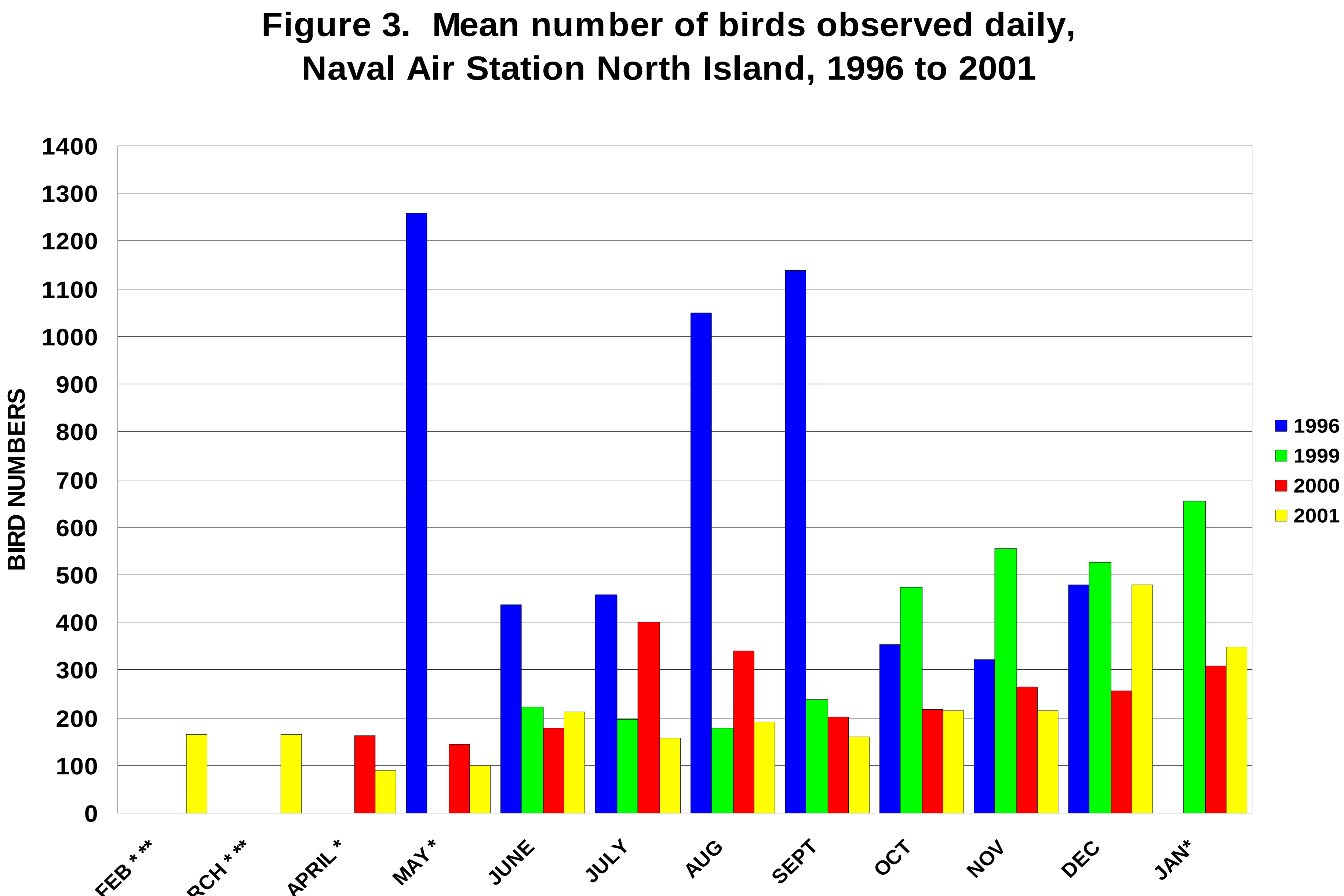
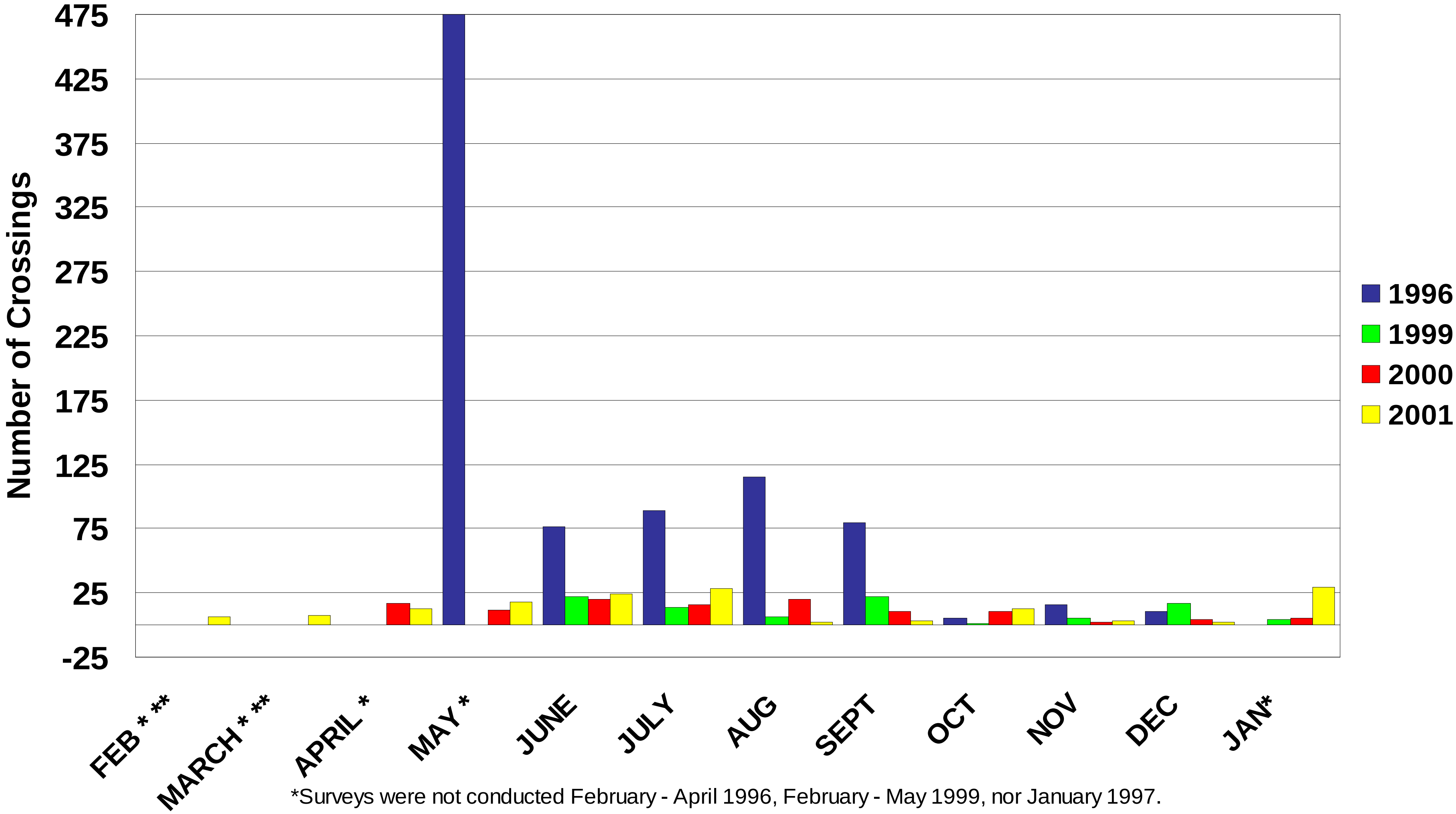


Figure 2. NASNI map demonstrating procedure used to record bird activity.



*Surveys were not conducted February - April 1996, February - May 1999, nor January 1997.
** Surveys were not conducted February through March 2000.

Figure 4. Mean number of observed daily runway crossings by birds, Naval Air Station North Island, 1996 through 2001.



*Surveys were not conducted February - April 1996, February - May 1999, nor January 1997.
** Surveys were not conducted February - March 2000.
Numbers of crossings May - September 1996 were 475, 76, 89, 115 and 80, respectively.

APPENDIX A

Appendix A. BASH airport data sheets used by Wildlife Services personnel to record details of all bird dispersals on NASNI.

BASH Airport Data Sheets

Name **Date** **Airfield** **#of pgs____**

time	location	#	species	action	#K	behavior	cover	ammo	#	comments

BEHAVIOR

Bd-bedding
Lf-loafing
Rs-roosting
Ns-nesting
Fg-foraging

Fl-flying
Cs-courtship
Dn-denning
None

COVER

Tsw-temp stand water
Lbw-large body water
Sbw-small body water
Shr-shrubs
Mar-marsh\wetland
Bch-beach

None
Twy-taxiway
Rwy-runway
Rmp-ramp
Asp-asphalt\concr.
Rrp-riprap

Unp-unpaved
Str-structure
Dtc-ditch
Gsh-grass short
Glg-grass long
Jty-jetty

APPENDIX B

Appendix B. Species of bird observed on NASNI during February 2001 through January 2002.

Common Name	**Scientific Name**
American Coot	*Fulica americana*
American Kestral	*Falico sparverius*
American White Pelican	*Pelecanus erythrorhynchos*
American Wigeon	*Anas Americana*
Barn Swallow	*Hirundo rustica*
Belted Kingfisher	*Ceryle alcyon*
Black-bellied Plover	*Pluvialis squatarola*
Black Phoebe	*Sayornis nigricans*
Black-crowned Night Heron	*Nycticorax nycticorax*
Blue-winged Teal	*Anas discors*
Brewer's Blackbird	*Euphagus cyanocephalus*
Brown Pelican	*Pelecanus occidentalis*
Bufflehead	*Bucephala albeola*
Burrowing Owl	*Athene cunicularia*
California Gull	*Larus californicus*
Caspian Tern	*Sterna caspia*
Cattle Egret	*Bubulcus ibis*
Cinnamon Teal	*Anas cynaoptera*
Cliff Swallow	*Hirundo pyrrhonota*
Common Loon	*Gavia immer*
Common Merganser	*Mergus merganser*
Common Raven	*Corvus corax*
Cooper's Hawk	*Accipiter cooperii*
Domestic Duck	
Double-crested Cormorant	*Phalacrocorax auritus*
Eared Grebe	*Podiceps nigricollis*
Elegant Tern	*Sterna elegans*
European Starling	*Sternus vulgaris*
Forster's Tern	*Sterna forsteri*
Garganey	*Anas querquedula*
Great Blue Heron	*Ardea herodias*
Great Egret	*Casmerodius albus*
Heermann's Gull	*Larus heermanni*
Horned Lark	*Eremophilia alpestris*
House Finch	*Carpodacus mexicanus*
Killdeer	*Charadrius vociferous*
Kingbird Sp.	*Tyrannus* spp.
Laughing Gull	*Larus atricilla*
Least Tern	*Sterna antillarum*
Lesser Scaup	*Aythya affinis*
Long-billed Curlew	*Numenius americanus*
Mallard	*Anas platyrhynchos*
Marbled Godwit	*Limosa fedoa*
Mourning Dove	*Zenaida macroura*
Northern harrier	*Circus cyaneus*
Northern Mockingbird	*Mimus polygottos*
Northern Shoveler	*Anas clypeata*
Osprey	*Pandion haliaetus*

Peregrine Falcon	*Falco peregrinus*
Pied-billed Grebe	*Podilymbus podiceps*
Red-tailed Hawk	*Buteo jamaicensis*
Ring-billed Gull	*Larus delawarensis*
Ring-necked Duck	*Aythya collaris*
Rock Dove	*Columbia livia*
Ross' Goose	*Chen rossii*
Royal Tern	*Sterna maxima*
Ruddy Duck	*Oxyura jamaicensis*
Sandpiper Sp.	*Limosa* spp.
Savannah Sparrow	*Passerculus sandwichensis*
Say's Phoebe	*Sayornis saya*
Snowy Egret	*Egretta thula*
Snowy Plover	*Chardrius alexandrinus*
Surf Scoter	*Melanitta perspicillata*
Western Grebe	*Aechmophorus occidentalis*
Western Gull	*Larus occidentalis*
Western Meadowlark	*Sturnella neglecta*
White-crowned Sparrow	*Zonotrichia atricapilla*
Willet	*Catoptrophorus semipalmatus*

Also identified, but not during observation period:

House Sparrow	*Passer domesticus*
Red-shouldered Hawk	*Buteo lineat*

APPENDIX 5: NASNI 2003 Cummings and Sheffer

FINAL REPORT
BIRD AIRCRAFT STRIKE HAZARD (BASH) MONITORING AND MANAGEMENT AT NAVAL AIR STATION NORTH ISLAND
2002

Prepared For: U.S. NAVY, NATURAL RESOURCES OFFICE,
COMMANDER NAVY REGION SOUTHWEST,
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FINAL REPORT
BIRD AIRCRAFT STRIKE HAZARD (BASH) MONITORING AND MANAGEMENT AT NAVAL AIR STATION NORTH ISLAND
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EXECUTIVE SUMMARY

Bird strikes to aircraft are a serious safety and economic problem in the United States, annually causing millions of dollars in damage to civilian and military aircraft and occasionally loss of human life. The Navy has experienced approximately 20,000 bird strikes since 1980 resulting in 2 deaths, 25 aircraft destroyed, and over $300 million in damage. It was on August 24, 1995 when an E-2 departing on runway 18 struck a large flock of western gulls (*Larus occidentalis)* roosting on the runway, killing over 100 birds and destroying the aircraft which initiated the start of a Wildlife Hazard Assessment at Naval Air Station North Island (NASNI). The National Wildlife Research Center (NWRC) conducted a wildlife hazard assessment (WHA) from 1996-1997 and have continued to monitor NASNI airfield for bird activity since 1999 to evaluate changes in bird numbers, locations and behavior resulting from Wildlife Services (WS) management activities and to determine additional measures that should be taken to reduce bird hazards at NASNI.

Bird observation in 2002 indicated that peak bird activity on the airfield occurred during August. The average daily number of birds using the airfield during this month was 730. Terns, including royal (*Sterna maxima*) and least terns (*Sterna antillarum californicus*) observed mainly near structures close to the approach of runway 18 accounted for about 54% and gulls, including western gulls, accounted for about 23% of the number of birds observed during August. The lowest bird activity occurred during February 2002, when an average of 105 birds was observed daily on the airfield. Western gulls, European starlings (*Sturnus vulgaris*), and house finches (*Carpodacus mexicanus*) were the most numerous bird species observed during the monitoring period.

The highest bird activity occurred during the AM observation period. Overall bird numbers during the 2002 monitoring period were lower than previous years. Specifically, western gull which still remain 42% lower than what was observed in 1996.

The number of runway crossings by birds was highest during May and June 2002. More than 60 runway crossings by birds were documented during each month. House finches and European starlings comprised 63% and 10% of birds observed crossing runways during May, and 43% and 27% of birds observed crossing runways during June, respectively. The lowest number of runway crossings occurred in December 2002 when an average of six birds were observed crossing runways. The greatest number of runway crossings occurred during the AM observation period.

During the monitoring period, six bird/aircraft strikes were reported to the Naval Safety Center which included two western gulls and four unidentified birds. In addition, NWRC personnel found nine dead birds during the monitoring period which were determined as bird/aircraft strikes. Of these, two were California least terns, one was a house finch, one was a juvenile mourning dove (*Zenaida macroura*), one was a European starling, one was a mallard (*Anas platyrhynchos*), one was a double-crested cormorant (*Phalacrocoax auritus*)and the remaining two were unidentified. All of these birds were found either on or in close proximity to the runways, and most were found on or near runway 18-36.

No birds were observed roosting on the runway, but there were three areas in close proximity to the airfield where birds were observed roosting. These areas were Zuniga Beach and Zuniga Point (west of runway 18-36) and the Weapon’s Pier (northwest of runway 11-29). The daily mean number of birds roosting in these areas was highest in August and September 2002 and lowest in February and March 2002.

Wildlife Services personnel dispersed 5,944 birds from the NASNI airfield using pyrotechnic devices and audio harassment. The most commonly dispersed species were western gulls, Heermann's gulls (*Larus heermanni*), mallards (*Anas platyrhynchos*), American coots (*Fulica americana*), and great blue herons (*Area herodias*). Western gulls and Heermann's gulls represented about 98% of all birds dispersed. The number of birds, chicks and eggs removed and/or destroyed in 2002 was 194. Of these, American coots, rock dove, and western gulls represent 41%, 18%, and 14% of the birds removed. Wildlife Services personnel worked 1,609 staff-hours on direct bird control activities on the NASNI airfield from February 1, 2002 to January 31, 2003.

In February 2002 Moral, Welfare and Recreation agreed to fill in the ponds on the golf course adjacent to runway 29 and convert them into "waste bunkers" eliminating the attraction to waterfowl. However, on July 15, 2002 Wildlife Services (WS), Commander Navy Region Southwest Natural Resources (NRO) and Morale, Welfare and Recreation (MWR) met to discuss the ponds and associated issues. At this time MWR informed Wildlife Services that the ponds would not be converted into waste bunkers as was previously agreed upon and would be relined in the future and the grid wire system would be reinstalled and maintained. On October 1, 2002, Wildlife Services, with assistance from MWR Golf Course personnel, completed construction of the grid wire system over all three ponds.

Two red-tailed hawks were captured, banded and translocated approximately 110 miles east of NASNI near El Centro, Imperial County, California. Neither of these hawks returned to NASNI.

Recommendations to reduce the bird aircraft hazards at NASNI are included in this report.

INTRODUCTION

Bird strikes to aircraft are a serious safety and economic problem in the United States, annually causing millions of dollars in damage to civilian and military aircraft and occasionally loss of human life (Cleary et al. 1999). The most significant military aircraft disaster caused by birds in the United States occurred at Elmendorf Air Force Base, Anchorage, Alaska on September 22, 1995, when an E-3 Sentry Airborne Warning and Control System aircraft ingested several Canada geese (*Branta canadensis*) on take off and crashed, killing 24 people. Since 1950, military aviation has experienced 353 documented serious accidents with a minimum of 165 fatalities (Transport Canada 2001). The Navy has experienced approximately 20,000 bird strikes since 1980 resulting in 2 deaths, 25 aircraft destroyed, and over $300 million in damage (Naval Safety Center 2002).

Naval Air Stations located along the coastal areas of the United States potentially have a greater chance for bird/aircraft strikes because of their location and the species of birds that are present on or around the airfield. Naval Air Station North Island is no exception; it is located on Coronado Island, situated adjacent to the Pacific Ocean and the San Diego Bay on two sides that make portions of the site attractive to birds. At Naval

Air Station North Island (NASNI), San Diego, California several bird strikes have been reported since the start of record keeping in 1980. It was on August 24, 1995 when an E-2 departing on runway 18 struck a large flock of western gulls (*Larus occidentalis)* roosting on the runway, killing over 100 birds and destroying the aircraft which initiated the start of a Wildlife Hazard Assessment at Naval Air Station North Island (NASNI).

Commander Navy Region Southwest, Environmental Department (CNRS ED) is responsible for providing environmental support for NASNI. The mission of CNRS ED is to provide guidance and technical expertise that will enhance mission readiness and ensure environmental compliance and protection to all fleet and tenant commands under their jurisdiction. In compliance with Title 14, Code of Federal Regulations (CFR), Part 139 (14 CFR 139) Section 139.337, ecological studies (wildlife hazard assessment) must be conducted at airports when aircraft have experienced multiple bird strikes, or wildlife are of a size or in numbers capable of causing damage to aircraft and they have access to airfield flight patterns or movement area. Further, OPNAV Instruction 3750.6R, Naval Aviation Safety Program (NASP) requires the enhancement of naval operational readiness by preserving the human personnel and material resources used in accomplishing naval aviation missions. An essential component of the NASP is the detection and elimination of aircraft hazards such as wildlife, specifically birds. In accordance with OPNAV Instruction 5090.1B CH-22, the Environmental Division or Natural Resource Section of a Naval Air Station is responsible for preparing and implementing a Bird Aircraft Strike Hazard (BASH) plan, following the outcome of an ecological study (wildlife hazard assessment).

The National Wildlife Research Center (NWRC) conducted a wildlife hazard assessment (WHA) from 1996-1997 and have continued to monitor NASNI airfield for bird activity since 1999 to evaluate changes in bird numbers, locations and behavior resulting from Wildlife Services (WS) management activities and to determine additional measures that should be taken to reduce bird hazards at NASNI. Wildlife Services (WS) management activities on NASNI have reduced the bird use of the airfield. For example, there were 15 documented bird/aircraft strikes between June 1996 and January 1997, compared to 6 reported bird strikes between June 1999 and January 2000, and 5 strikes between April 2000 and January 2001, for a reduction of about 60% (York et al. 2000, 2001). However from February 2001 and January 2002, fourteen bird strikes were documented (Sheffer et al. 2002). Gulls, specifically western gulls, were not involved in any known bird strikes in 1999 and 2000, and gulls represented only 14% of bird strikes in 2001, which represented a substantial change from 1996 when western gulls represented 77% of all reported bird strikes. There has also been a 95% reduction in gulls observed on the airfield since 1996 (York et al. 2000, York et al. 2001, Sheffer et al. 2002). Since 1996, runway crossings by all birds have significantly declined, specifically western gulls (Cummings and Foley 1997, York et al. 1996, York et al. 2000, York et al. 2001, Sheffer et al. 2002). The average number of daily runway crossings has decreased from 100 birds in 1996 to 10 in 1999, 13 in 2000, 14 in 2001 and 30 in 2002. This reduction in the number of runway crossings by birds, specifically western gulls, has reduced the potential hazard to aircraft operations on NASNI, and is a direct result of WS management practices on NASNI.

In addition to direct management practices to reduce the bird numbers and runway crossings, Cummings and Foley (1997) mapped all areas on NASNI that presented a risk to aircraft from bird strikes. Some areas that were designated as 'high risk' were modified in 1999 by soil cementing which eliminated 52 acres of gull nesting, loafing and foraging habitat at the approach end of runways 11 and 18. Soil cementing of this area also reduced ground squirrel habitat and activity which in turn reduced the number of overall avian predators (i.e. hawks, herons and gulls) using this area (York et al. 2000). This effort has greatly reduced the incident of runway crossings by all species of birds in these areas of the airfield. In addition, management efforts are still being conducted to reduce the number of American coots (*Fulica americana*) and other waterfowl using the golf course ponds near the approach end of runway 29.

Although overall bird use of NASNI has been reduced significantly, the presents of gulls (*Larus sp.*), great blue herons (*Ardea herodias*), raptors (*Buteo sp.*) and waterfowl (*Anas sp.*) still present a hazard to aircraft at various times during the year. The following are areas or species that are still a concern: an active heron rookery on base is a source for great blue herons which cross the runways, golf course ponds directly adjacent to runway 29 attract large numbers of American coots and waterfowl, gull nesting at various locations during the spring, and various raptor species hunting near active runways. The purpose of this BASH project was to continue to monitor bird activity at NASNI, identify potential bird/aircraft hazards, make recommendations to reduce potential bird/aircraft hazards and implement management strategies.

STUDY AREA

NASNI is a 2,865 acre air station located on Coronado Island, San Diego, California that has a number of naturally occurring characteristics that make portions of the site attractive to birds. NASNI is border on the north and west by the San Diego Bay, on the south by the Pacific Ocean and on the east by the city of Coronado. There are two runways on NASNI, runway 11-29 which runs in an approximate northwest-southeast alignment and runway 18-36 which runs in an approximate north-south alignment. Runway 11-29 is approximately 7500 feet by 300 feet and runway 18-36 is approximately 8000 feet by 200 feet. On NASNI there are vast areas of vegetative habitat, intermittent and permanent water sources, and flat open areas which support an array of wildlife. There were 158,016 air operations on NASNI in 2000, 159,596 air operations in 2001 (airfield was closed for one month following September 11th), and 152,524 air operations in 2002. The number of yearly air operations have remained fairly constant.

METHODS: MONITORING PHASE

Bird Use of NASNI

NWRC personnel conducted monthly bird surveys for three consecutive days on NASNI from February 2002 to January 2003. Counts of both live and dead birds were made from stations and transects associated with runways, and vantage points in areas which are attractive to birds. The following surveys were conducted:

<u>Station Counts</u>: NWRC used eight permanent stations established in 1996 that encompass the NASNI airfield for comparative purposes (Figure 1). A route that

connects each station was driven in the morning starting at sunrise and then reversed in the evening starting about two hours before sunset. Generally, each survey route took two hours to complete. Each day the starting location was alternated between Stations 1 and 8 in order to reduce time bias. Station counts were conducted for ten minute intervals. The number, species of birds and their activities (e.g. flying, feeding, loafing, roosting, etc.) within the stations boundaries, 1,000 feet in all directions from the observation point, were recorded. The location, direction of flight and altitude above ground level (AGL) of birds observed were recorded on the base map. Symbols and abbreviations were used to prevent over crowding the map with details. For example, 2 ST within a circle with an arrow pointing northeast from the circle and a number 42 on the outer edge of the circle indicated 2 European starlings were flying northeast at an estimated height of 42 meters AGL (Figure 2). A circle without an arrow or outside number indicated the bird was fixed at that location.

The mean number of birds on and around the airfield was calculated for morning and evening observations. The daily mean was determined for each month by adding together the number of birds observed each morning and evening from Stations 1 to 8 and dividing by six (two surveys per day times three assessment days). Mean bird numbers by station were calculated by totaling the number of birds observed from each specific station and time period and dividing by twelve (number of monthly surveys).

The mean number of runway crossings was determined for morning and evening observations. The daily mean was determined for each month by adding together the number of birds observed each morning and evening from Stations 1 to 8 and dividing by six (two surveys per day times three assessment days). For the entire assessment period, mean runway crossings by station were calculated by totaling the number of mean birds observed from a specific station and time period and dividing by twelve (number of monthly surveys).

Bird/Aircraft Strikes

During the station counts, NWRC personnel observed the runway and the overrun area for dead or injured birds. In addition, NWRC personnel searched the overrun areas at the approaches of runways 11, 29, 18 and 36 for dead or injured birds. All remains (e.g. feathers, bones and carcasses) were collected, identified, labeled, recorded and frozen. The location of each was recorded with a Geographic Positioning System (GPS) and mapped on the NASNI map. A BASH storage freezer located in the Berry Aviation building was used for remains found by NASNI personnel. All birds were recovered under a U.S. Fish and Wildlife Collecting/Salvage Permit (#MB693188-0) issued to NWRC.

NWRC personnel recorded the number of bird/aircraft strikes which occurred at NASNI during the study. A strike was defined as one or more birds found intact, and/or remains found at a location on the airfield. If possible, the type of aircraft was identified from records of flight operations.

Roosting Surveys

NWRC personnel searched the airfield and surrounding areas after evening surveys for roosting birds. The species, number and location of roosting birds was recorded.

Interviews

NWRC personnel conducted interviews with expert and authorities as necessary to accomplish the Wildlife Hazard Assessment, i.e. contacted NASNI Aviation Safety Officer regarding bird strikes at NASNI.

Environmental Conditions

Environmental conditions were not controlled. Observations were conducted in variable weather conditions (e.g. fog, rain, windy, clear).

Records

A map of the NASNI airfield and surrounding areas was used for recording observational data (location, species, and activity of birds). One map was used for each separate observation period (four maps per day). On each map, observers recorded the date, time of day the observations began and ended, name of observer(s), prevailing weather conditions and other pertinent notes. Map data was transposed onto computer spreadsheets, which was used to tabulate data and create graphs. Detailed notes of daily observer activities were kept in notebooks. The study protocol and any amendments were kept, as well as relevant correspondence between study participants and/or cooperators.

METHODS: MANAGEMENT PHASE

WS Bird Dispersal

WS implemented bird management activities on NASNI beginning February 1, 2002. The type of techniques used to disperse birds were dependent on the species, location, bird activity, time of day and the level of threat the bird posed to aircraft. In addition, the following decision making model was used to choose the appropriate dispersal technique: first, if the birds were dispersed, would the problem be solved; second, were they resident birds which would continually return, post-dispersal; and third, were they birds that would not disperse even after hazing.

Multiple tools and techniques were used for bird dispersal which included hand-held pyrotechnics, spotlights, hazing with a vehicle, electronic distress calls, shooting, and dead gull effigies. All dispersal efforts during airfield operation hours were coordinated with the NASNI Air Traffic Control Tower and Navy Security via radio communications. The species and number of birds were recorded prior to each bird dispersal operation. The actual number of birds hazed and pyrotechnics fired were recorded on Airport Data Sheets (Figure 21). During 2002, the need for propane cannons (Reed Joseph International, model M-8) was not warranted. Pyrotechnic devices (Sutton Ag. Enterprises) fired from a specialized, double-barreled pistol were most often used to disperse birds from the NASNI airfield. Pyrotechnics were specifically used to disperse birds from loafing on Ramp 10, and areas along Moffett Road. Also, weapons personnel approved the use of pyrotechnics to disperse roosting gulls from the Weapons Complex which included the pier and perimeter road. Pyrotechnics were only used on the Weapons Pier when the red flag was down and ordnance was not being unloaded or transported.

Vehicle and spotlight hazing were implemented in areas designated too sensitive for pyrotechnics. These areas included the Fuel Farm and Weapons Magazines. These techniques were also implemented throughout the NASNI airfield to augment the dispersal affect of pyrotechnics. To discourage gull loafing on roof tops, dead gull effigies were placed on buildings that were known gull loafing locations, e.g. Building 805.

Pyrotechnics were used to disperse waterfowl, typically American coots and mallards, from the golf course ponds to the north of the approach end of Runway 29. Hazing efforts ceased at 0730 hours due to the start of normal air operations, the arrival of golfers on the course, and the risk of dispersing waterfowl from the ponds, which was deemed too risky to air operations since the birds could possibly cross the approach to Runway 29 or Runway 11-29. On January 18, 1999 a grid-wire system was constructed over two of the golf course ponds adjacent to the approach to Runway 29. The grid-wire system was designed to reduce the number of waterfowl, specifically American coots and American wigeons from utilizing the ponds when other control activities could not be implemented. The grid-wire systems were removed from the golf course ponds during February 2002 because of fluctuating water levels which allowed American coots and other waterfowl to swim under or over the wires. Also in February 2002 Moral, Welfare and Recreation agreed to fill in the ponds at the golf course and convert them into "waste Bunkers" eliminating the attraction to waterfowl. On July 15, 2002 Wildlife Services (WS), as well as Commander Navy Region Southwest Natural Resources (NRO) and Morale, Welfare and Recreation (MWR) met to discuss the ponds and associated issues. At this time MWR informed Wildlife Services that the ponds would not be converted into waste bunkers as was previously agreed upon and would be relined in the future. During this meeting it was decided that the grid wire system would be reinstalled and maintained until the ponds would be relined. On October 1, 2002 Wildlife Services, with assistance from MWR Golf Course personnel, completed construction of the grid wire system over all three ponds. This year the system was improved as a 12” poultry fencing was used to surround the ponds to deter waterfowl from walking into the water and the grid pattern over the water was tightened to 10’ by 10’ squares which would help in deterring waterfowl from utilizing the ponds.

WS Bird Removal

Lethal control of birds on the NASNI airfield was implemented when other methods were ineffective or there was a perceived threat to aircraft safety. The objectives for lethal control were to reduce overall population levels of certain bird species causing a potential bird/aircraft hazard, and to reinforce the bird hazing program. All weapons used for bird control activities on NASNI were registered with security and used only when conditions were safe and in accordance with the Navy and WS regulations and policy. All shooting events were coordinated with the NASNI Tower and Navy Security. When shooting events occurred within the Weapons Compound, all procedures previously set forth were followed. Several methods were used to lethally remove gulls, rock doves (*Columba livia*) and waterfowl on or around the NASNI airfield which included shooting with 12 gauge shotguns (2 ¾” and 3” shells, utilizing #4 and #6 bird shot), .177 caliber air guns, and .22 caliber rifles using subsonic ammunition (CCI CB Longs), the use of rock dove traps, nest destruction, alpha chloralose (AC) baiting, Bal-chatri traps, pole traps, decoy traps and hand capture. Alpha chloralose is a tranquilizing drug not intended for use as a pesticide and may be administered only by trained USDA/APHIS/WS personnel or FDA-approved and trained pest control operators in accordance with the FDA label and WS policy. Captured birds were euthanized by

CO_2 inhalation under American Veterinary Medical Association guidelines (AVMA 1993).

Removal of waterfowl from the golf course with AC was approved and scheduled in advance with Natural Resources Office (NRO), Public Affairs Office, and golf course personnel. On August 19, 2002 resident domestic, non-migrating waterfowl were pre-baited with untreated cracked-corn adjacent to the ponds. On September 17, 2002 an alpha-chloralose project was completed to capture and remove the waterfowl using golf course ponds, prior to the installation of the grid wire system.

Raptor Translocation

Translocation of live-captured raptors on NASNI was allowed under a U.S. Navy depredation permit issued to Tammy Conkle (permit # MB746332-0), and banding was allowed under NWRC's banding permit (U.S. Fish and Wildlife Service Bird Banding Laboratory: Permit #8567). WS, under NWRC's guidance, initiated efforts to translocate resident and migrating raptors that were a threat to aircraft safety. Raptors were caught with a Bal-chatri trap, banded, held in captivity until conditions were appropriate for release, and translocated 110 miles east of NASNI. The time held and distance released were based on data from past translocation efforts from NASNI (York et al. 2000).

RESULTS: MONITORING PHASE

Bird Use of NASNI

Seventy bird species were observed on NASNI during the 2002 monitoring period (Table 1). Bird observations indicated peak bird activity on the airfield (all stations) occurred during August 2002. The average daily number of birds using the airfield during this month was 730 (Figure 3). Terns, including royal (*Sterna maxima*) and least terns (*Sterna antillarum californicus*) observed mainly near structures close to the approach of runway 18 accounted for about 54% and gulls, including western gulls, accounted for about 23% of the number of birds observed during August. The lowest bird activity occurred during February 2002, when an average of 105 birds was observed daily on the airfield (Figure 3). Western gulls, European starlings (*Sturnus vulgaris*), and house finches (*Carpodacus mexicanus*) were the most numerous bird species observed during the monitoring period (Figure 4). The highest bird activity occurred during the AM observation period (Figure 5).

Observations by station indicate that station 5 had the highest bird activity and station 4 had the lowest bird activity (Figure 6). Western and Heermann's (*Larus heermann*) gulls accounted for the majority of the birds observed at station 5 during the monitoring period. In addition, station 3 and 6 also had relatively high bird activity. European starlings were the most abundant birds observed at station 3 and western gulls were the most abundant birds observed at station 6 (Figure 7). The peak daily mean number of birds by station varied during the monitoring period. For example, peak bird numbers for station 1 averaged 54 and occurred during July and for station 5 peak bird numbers averaged 168 and occurred during August (Figure 8).

Overall bird numbers during the 2002 monitoring period were lower than previous years, except during August 2002 (Figure 9). During this month the number of birds was much higher than the previous years due to an increase in the number of gulls, terns and starlings. Specifically, western gull numbers have shown an increase since 1999 but numbers are still 42% lower than what was observed in 1996. Terns have (elegant and Forster's) increased six-fold since 1999. European starlings have increased dramatically since 1996, from zero to 357 mean birds observed daily in 2002.

Overall, stations 3 and 5 had the highest bird activity from 1996 through 2002, except in 1996 when station 7 had the highest bird activity. The high number of birds at station 7 was attributed to western gulls loafing on the approach of runway 29. Bird activity has decreased from 1996 to 2002 at stations 1, 3, 6, 7, and 8 while it has increased at stations 2, 4, and 5.

The number of runway crossings by birds was highest during May and June 2002. More than 60 runway crossings by birds were documented during each month (Figure 10). House finches and European starlings comprised 63% and 10% of birds observed crossing runways during May, and 43% and 27% of birds observed crossing runways during June, respectively. The lowest number of runway crossings occurred in December 2002 when an average of six birds were observed crossing runways (Figure 10). The greatest number of runway crossings occurred during the AM observation period (Figure 12).

Observations by station indicate that station 3 had the greatest number of crossings and station 5 and 6 had the lowest number of crossings (Figure 13). In addition, station 8 also had a relatively high number of runway crossings. European starlings and house finches were the most abundant species crossing the runway at station 3 and willets were the most abundant species crossing the runway at station 8 (Figure 14). The peak daily mean number of runway crossings by station varied during the monitoring period. For example, peak number of runway crossings for station 1 averaged 42 and occurred during May and for station 3 peak bird numbers averaged 173 and occurred during June (Figure 15).

Overall, although numbers have fluctuated from 1996 to 2002, runway crossings during the 2002 monitoring period have decreased over prior years (Figure 16). Specifically, western gull runway crossings greatly decreased from a daily average of 42 in 1996 to three in 2002, a 93% decrease.

Overall, runway crossings during the AM observation period have increased from prior years (Figure 17). In May 2002, the number of crossings was much higher than previous years due to an increase in the number of house finches and common ravens observed crossing the runways. In August 2002, the numbers were much higher than previous years due to an increase in the number of house finches, European starlings, and barn swallows observed crossing the runways. House finch crossings increased from zero to 160 from 2000 to 2002 in May (no data from 1996 and 1999), and from zero to 40 from 2000 to 2002 in August (no data from 1996 and 1999). Common raven (*Corvus corax*) crossings increased from three in 24 from 1996 to 2002 in May. European starling crossings increased from zero to 13 from 1999 to 2002 in August 2002 (no data from 1996). Overall, runway crossings during the PM observation period have decreased from prior years (Figure 18).

In May, July and September 2002, the number of crossings was much lower than previous years, which was attributed to continual wildlife hazing techniques and removal of problem bird species by Wildlife Services personnel. Specifically, western gull runway crossings during May decreased from 462 in 1996 to 1 in 2002, decreased in July from 83 in 1996 to 15 in 2002, and decreased in September from 73 in 1996 to 12 in

2002. However, in these same months, European starling numbers increased from 4 to 17 in May, zero to 8 in July and zero to 48 in September from 1996 to 2002, respectively.

Bird/Aircraft Strikes

During the monitoring period, six bird/aircraft strikes were reported to the Naval Safety Center which included two western gulls and four unidentified birds (Table 2). The western gull strikes occurred in April and the unidentified bird strikes occurred in July, December and January (Table 2). Of the six strikes, five involved helicopters that were departing, parking, and/or flying over the channel in the San Diego Bay, and one involved an S-3 on a short final approach to runway 18. Five of the bird/aircraft strikes occurred between 1430 and 2400 hours (Table 2).

In addition, NWRC personnel found nine dead birds during the monitoring period which were determined as bird/aircraft strikes (Table 3). Of these, two were California least terns, one was a house finch, one was a juvenile mourning dove (*Zenaida macroura*), one was a European starling, one was a mallard (*Anas platyrhynchos*), one was a double-crested cormorant (*Phalacrocoax auritus*)and the remaining two were unidentified. All of these birds were found either on or in close proximity to the runways, and most were found on or near runway 18-36 (Table 3).

Roosting Bird Surveys

No birds were observed roosting on the runway, but there were three areas in close proximity to the airfield where birds were observed roosting. These areas were Zuniga Beach and Zuniga Point (west of runway 18-36) and the Weapon's Pier (northwest of runway 11-29). The daily mean number of birds roosting in these areas was highest in August and September 2002 and lowest in February and March 2002

(Figure 19). Overall, western gulls (34%), Heermann's gulls (28%), California brown (*Pelecanus occidentalis*) pelicans (14%) and sanderlings (9%) were the most frequently observed species roosting at areas around the NASNI airfield. Of the birds observed on Zuniga Beach, western gulls represented 48%, sanderlings represented 21%, Heermann's gulls represented 12%, and marbled godwits represented 5% (Table 4). Of the birds observed on Zuniga Point, California brown pelicans represented 33%, western gulls represented 31% and Heermann's gulls represented 16% (Table 4). Of the birds observed on Weapon's Pier, Heermann's gull represented 78%, western gull represented 14%, and California brown pelicans represented 5% (Table 4). Movements of these birds are generally restricted to open water or along the coastline just above water level. However, on occasion several of these species have been observed flying over the flight path of departing or landing aircraft.

RESULTS: MANAGEMENT PHASE

WS Bird Dispersal and Removal

Wildlife Services personnel dispersed 5,944 birds from the NASNI airfield using pyrotechnic devices and audio harassment. The most commonly dispersed species were western gulls, Heermann's gulls (*Larus heermanni*), mallards (*Anas platyrhynchos*), American coots (*Fulica americana*), and great blue herons (*Area herodias*) (Table 5). Western gulls and Heermann's gulls represented about 98% of all birds dispersed.
The number of birds, chicks and eggs removed and/or destroyed in 2002 was 194 (Table 6). Of these, American coots, rock dove, and western gulls represent 41%, 18%, and 14% of the birds removed, respectively (Table 6). Most birds removed were shot,

however, 14 mallards and five American coots were removed in October as part of an AC project on the golf courses. Wildlife Services personnel worked 1,609 staff-hours on direct bird control activities on the NASNI airfield from February 1, 2002 to January 31, 2003. These staff-hours represent only time spent in the field and did not include time spent repairing and maintaining equipment, writing reports, attending meetings, or providing oversight.

Waterfowl on Golf Course Ponds

Migratory waterfowl (American coots, American wigeon, and mallards) generally arrive at NASNI in October and depart in February. While wintering at NASNI they use the golf course ponds and surrounding turf adjacent to the approach of Runway 29 for loafing and foraging. In the past, a grid-wire system was utilized to reduce the number of waterfowl, specifically American coots and American wigeons from using the ponds when other control activities could not be implemented. In February 2002, the grid-wire system was removed from the golf course ponds because of fluctuating water levels and lack of maintenance which allowed American coots and other waterfowl to swim under or over the wires making them ineffective. Also in February 2002 Moral, Welfare and Recreation agreed to fill in the ponds at the golf course and convert them into “waste Bunkers” eliminating the attraction to waterfowl. However, on July 15, 2002 Wildlife Services (WS), as well as Commander Navy Region Southwest Natural Resources (NRO) and Morale, Welfare and Recreation (MWR) met to discuss the ponds and associated issues. At this time MWR informed Wildlife Services that the ponds would not be converted into waste bunkers as was previously agreed upon and would be relined in the future. During this meeting it was decided that the grid wire system would be reinstalled and maintained until the ponds would be relined. On October 1, 2002, Wildlife Services, with assistance from MWR Golf Course personnel, completed construction of the grid wire system over all three ponds. This year the system was improved as a 12” poultry fencing was used to surround the ponds to deter waterfowl from walking into the water and the grid pattern over the water was tightened to 10’ by 10’ squares which would help in deterring waterfowl from utilizing the ponds. At this time MWR agreed to maintain the water levels in the ponds to allow the grid wire system to be effective.

Raptor Translocation

Two red-tailed hawks were captured, banded and translocated approximately 110 miles east of NASNI near El Centro, Imperial County, California (Table 7). Neither of these hawks returned to NASNI.

DISCUSSION

Birds on and around the NASNI airfield represent an aviation safety risk to aircraft operations. Every reasonable effort should be made to discourage birds from using NASNI habitat within the primary surface area of the airfield. Particular emphasis should be made to discourage birds from using habitat around and/or crossing the area near the approach to runway 29 and the area northeast of the approach to runway 18. This habitat attracts a wide variety of species. Of the birds observed on NASNI, house finches, European starlings and western gulls present the greatest risk to pilots and aircraft. An integrated management strategy directed at these species and others would have a large impact on aircraft safety and should be directed at the species itself, its foraging source and its loafing/roosting habitat. Elimination of the golf course ponds near the approach to runway 29 and bird hazing at the approach to runway 18 could be the most effective measures to reduce the bird hazard on NASNI.

Observations by station indicated that station 5 had the highest number of birds observed, but the lowest number of birds crossing the runway. This is due to the fact that this station is adjacent to the San Diego Bay and many birds are observed flying along the coastline, but never seen crossing over into the airfield. Birds are generally one meter above ground as they fly along the coastline, but occasionally do fly at higher altitudes. While they usually remain off the airfield, they pose a risk to helicopters and other aircraft departing or landing on helipad 3 and runway 18-36, respectively.

While western gulls are still observed on the airfield, their numbers are far lower than when monitoring first began on NASNI in 1996. Mean daily numbers observed were 453 in 1996 as compared to 48 in 2002; mean daily number of runway crossings were 42 in 1996 as compared to 3 in 2002. Western gulls use of the NASNI airfield has been reduced significantly which is attributed to non- and lethal control, hazing, the use of effigies and elimination of nesting, loafing, foraging and roosting areas. However, it appears several species of terns have taken advantage of this open niche. Tern numbers have greatly increased over previous years – they represented 18% of species observed in 2002, and only 3% in 1996. Terns observed on or around the airfield were almost exclusively observed either along the coastline of the San Diego Bay at station 5, 6 and 7, or in areas on the outskirts of the airfield near station 8. These birds because of their location do not pose a great risk to aircraft operations.

Data gathered from the management and monitoring indicates that habitat management, direct population control and innovative management techniques on NASNI should significantly reduce the bird/aircraft hazard.

Direct population control will be an effective short-term solution to reducing the bird/aircraft hazard at NASNI. Individual species could be targeted for management based upon their level of bird/aircraft strike risk. Removal of European starlings and house finches especially just before and during the breeding season would be most beneficial since they pose the greatest problem at NASNI. Management of individual species should be based on population numbers, presence, movement patterns, size, weight, activities and habitat preference. Dispersing western gulls using gull effigies has been successful in the past and efforts should be continued in areas around the airfield where the gulls congregate for foraging, loafing, or roosting. Dispersing birds with hazing techniques or developing innovative control measure to manage the bird/aircraft hazard at NASNI will require significantly more logistical support for a longer duration.

NASNI operates continuously from Monday at 0630 hours through Friday at 2200 hours, and Saturday and Sunday from 0800 to 2200 hours. NASNI supports nearly every type of aircraft in the Department of Defense inventory which consists of propeller and jet aircraft as well as helicopters. The greatest bird activity was during August 2002. During this time, efforts such as pyrotechnics and hazing techniques should be taken to decrease the number of birds on and around the airfield. The birds generating the greatest risk on NASNI are, in descending order, western gulls, European starlings and house finches. Removal of loafing, foraging and nesting habitat from the vicinity of the airfield by the above management techniques would greatly decrease the bird/aircraft strike hazard. Although two of these bird species are small in size, they are capable of causing damage to aircraft. In fact, European starlings are considered "feathered bullets" as they have a body density 27% higher than herring gulls and a flock of European starlings caused a C-130 military aircraft to crash in Eindhoven, Netherlands in 1996, killing 34 people. Western gulls represent 14%, European starlings represent 7% and house finches represent 7% of NASNI strikes that were either reported to the safety officer or found by NWRC personnel.

The AM observation periods had the greatest daily activity during the monitoring period. However, 83% of strikes reported at NASNI to the safety officer occurred from 1430-2400 hours. Many of these strikes occurred over the Pt. Loma Channel. Nightly monitoring surveys may need to be conducted to evaluate bird/aircraft strike risk during nighttime operations on and around the NASNI airfield, however, evaluating the risk over the channel could be quite difficult.

Stations 3 and 5 had the greatest daily activity, but many of the birds at Station 5 were observed in the San Diego Bay, not directly associated with the airfield. The greatest overall risk to aircraft operations is near Station 3 (approach to runway 29), where most bird runway crossings occur. Filling in the golf course ponds, trapping the small passerines in this area, and installing anti-perching devices to any structures would greatly reduce bird use of this area.

The greatest number of daily runway crossings occurred from March through June 2002, with peak months being May and June 2002. During these months, efforts such as pyrotechnics and hazing techniques should be taken to decrease the number of birds on and around the airfield. The birds generating the greatest risk to aircraft regarding runway crossings on NASNI are, in descending order, house finches, European starlings, and western gulls. Thirteen percent of strikes have been found on runway 11-29 or the approach to runway 11-29 near Station 3, and 13% of strikes have been found on runway 18-36 or the approach to runway 18-36 near Station 5. These strikes have involved small to large birds, including mallards and western gulls.

No strikes were reported on great blue herons, but these birds do present a risk to aircraft because of there size and they have been observed crossing the airfield to and from roosting areas. Gull species also present some risk to aircraft when crossing the airfield from roosting to foraging areas.

MANAGEMENT RECOMMENDATIONS

1. Develop a bird/aircraft strike hazard plan. The plan is currently being produced. It will outline procedures and set forth guidelines to address bird/aircraft strikes at NAS North Island. An outline in cooperation with NASNI, Tammy Conkle, BASH Project Manager has been developed.

2. Implement a habitat management plan.

- Prioritize bird hazard areas on NASNI. We have prioritized these areas based upon runway crossings, bird use, and bird strike locations.
- Restructuring golf course ponds by filling in and moving to other locations to reduce the attractiveness to waterfowl.

- Remove all unnecessary structures, junk, and debris on and around the airfield (specifically the Federal Fire Department and Compass Rose graveyard) that is used by birds for loafing.
- Install anti-loafing devices on structures remaining on or near the airfield, including buildings, equipment, markers and lights on the airfield and radar towers.
- Close lids of trash dumpsters around the airfield and on the base.

3. **Continue to monitor and review BASH activities at NASNI.** Continue ongoing monitoring activities of wildlife by NASNI personnel. Apply these monitoring activities to high risk areas identified in this report.

4. **Develop high bird strike hazard airfield operation procedures.** Develop a set of operational procedures for air traffic that takes into account risk of bird strikes based on seasonal and daily variability in numbers of birds, species present and historic estimates of runway crossings based upon existing and future monitoring data.

5. **Provide information to all aircrews about current bird hazards at NASNI.** This report should be distributed to all personnel involved with aircraft with aircraft and airfield operations. It should be a priority to have pilots, air operations, and ground personnel report any bird/aircraft related incidents, i.e. blood on the aircraft, bird parts on the runway or taxiway, damage to the aircraft, etc.

Documentation is the key to increased safety.

6. **Implement a no bird/mammal feeding program.** Post no feeding signs at the air terminal and surrounding buildings. The signs should discuss the hazard. Police outside break and lunch areas for trash. Trash bins and dumpsters should always remain closed.

7. **Implement a species specific population control program.** Emphasis should be on small flocking birds. Use of techniques identified in this report and lethal control actions should be used to reduce runway crossing by species of concern.
   - Lethal control for populations of European starlings and house finches, when and where it can be legally implemented with traps.
   - Non-lethal control, removal, and dispersal when it is practical and effective using lasers, traps, mechanical devices and pyrotechnics.

8. **Continue to employ a wildlife specialist to implement and monitor BASH activities.**
9. **Train Navy personnel in wildlife hazing procedures and species identification.**
10. **Adopt a policy of zero tolerance toward hazardous wildlife within the PSA.**
11. **Discourage restoration or remediation of habitat adjacent to the airfield for endangered or threatened species.**
12. **Concentrate hazing efforts within the PSA.**

13. Wildlife specialist should continue to updates the installation ASO on BASH threats and program activities.

ACKNOWLEDGEMENTS

We thank the U.S. Navy for their support on this project. A special thanks to Lts. M. Wettstein and D. Liebmann, T. Conkle, S. Barnhill, J. Johns, D. Flynn, and J. Larson for their support. Thanks to B. Stewart, U.S. Department of Agriculture, Wildlife Services for their assistance.

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York, D.L., J.L. Cummings, K.C. Lansford, and J.W. Turman. 2001. Bird/aircraft strike hazards (BASH) management and monitoring at Naval Air Station North Island, San Diego, California: 2000. USDA National Wildlife Research Center Technical Paper 00-1.

Table 1. Species of birds observed on or around Naval Air Station North Island during February 2002 through January 2003. Species names obtained from National Geographic's Field Guide to the birds of North America, Third Edition.

Common Name	**Scientific Name**
American Coot	*Fulica americana*
American Crow	*Corvus brachyrhynchos*
American Kestrel	*Falco sparverius*
American Wigeon	*Anas americana*
Barn Swallow	*Hirundo rustica*
Belted Kingfisher	*Ceryle alcyon*
Black Phoebe	*Sayornis nigricans*
Black-bellied Plover	*Pluvialis squatarola*
Black-crowned night heron	*Nycticorax nycticorax*
Brewer's Blackbird	*Euphagus cyanocephalus*
Bufflehead	*Bucephala albeola*
Burrowing Owl	*Athene cunicularia*
California Brown Pelican	*Pelecanus occidentalis californicus*
California Gull	*Larus californicus*
California Least Tern	*Sterna antillarum californicus*
Caspian Tern	*Sterna caspia*
Cliff Swallow	*Hirundo pyrrhonota*
Common Loon	*Gavia immer*
Common Raven	*Corvus corax*
Cooper's Hawk	*Accipiter cooperii*
Double-crested Cormorant	*Phalacrocorax auritus*
Eared Grebe	*Podiceps nigricollis*
Elegant Tern	*Sterna elegans*
European Starling	*Sturnus vulgaris*
Forster's Tern	*Sterna forsteri*
Great Blue Heron	*Ardea herodias*
Gull-billed Tern	*Sterna nilotica*
Heermann's Gull	*Larus heermanni*
Herring Gull	*Larus argentatus*
Horned Grebe	*Podiceps auritus*
Horned Lark	*Eremophila alpestris*
House Finch	*Carpodacus mexicanus*
House Sparrow	*Passer domesticus*
Killdeer	*Charadrius vociferus*
Loggerhead Shrike	*Lanius ludovicianus*
Long-billed Curlew	*Numenius americanus*
Long-billed Dowitcher	*Limnodromus scolopaceus*
Mallard	*Anas platyrhynchos*

Marbled Godwit	*Limosa fedoa*
Mourning Dove	*Zenaida macroura*
Northern Mockingbird	*Zenaida macroura*
Northern Mockingbird	*Mimus polyglottos*
Northern Shoveler	*Anas clypeata*
Osprey	*Pandion halieatus*
Peregrine Falcon	*Falco peregrinus*
Pied-billed Grebe	*Podilymbus podiceps*
Purple Finch	*Carpodacus purpureus*
Red-breasted Merganser	*Mergus serrator*
Red-tailed Hawk	*Buteo jamaicensis*
Redhead	*Aythya americana*
Red-winged blackbird	*Agelaius phoeniceus*
Ring-billed Gull	*Larus delawarensis*
Red-breasted Merganser	*Mergus serrator*
Rock Dove (Pigeon)	*Columba livia*
Royal Tern	*Sterna maxima*
Ruddy Duck	*Oxyura jamaicensis*
Sanderling	*Calidris alba*
Sandpiper spp.	*Limosa* spp.
Say's Phoebe	*Sayornis saya*
Snowy Egret	*Egretta thula*
Spotted Sandpiper	*Actitis macularia*
Surfbird	*Aphriza virgata*
Surf Scoter	*Melanitta perspicillata*
Western Grebe	*Aechmophorus occidentalis*
Western Gull	*Larus occidentalis*
Western Kingbird	*Tyrannus verticalis*
Western Meadowlark	*Sturnella neglecta*
Western Snowy Plover	*Charadrius alexandrinus nivosus*
Whimbrel	*Numenius phaeopus*
Willet	*Catoptrophorus semipalmatus*

Table 2. Strikes reported to the safety officer on Naval Air Station North Island, San Diego, California, during the management and monitoring from February 2002 through January 2003.

Date	**Time**	**Species**	**No.**	**Aircraft**	**Location**
April 29, 2002	2345	Western gull	1	CH-46	Helo stopped to park; rotors were engaged
April 30, 2002	1730	Western gull	1	HC-3	Near Helopad 3
July 12, 2002	1435	Unknown bird	1	S-3	App. to RW 18
July 17, 2002	2230	One large or two small unknown birds (violet-green swallow)	1-2	MH-60	Channel south of Pt. Loma
Dec. 10, 2002	unk	Unknown seabird	1	SH-60	Channel North of Helopad 3
Jan. 21, 2003	1900	Unknown bird	1	SH-60	Mid-Pacific Ocean

Table 3. Birds found on Naval Air Station North Island, San Diego, California, during the management and monitoring from February 2002 through January 2003 that were determined to be strikes.

Date	**Time**	**Species**	**No.**	**Location**
May 13-17, 2002	unk	Small unknown bird	1	RW 18-36 at Charlie Gear
June 10, 2002	0700	House finch	1	App to RW 36
June 19, 2002	0710	Mourning dove (juv)	1	RW 18-36; Delta Gear
July 15, 2002	unk	California least tern	1	RW 18-36; Delta Gear
Aug. 2, 2002	unk	California least tern	1	Midpoint on Taxiway L
Sept 9-13, 2002	unk	Small unknown bird	1	RW 11-29 at Alpha Gear
Sept 27, 2002	1015	Mallard (adult female)	1	Overrun area at app to RW 29
Nov. 4-8, 2002	unk	European starling (decapitated)	1	Near fuel farm on RW 18-36
Jan. 22, 2003	0950	Double-crested cormorant (decapitated)	1	Overrun area at app to RW 36

Table 4. Mean daily number of birds roosting on various areas around Naval Air Station North Island, San Diego, California, during the Management and Monitoring from February 2002 through January 2003.

	Zuniga Beach
Western gull	18
Sanderling	8
Heermann's gull	4

	Zuniga Point
California brown pelican	12
Western gull	12
Heermann's gull	6

	Weapon's Pier
Heermann's gull	19
Western gull	3
California brown pelican	1

Table 5. Birds dispersed from Naval Air Station North Island airfield by Wildlife Services personnel using pyrotechnic devices from February 1, 2002 to January 31, 2003.

SPECIES	**NUMBER DISPERSED**	
	2001	**2002**
Western gull	3,920	3,224
Heermann's gull	1,710	2,625
American coot	445	11
Mourning dove	390	0
American wigeon	260	2
Mallard	120	57
Caspian tern	115	0
Swallow	80	0
Great blue heron	20	18
Snowy Egret	0	2
TOTAL	**7,060**	**5,939**

Table 6. Number of birds and eggs removed and methods used to remove them on Naval Air Station North Island airfield by Wildlife Services personnel from February 1, 2002 to January 31, 2003.

SPECIES	SHOOTING	TRAPPING	HAND CAUGHT[a]	EGGS REMOVED	TOTAL
Western gull	24	0	0	3	**27**
Heermann's gull	0	0	0	0	**0**
Rock dove	2	33	0	0	**35**
American coot	76	0	5	0	**81**
Mallard	1	0	14	0	**15**
American crow	14	0	0	0	**14**
Ring-billed gull	0	0	0	0	**0**
Common raven	22	0	0	0	**22**
Red-tailed hawk	0	2	0	0	**2**
TOTAL	**139**	**35**[b]	**19**	**3**	**196**

[a] Includes birds captured using AC bait.
[b] Translocated raptors.

Table 7. Raptors translocated from Naval Air Station North Island airfield by Wildlife Services personnel from February 1, 2002 to January 31, 2003.

SPECIES AND AGE	CAPTURE DATE	CAPTURE LOCATION	RELEASE DATE	RELEASE LOCATION
Red-tailed hawk, Juvenile, #1207-43703	April 29, 2002	Radar Field	June 24, 2002	Imperial Valley, CA
Red-tailed hawk, Juvenile, #1207-43705	December 17, 2002	Radar Field	January 8, 2003	Imperial Valley, CA

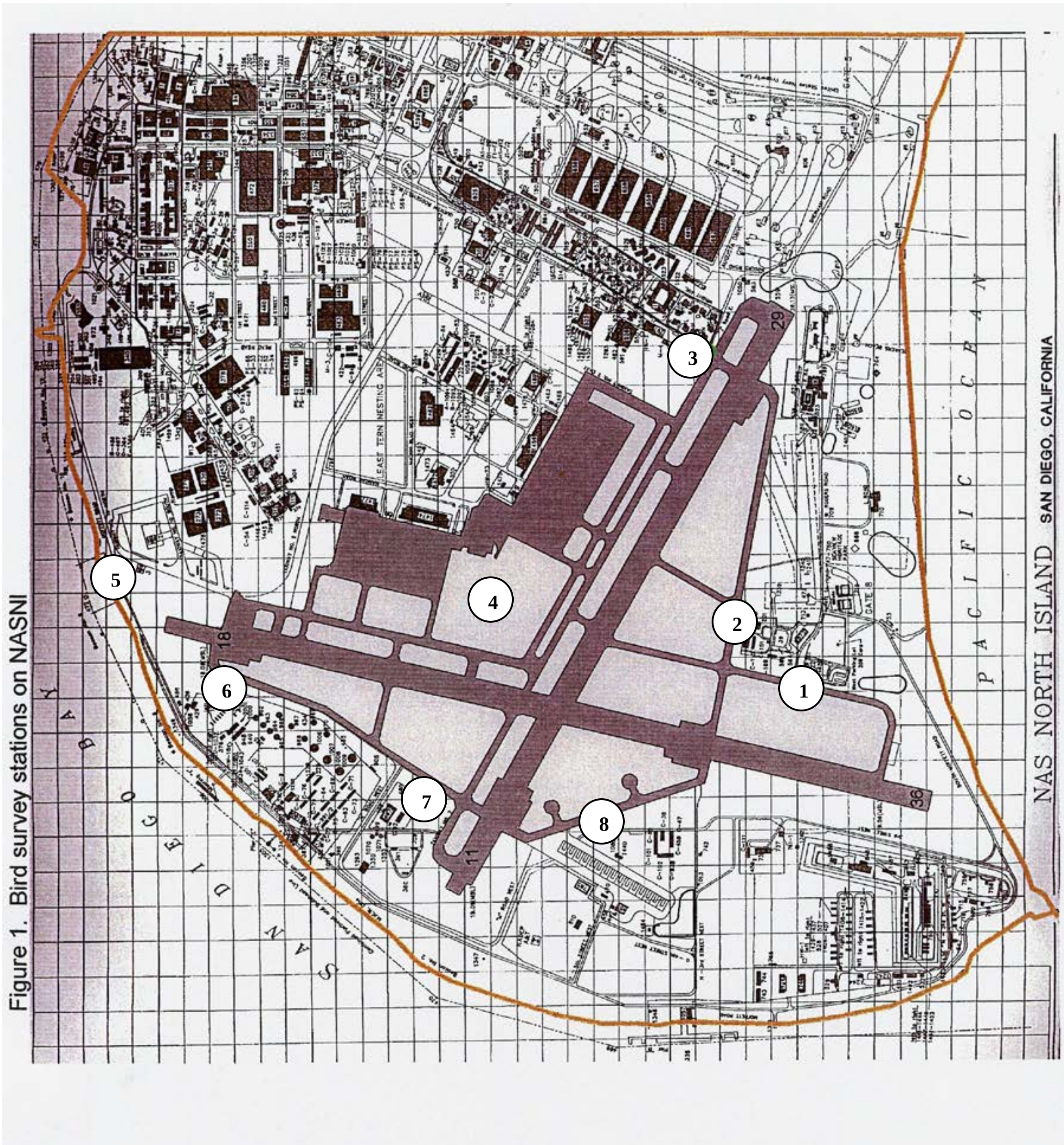

Figure 1. Observation Stations 1 through 8 at Naval Air Station North Island, Naval Base Coronado, San Diego, California.

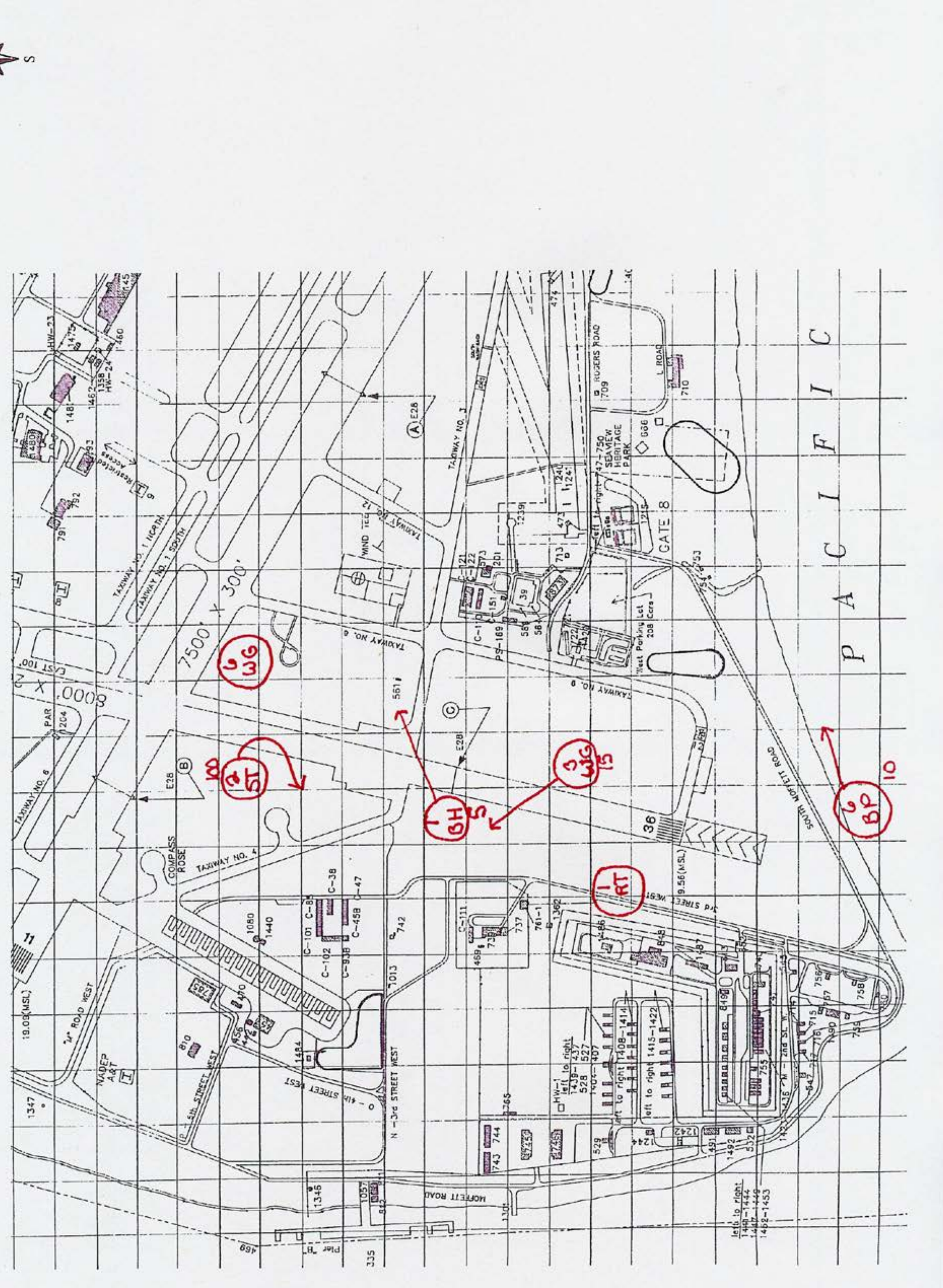

Figure 2. NASNI map demonstrating procedure used to record bird activity.

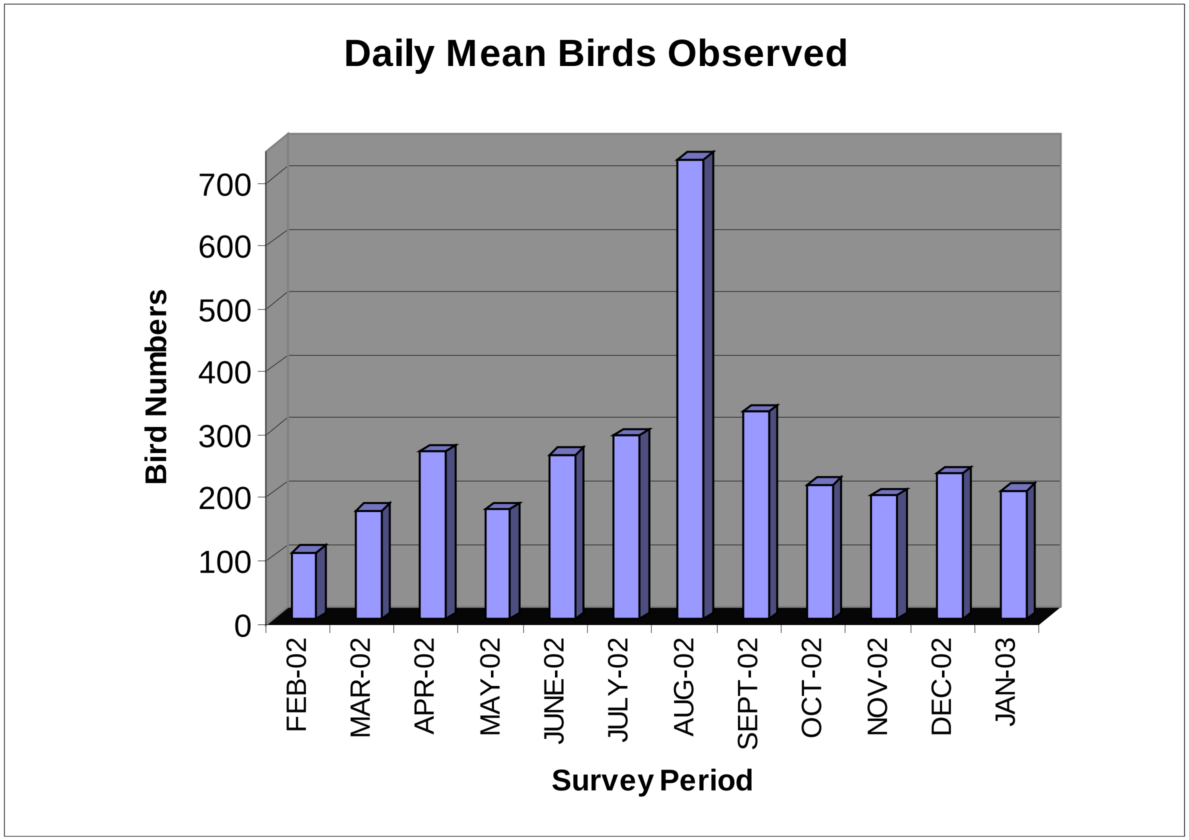

Figure 3. Daily mean birds observed during monitoring at Naval Air Station North Island, San Diego, California from February 2002 through January 2003.

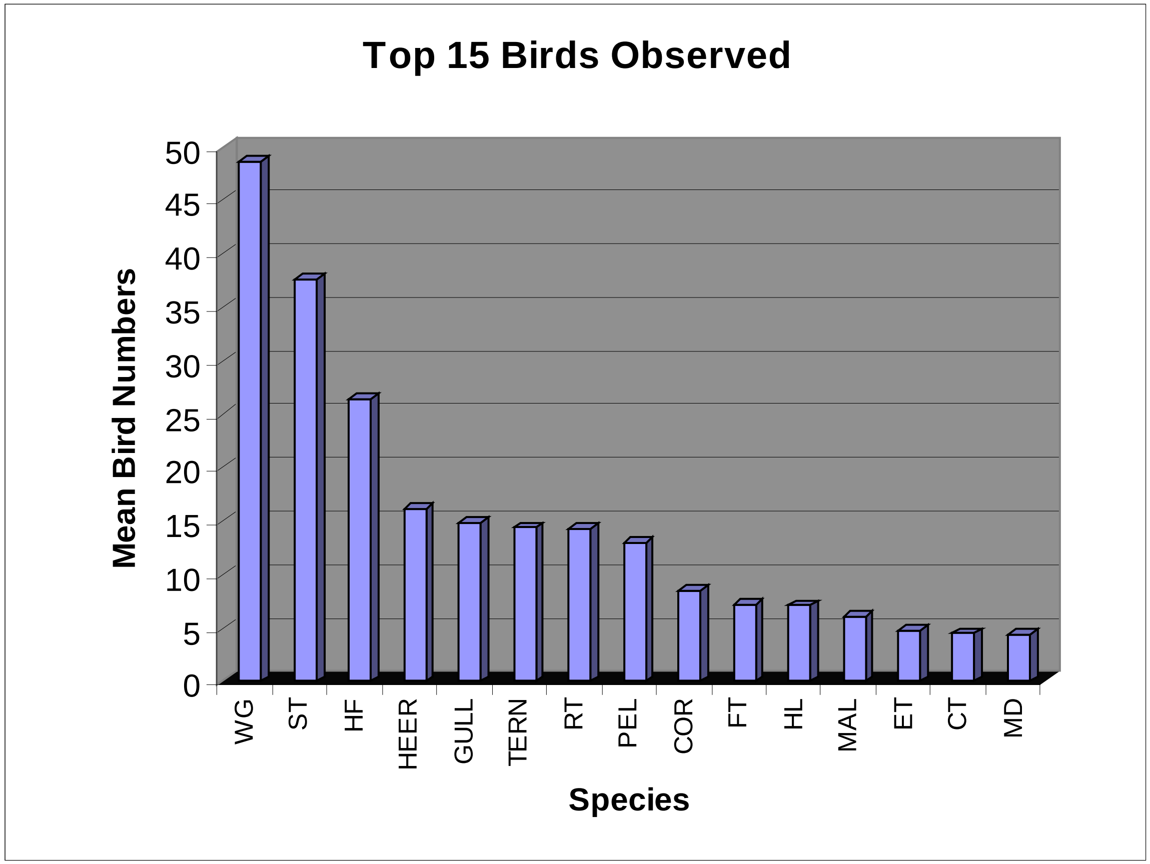

Figure 4. Top fifteen species of birds observed during monitoring at Naval Air Station North Island, California from February 2002 through January 2003. WG = western gull; ST = European starling; HF = house finch; HEER = Heermann's gull; GULL = unidentified gull; TERN = unidentified tern; RT = royal tern; PEL = California brown pelican; COR = double-crested cormorant; FT = forster's tern; HL = horned lark; MAL = mallard; ET = elegant tern; CT = Caspian tern; MD = mourning dove.

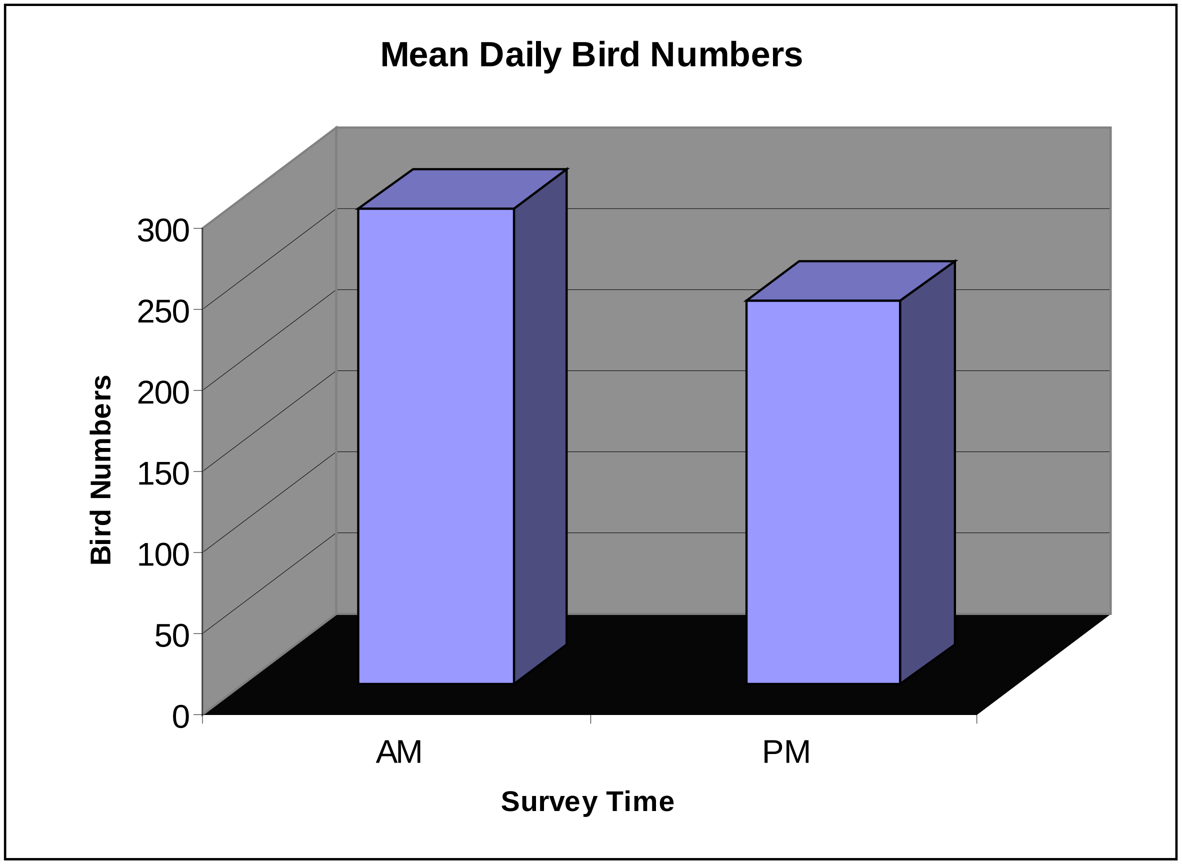

Figure 5. Mean daily birds observed during AM and PM observation periods during monitoring at Naval Air Station North Island, San Diego, California from February 2002 through January 2003.

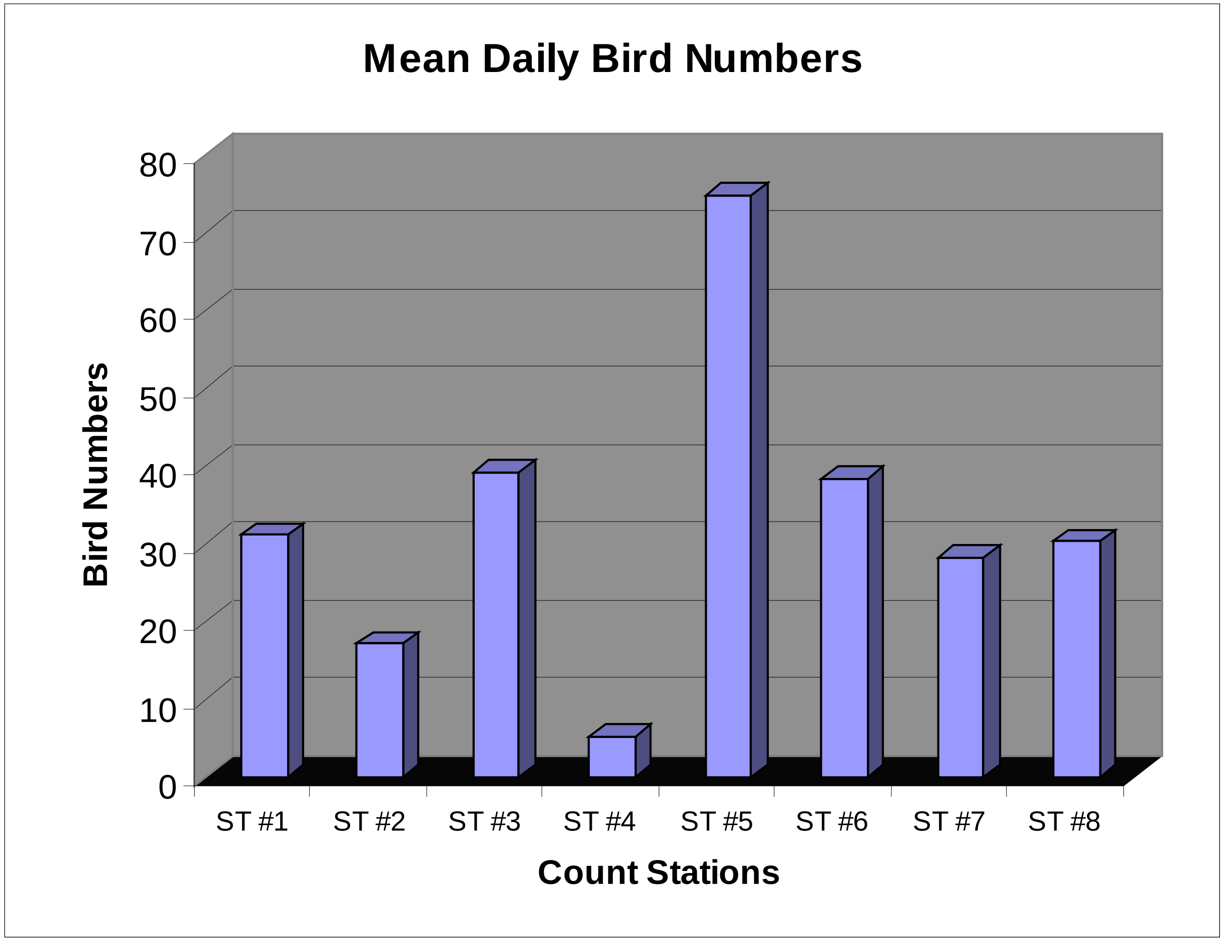

Figure 6. Mean daily bird numbers observed at each station during monitoring at Naval Air Station North Island, San Diego, California from February 2002 through January 2003.

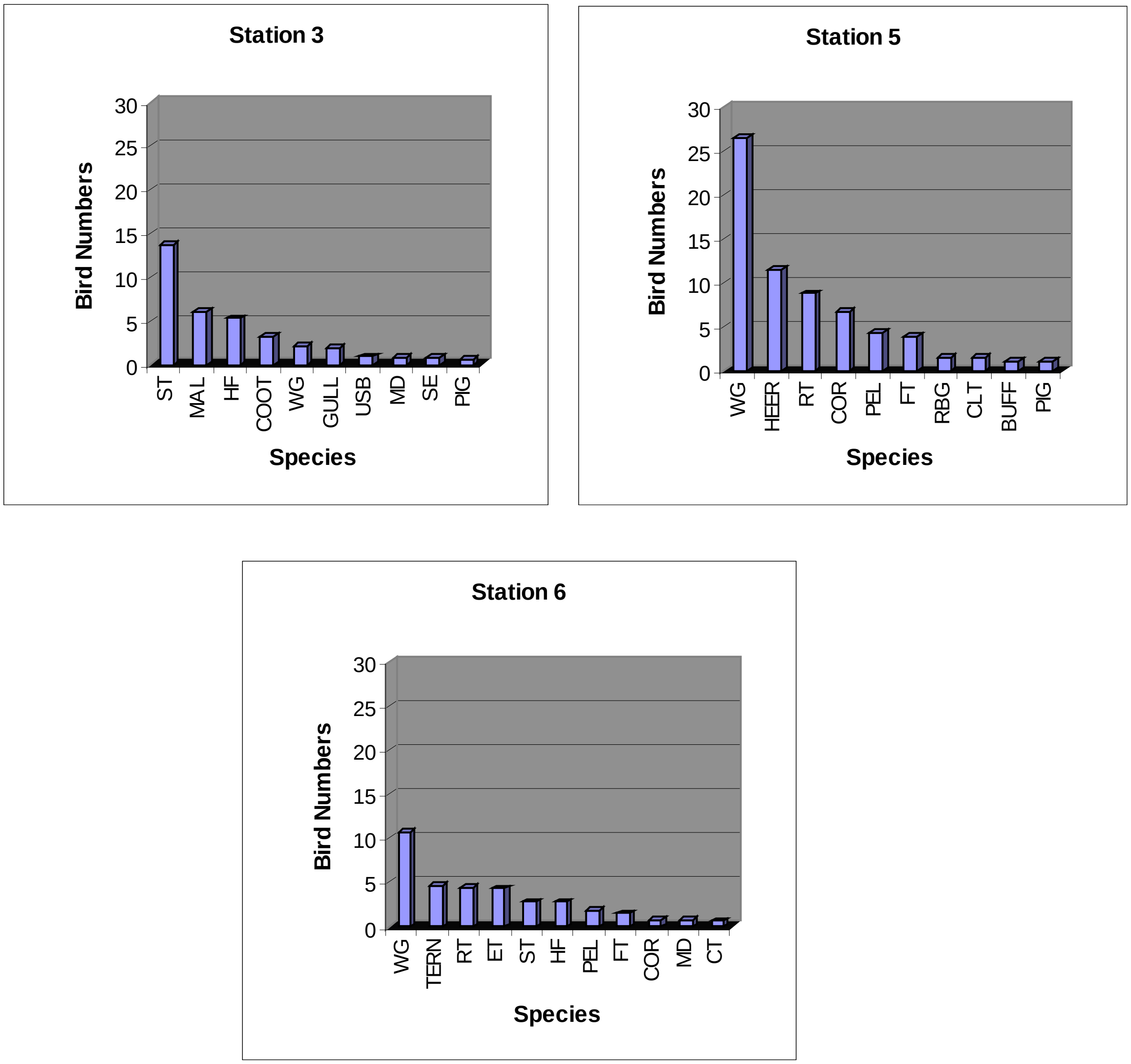

Figure 7. Daily mean number of most common birds observed at Stations 3, 5, and 6 on NASNI during the Wildlife Hazard Assessment from February 2002 through January 2003. BUFF = bufflehead; CLT = California least tern; COR = double-crested cormorant; COOT = American coot; CT = Caspian tern; ET = elegant tern; FT = Forster's tern; GULL = unidentified gull; HEER = Heermann's gull; HF = house finch; MAL = mallard; MD = mourning dove; PEL = California brown pelican; PIG = rock dove (pigeon); RBG = ring-billed gull; RT = royal tern; SE = snowy egret; ST = European starling; TERN = unidentified tern; USB = unidentified small bird; WG = western gull.

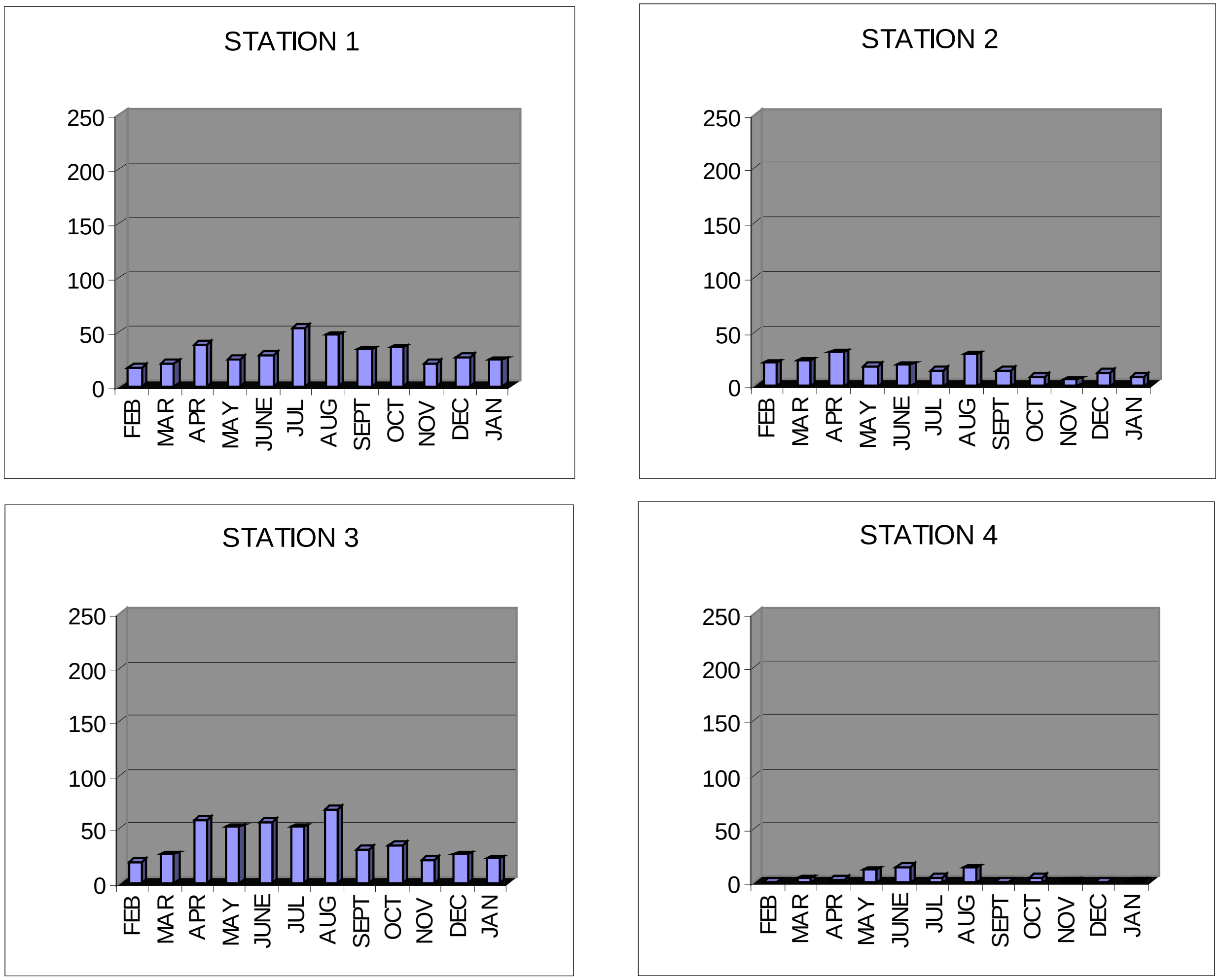

Figure 8. Daily mean number of birds observed at Station's 1-4 during monitoring at Naval Air Station North Island, San Diego, California from February 2002 through January 2003.

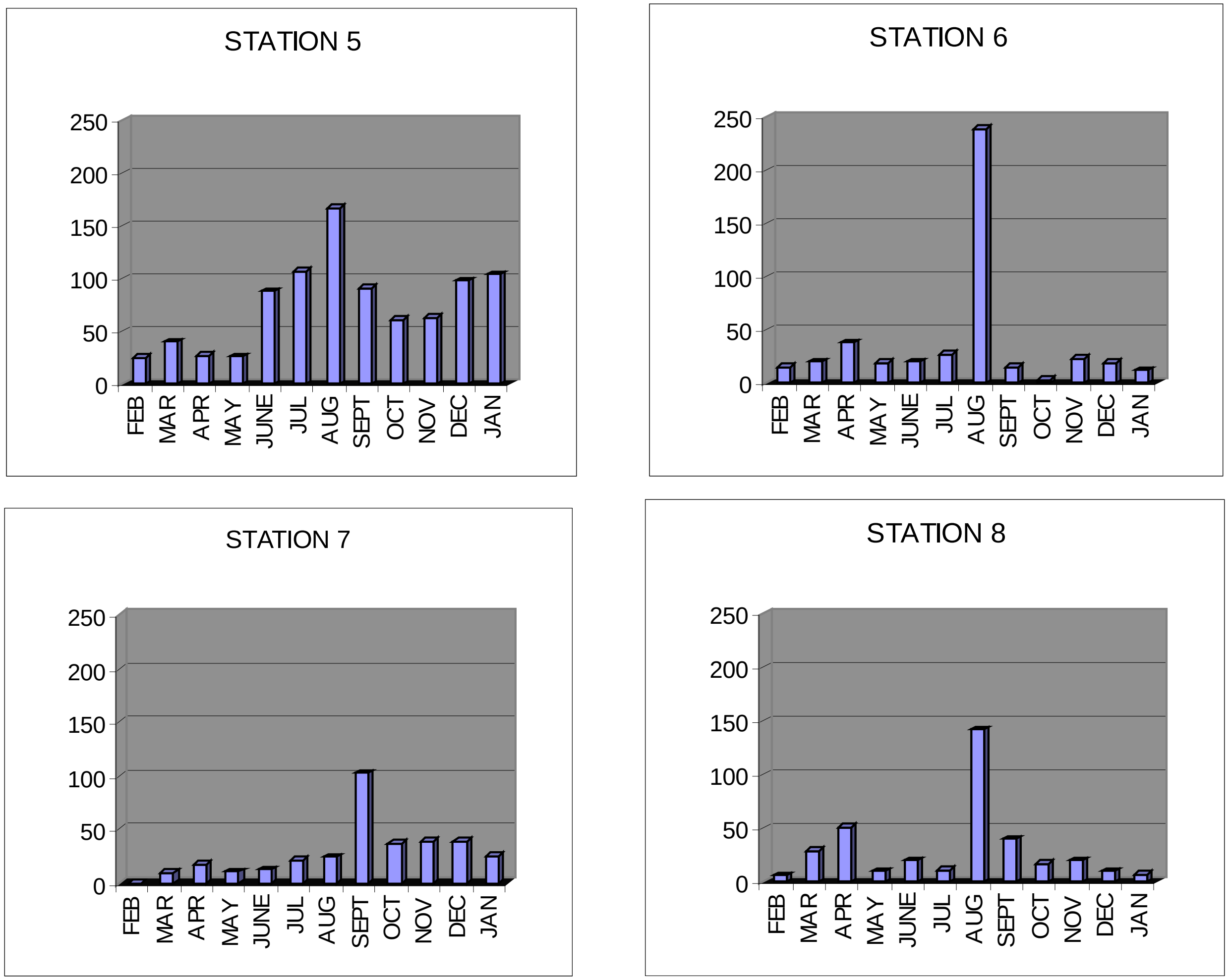

Figure 8 cont. Daily mean number of birds observed at Station's 5-8 during monitoring at Naval Air Station North Island, San Diego, California from February 2002 through January 2003.

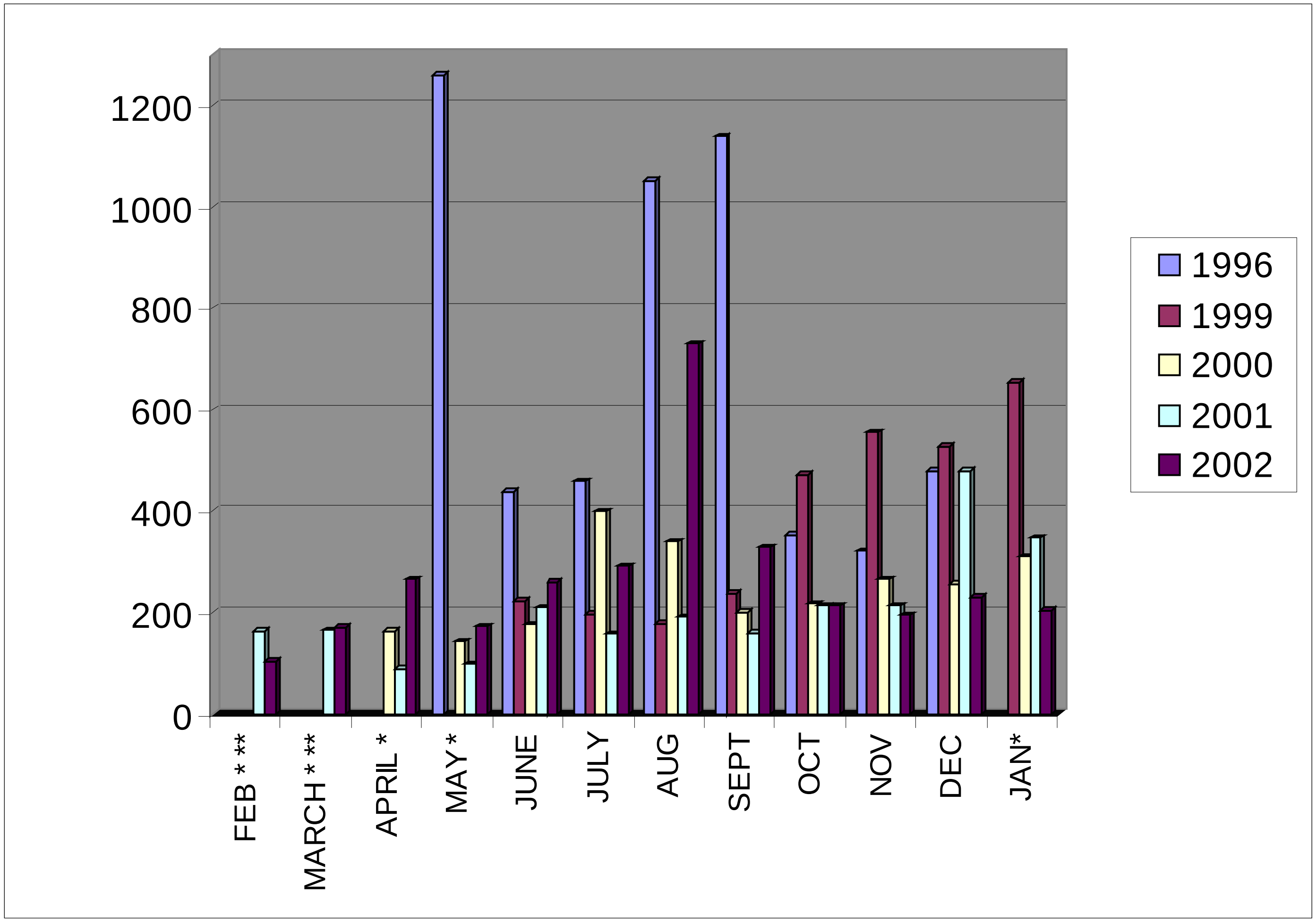

Figure 9. Mean daily number of birds observed during monitoring at Naval Air Station North Island, California from 1996-2002.
* Surveys were not conducted February – April 1996, February – May 1999, nor January 1997.
** Surveys were not conducted February – March 2000.

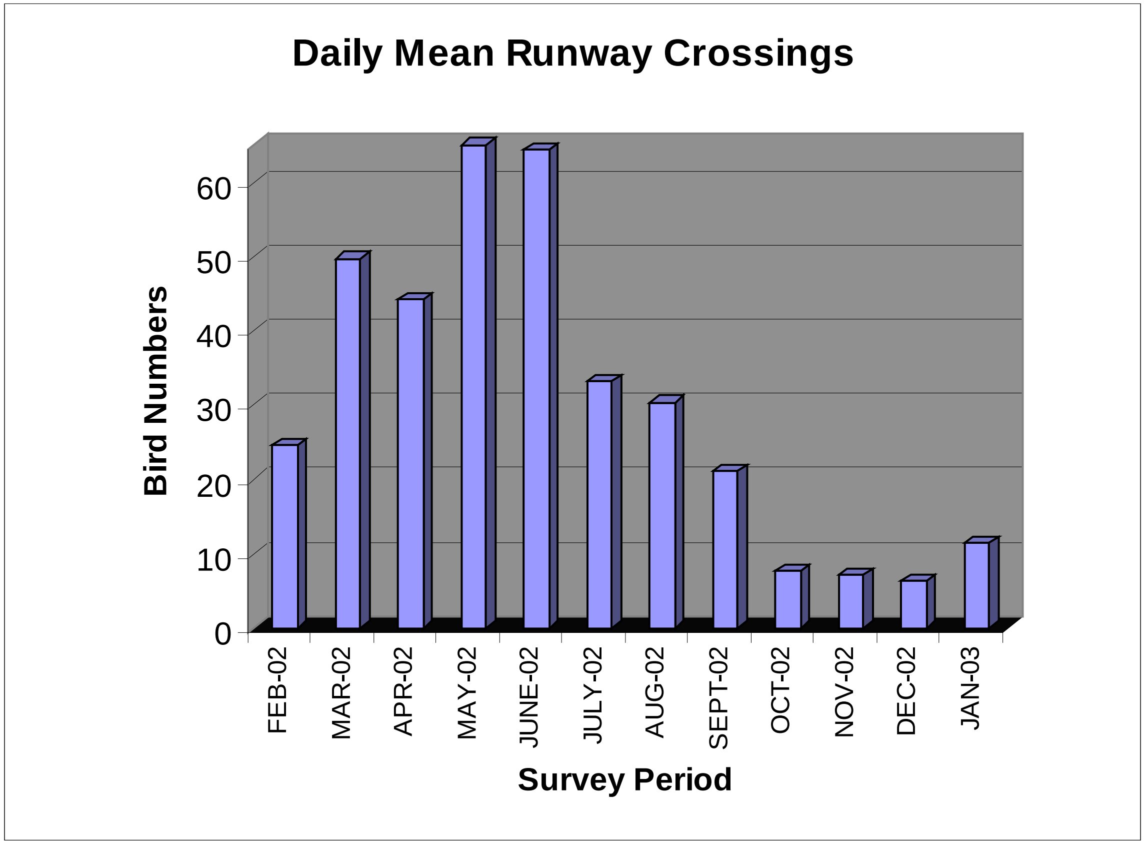

Figure 10. Daily mean number of birds crossing runways during monitoring at Naval Air Station North Island, San Diego, California from February 2002 through January 2003.

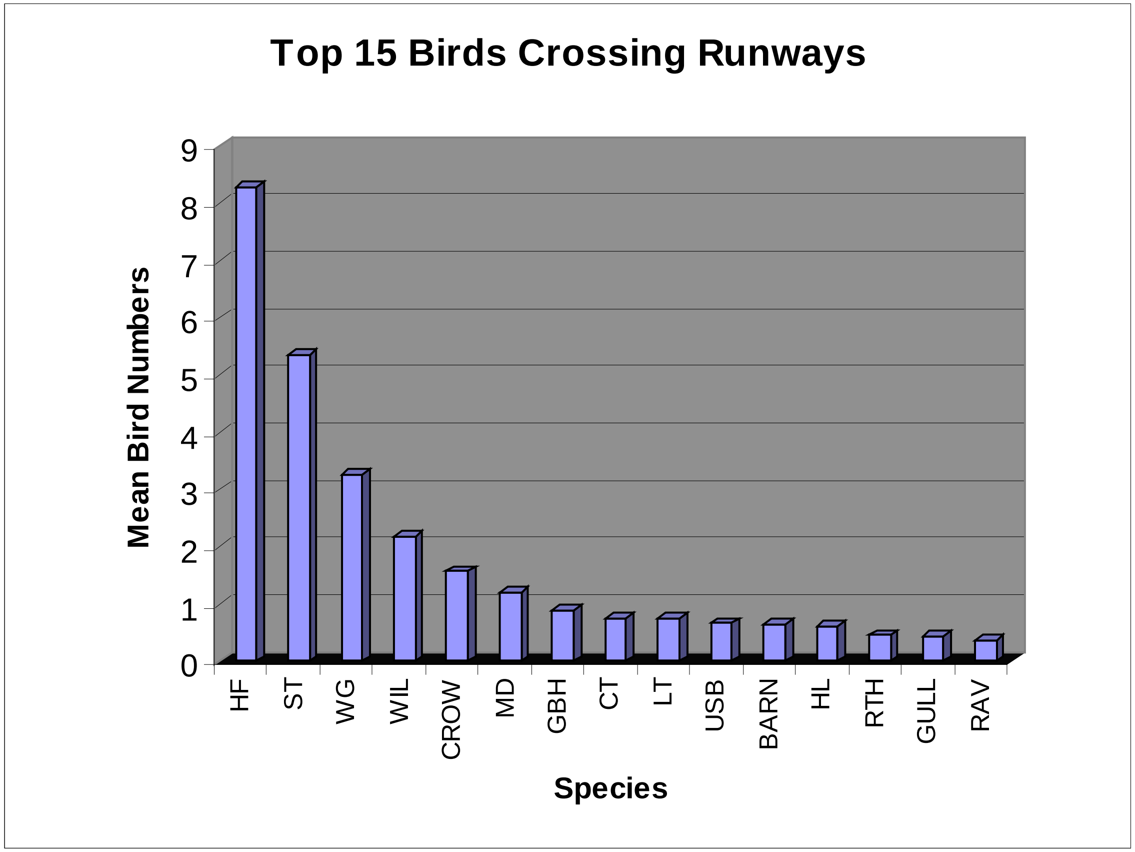

Figure 11. Top fifteen species of birds crossing runways during monitoring at Naval Air Station North Island, San Diego, California from February 2002 through January 2003.

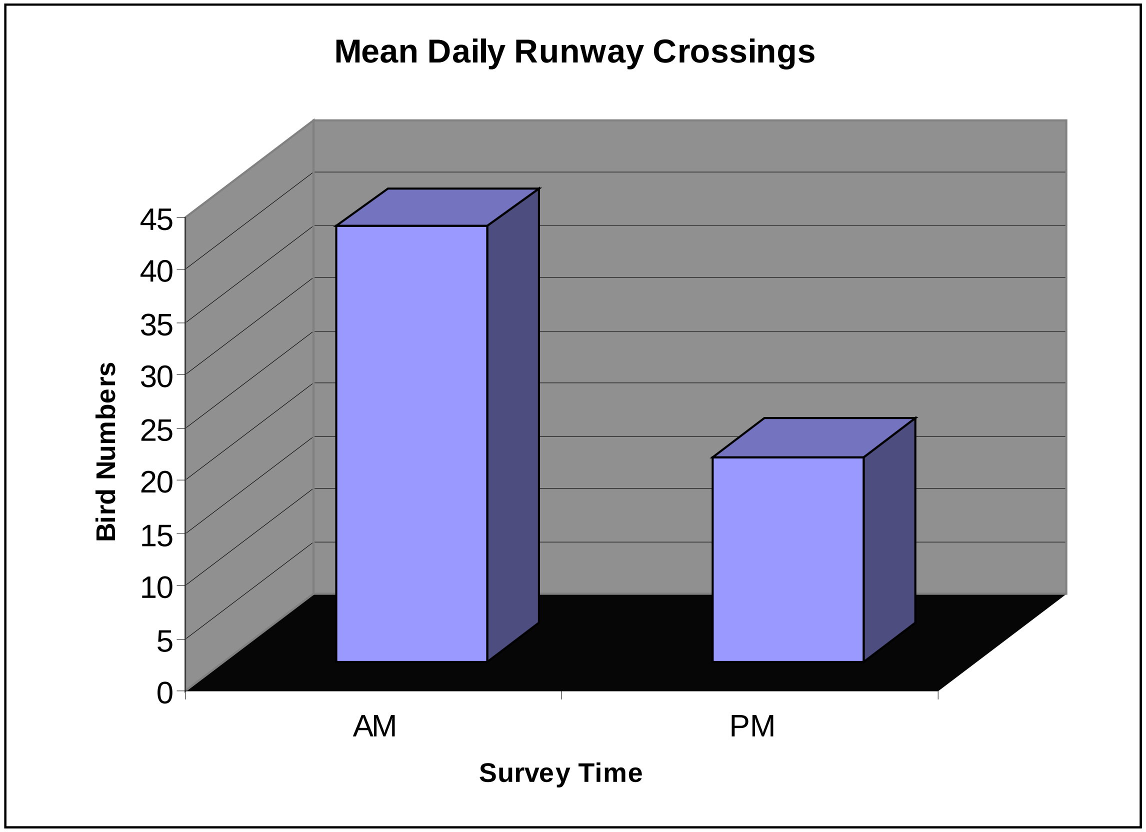

Figure 12. Mean daily runway crossings during AM and PM observation periods during monitoring at Naval Air Station North Island, San Diego, California from February 2002 through January 2003.

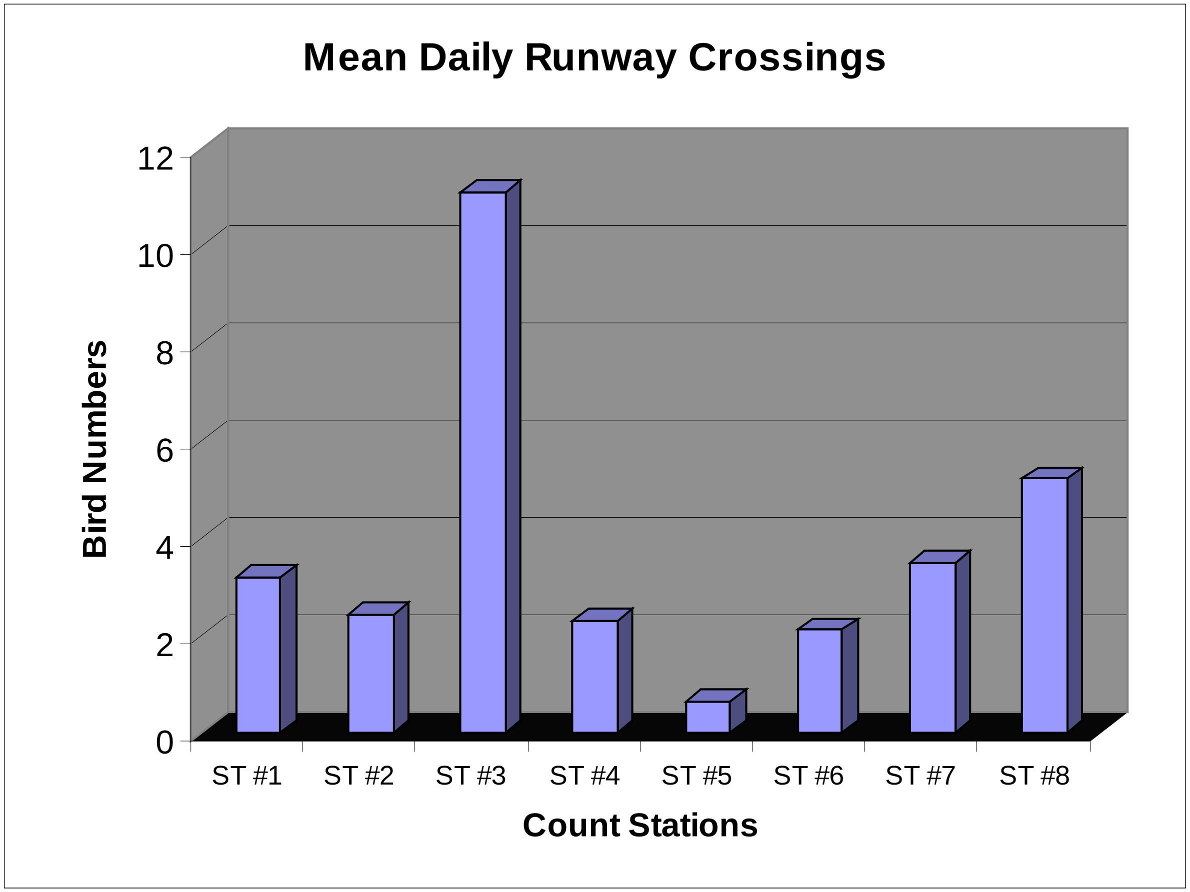

Figure 13. Daily mean runway crossings at each station during monitoring at Naval Air Station North Island, San Diego, California from February 2002 through January 2003.

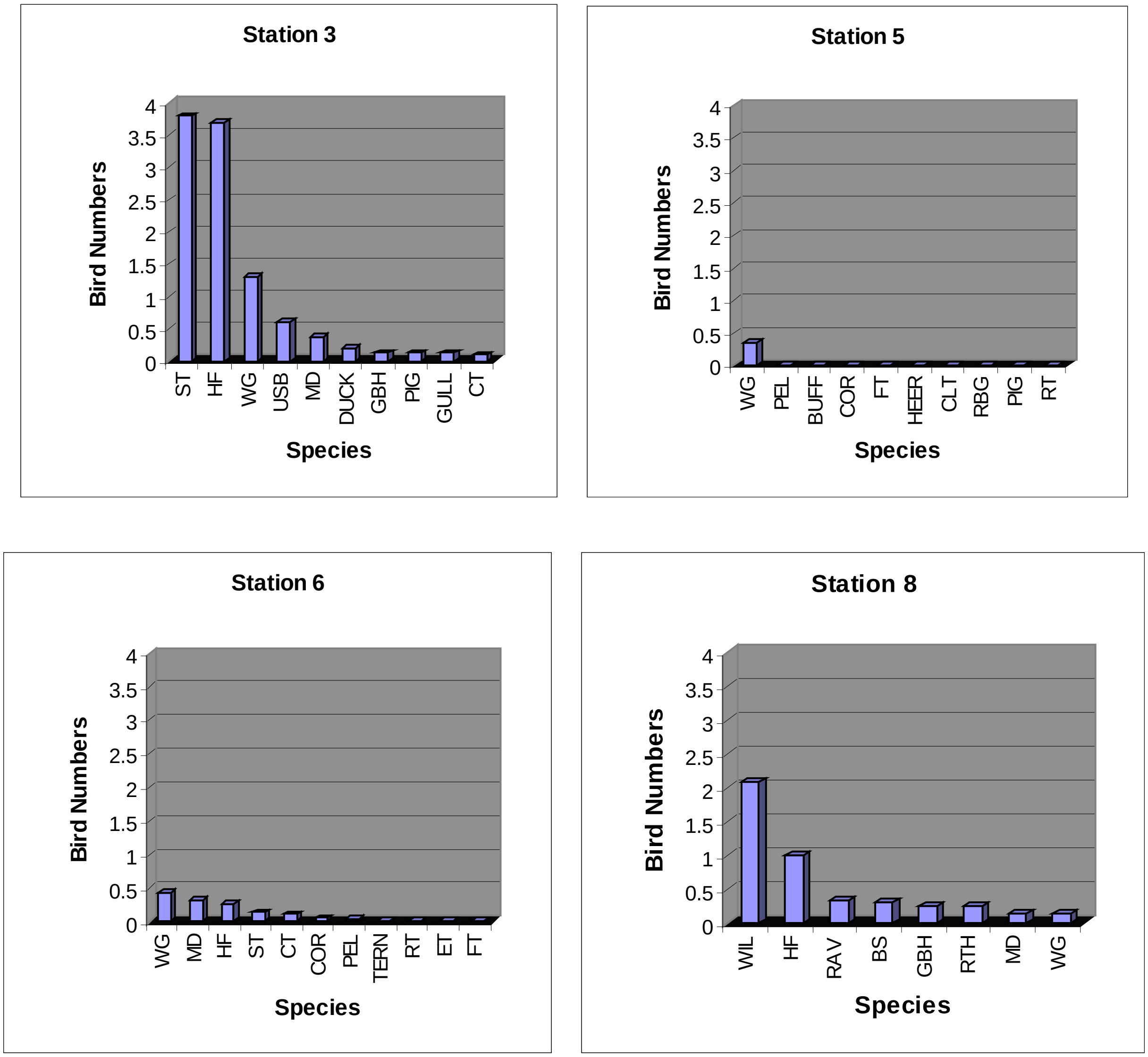

Figure 14. Daily mean number of most common birds crossing the runway at Stations 3, 5, and 6 on NASNI during monitoring from February 2002 through January 2003. BS = barn swallow; BUFF = bufflehead; CLT = California least tern; COR = double-crested cormorant; CT = Caspian tern; DUCK = unidentified duck; ET = elegant tern; FT = Forster’s tern; GBH = great blue heron; GULL = unidentified gull; HEER = Heermann’s gull; HF = house finch; MD = mourning dove; PEL = California brown pelican; PIG = rock dove (pigeon); RAV = common raven; RBG = ring-billed gull; RT = royal tern; RTH = red-tailed hawk; ST = European starling; TERN = unidentified tern; USB = unidentified small bird; WG = western gull; WIL = willet.

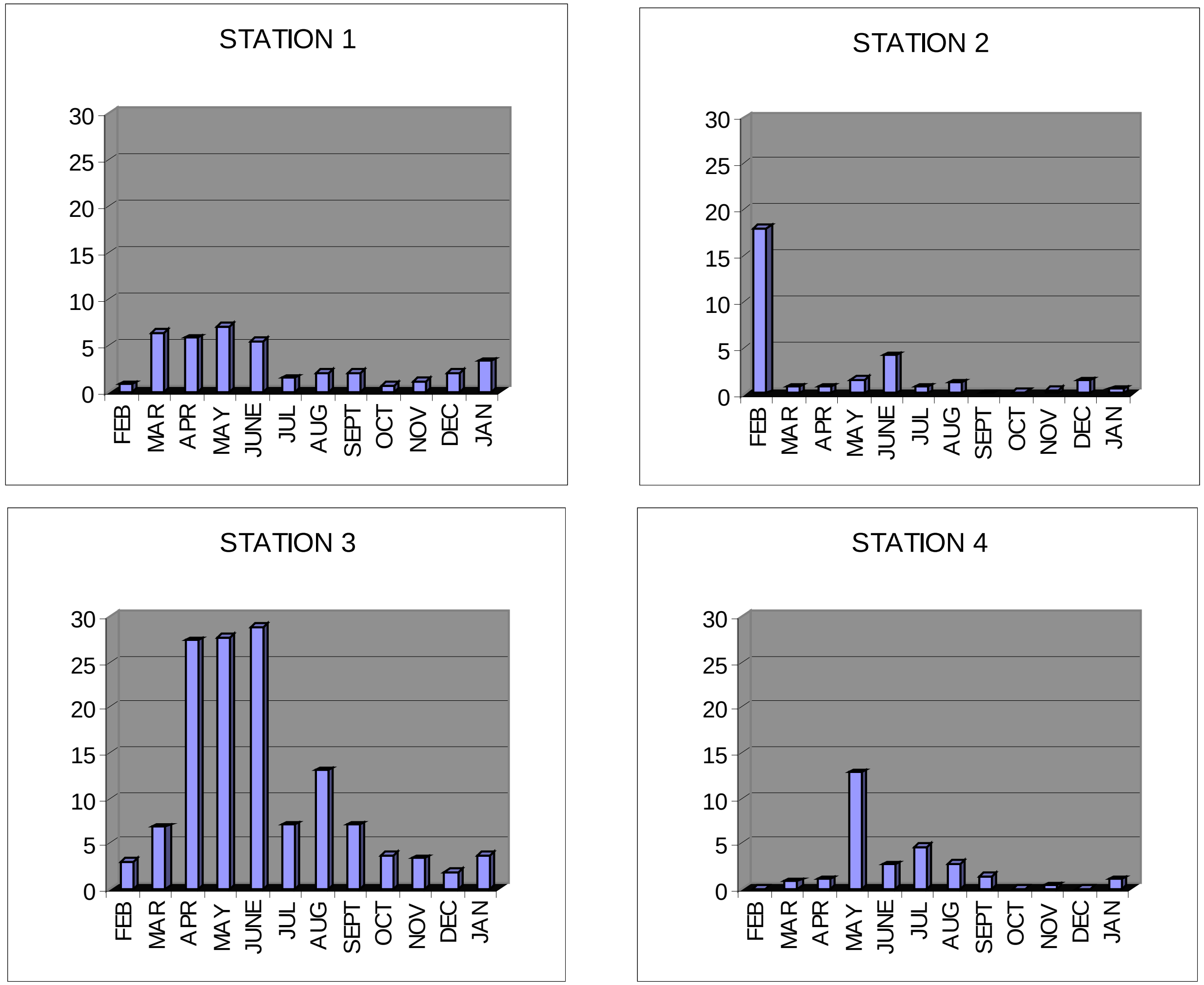

Figure 15. Daily mean number of birds crossing runways at Station's 1-4 during monitoring at Naval Air Station North Island, San Diego, California from February 2002 through January 2003.

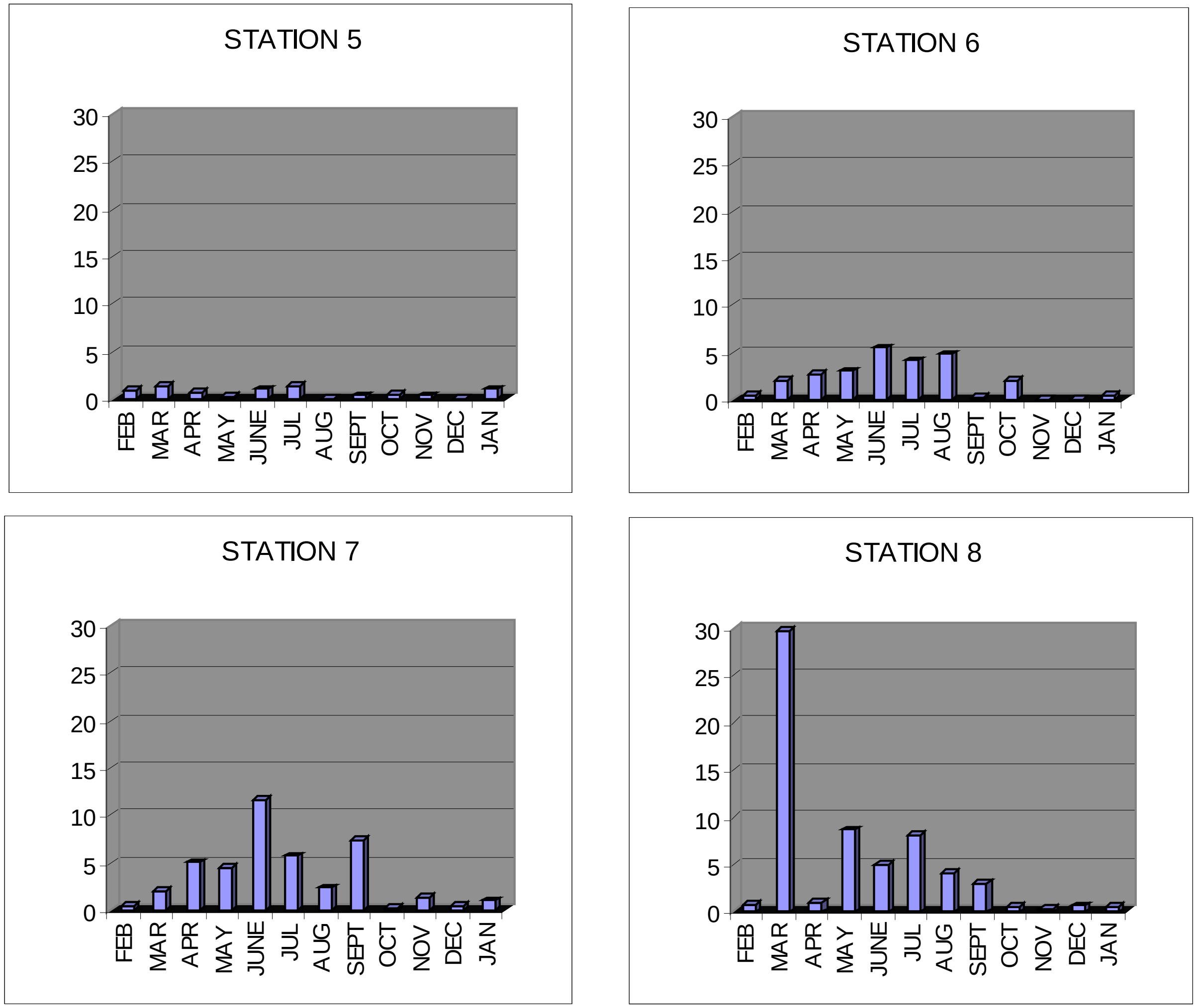

Figure15 cont. Daily mean number of birds crossing runways at Station's 5-8 during monitoring at Naval Air Station North Island, San Diego, California from February 2002 through January 2003.

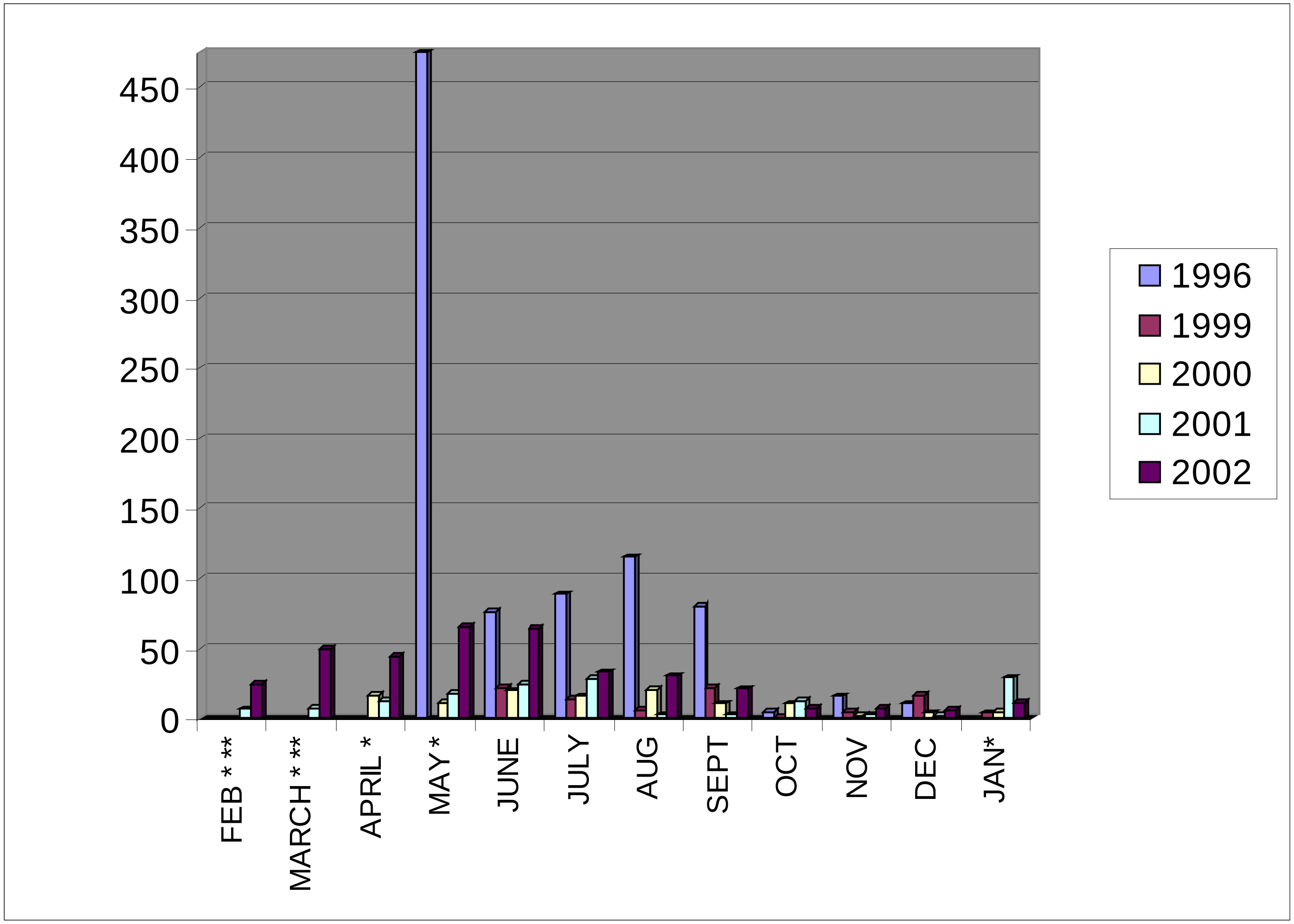

Figure 16. Mean daily runway crossings by birds during monitoring at Naval Air Station North Island, California from 1996-2002.
* Surveys were not conducted February – April 1996, February – May 1999, nor January 1997.
** Surveys were not conducted February – March 2000.

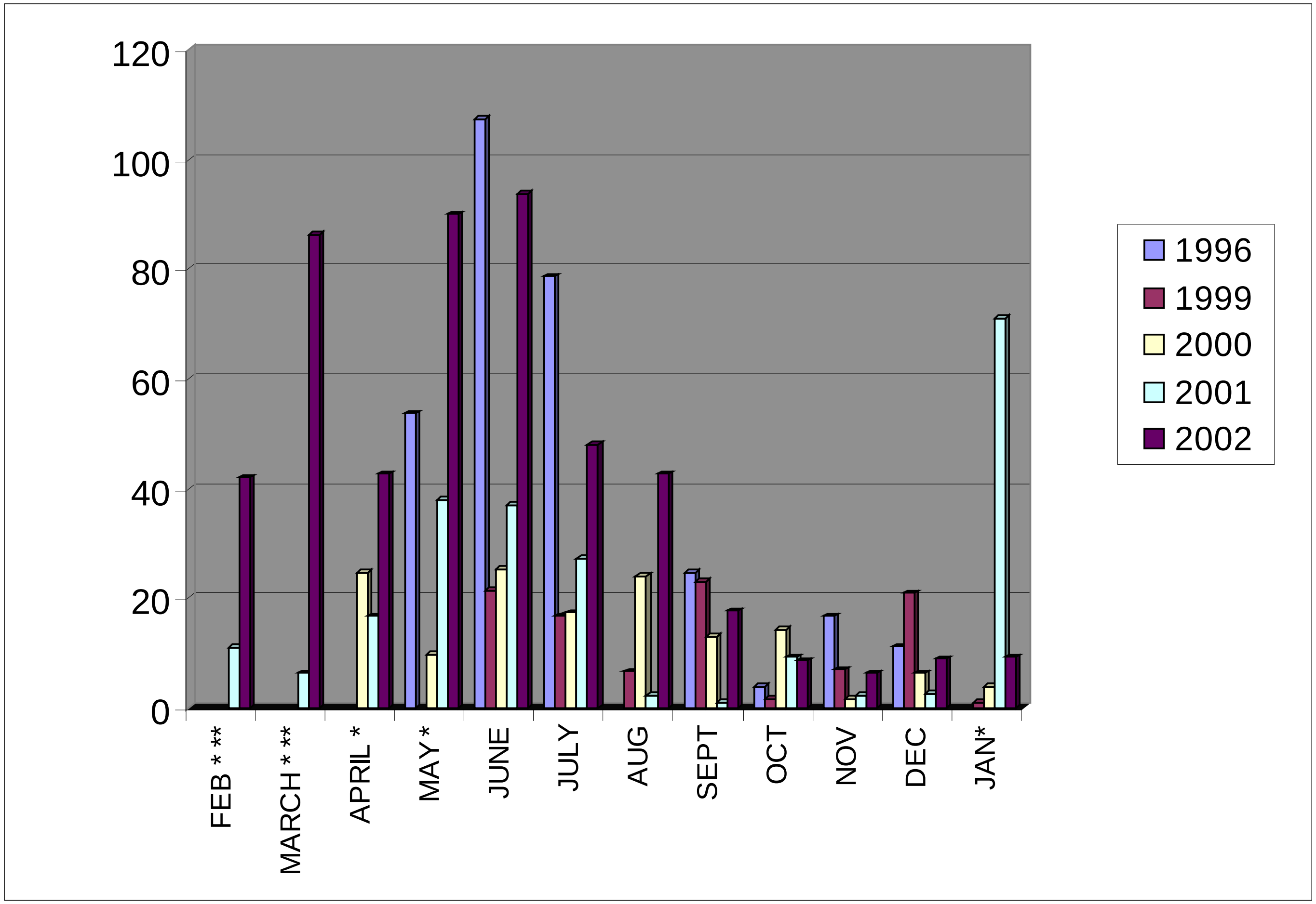

Figure 17. Mean runway crossings during the AM observation period during monitoring at Naval Air Station North Island, California from 1996-2002.
* Surveys were not conducted February – April 1996, February – May 1999, nor January 1997.
** Surveys were not conducted February – March 2000.

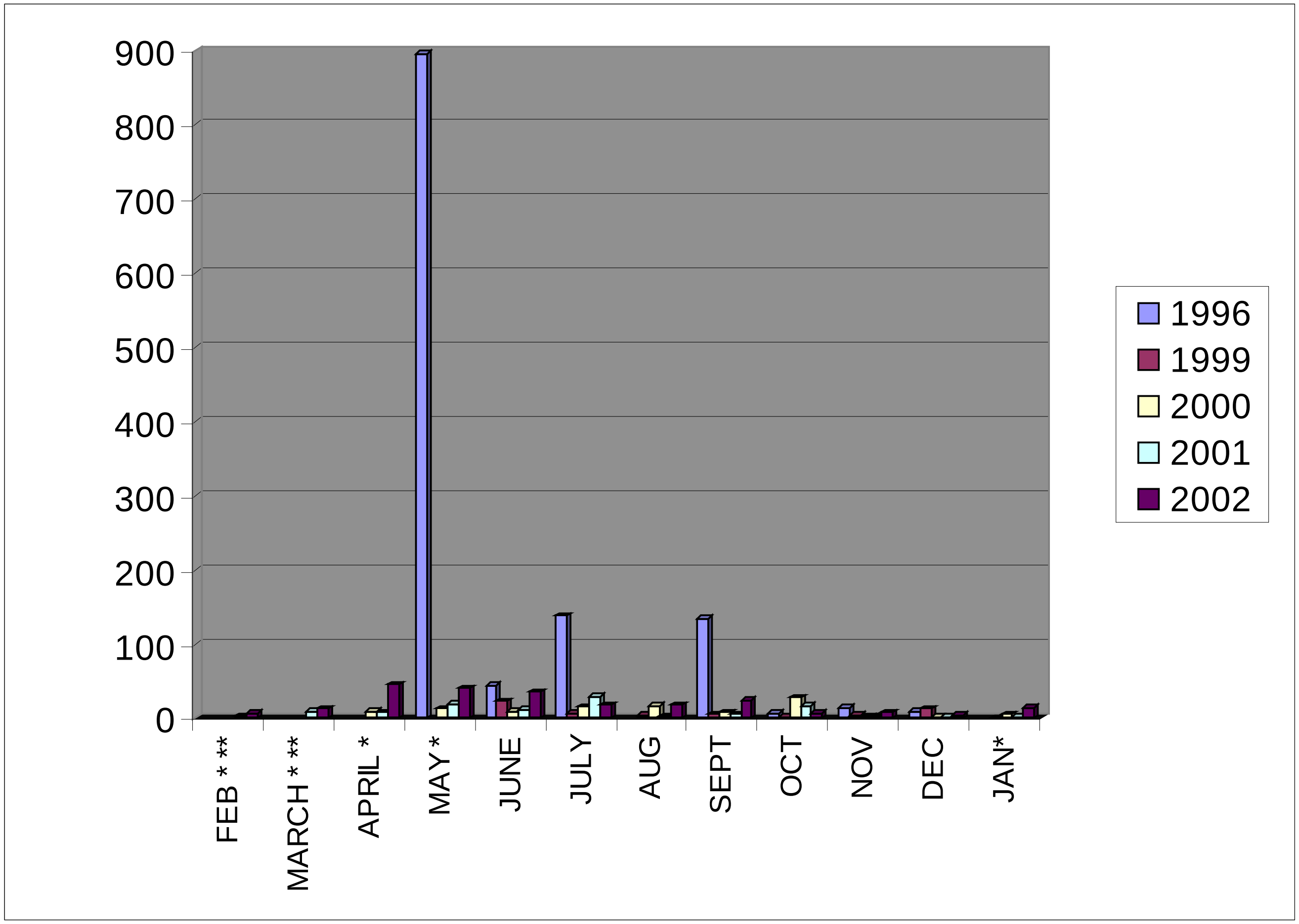

Figure 18. Mean runway crossings during the PM observation period during monitoring at Naval Air Station North Island, California from 1996-2002.
* Surveys were not conducted February – April 1996, February – May 1999, nor January 1997.
** Surveys were not conducted February – March 2000.

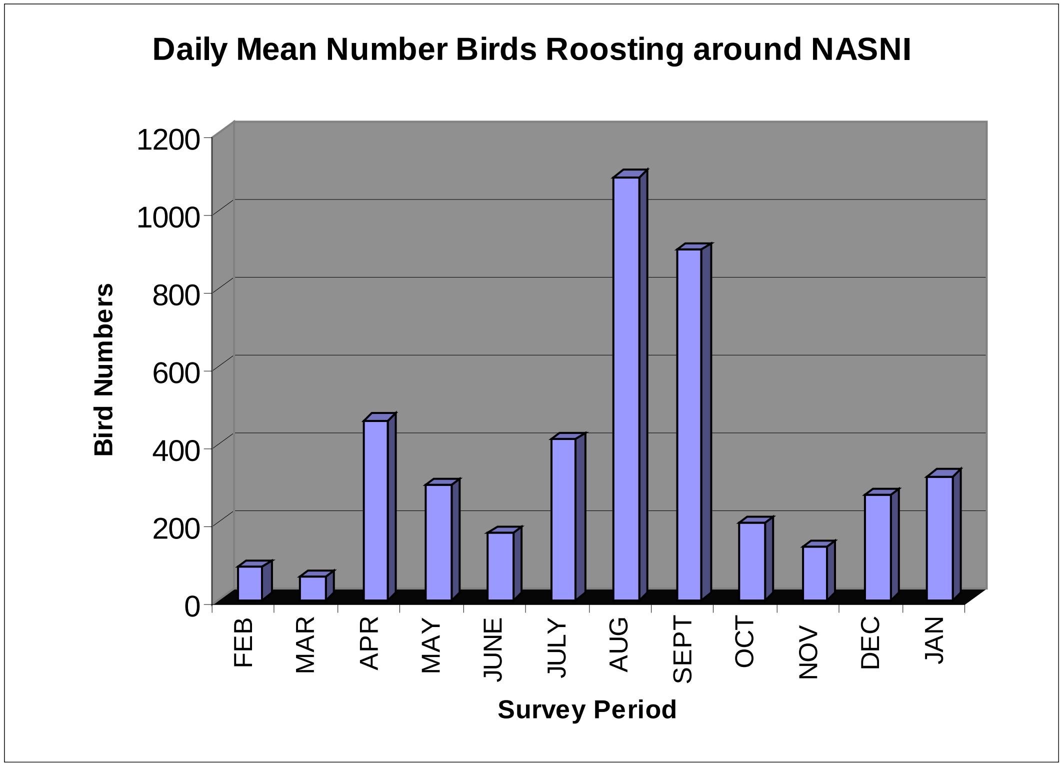

Figure 19. Mean daily number of birds roosting in three popular areas around Naval Air Station North Island, California during monitoring from February 2002 through January 2003.

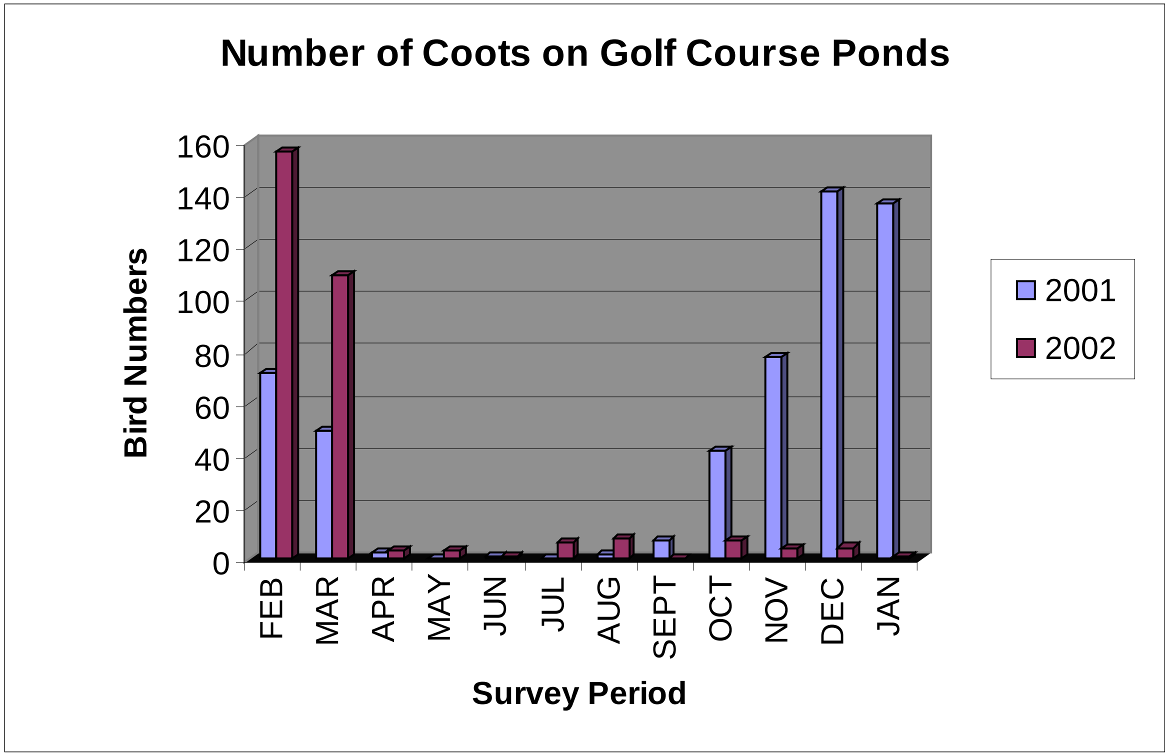

Figure 20. Number of American coots observed on the Golf Course Ponds during monitoring at Naval Air Station North Island, San Diego, California from 2001-2002.

BASH Airport Data Sheets

Name **Date** **Airfield** **#of pgs____**

time	location	#	species	action	#K	behavior	cover	ammo	#	comments

BEHAVIOR

Bd-bedding
Lf-loafing
Rs-roosting
Ns-nesting
Fg-foraging

Fl-flying
Cs-courtship
Dn-denning
None

COVER

Tsw-temp stand water
Lbw-large body water
Sbw-small body water
Shr-shrubs
Mar-marsh\wetland
Bch-beach

None
Twy-taxiway
Rwy-runway
Rmp-ramp
Asp-asphalt\concr.
Rrp-riprap

Unp-unpaved
Str-structure
Dtc-ditch
Gsh-grass short
Glg-grass long
Jty-jetty

Figure 21. BASH airport data sheets used by Wildlife Services personnel to record details of all bird dispersals on NASNI.

APPENDIX 6: WHA NALF SCI

WILDLIFE HAZARD ASSESSMENT FOR NAVAL AUXILIARY LANDING FIELD SAN CLEMENTE ISLAND, CALIFORNIA 2002

Prepared For: **U.S. NAVY, NATURAL RESOURCES OFFICE,**
COMMANDER NAVY REGION SOUTHWEST,
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Prepared Under Contract No: **N68711-01-LT-01042**

WILDLIFE HAZARD ASSESSMENT FOR NAVAL AUXILIARY LANDING FIELD, SAN CLEMENTE ISLAND, CALIFORNIA 2002

Karen H. Sheffer and John L. Cummings
National Wildlife Research Center, United States Department of Agriculture, Wildlife Services, 4101 La Porte Avenue, Fort Collins, CO 80521

July 7, 2003

EXECUTIVE SUMMARY

Birds represent a direct bird hazard to aviation safety at Naval Auxiliary Landing Field, San Clemente Island, California. Every reasonable effort should be made to discourage birds from using the airfield. Bird strikes to aircraft are a serious economic and safety problem in the United States, annually causing $200 million dollars in damage to civilian and military aircraft and the occasional loss of human life. The most significant military aircraft disaster caused by birds in the United States occurred at Elmendorf Air Force Base, Anchorage, Alaska on September 22, 1995, when an E-3 Sentry Airborne Warning and Control System aircraft ingested several Canada geese on take off and crashed, killing 24 people. The Navy has experienced approximately 20,000 bird strikes since 1980 resulting in 2 deaths, 25 aircraft destroyed, and over $300 million in damage.

At NALF SCI, National Wildlife Research Center personnel documented twelve bird/aircraft strikes during the Wildlife Hazard Assessment from February 2002 through January 2003. Of these, horned larks and western meadowlarks represented 41% and the remaining strikes were distributed among a wide variety of other bird species. Most strikes occurred between August and December and the strike reporting rate was about 25%.

NALF SCI in its entirety attracts wildlife, specifically birds that could potentially represent a risk to pilots and aircraft. Key habitat types such as vegetation on either side of the runway, and the cliffs, beach and open water at either end of the runway offer foraging, loafing, nesting and roosting for several species of birds. In addition, predators

such as San Clemente Island foxes, red-tailed hawks, common ravens and American kestrels are attracted to the airfield in search of prey.

Bird use patterns on NALF SCI varied by species, time and location. Fifty-three bird species were observed on NALF SCI during the Wildlife Hazard Assessment from February 2002 through January 2003. Bird observations indicated that the greatest bird activity on the airfield occurred between June and December 2002. Peak bird activity was in August and November 2002 with daily bird counts averaging approximately 200 birds. The lowest bird activity occurred in March 2002, during which only a daily mean of 46 birds were observed. Most numerous birds observed during the assessment period were, in descending order, horned larks, European starlings, house finches and western meadowlarks. There was little evidence of bird activity at night in and around the airfield. The greatest bird numbers were observed during April, when an average of two birds was observed on the runway each night. Of the birds that could be identified, barn owls, western meadowlarks, western snowy plovers and burrowing owls were most commonly observed on and around the airfield during night surveys.

Runway crossing varied each month, and daily mean crossings were most abundant from May to November 2002 with the greatest number of runway crossings occurring in August and September 2002. The lowest number of runway crossings occurred in March 2002 and January 2003, during which the daily mean number of birds crossing the runway was six. The greatest number of birds crossing the runway was, in descending order, horned larks, European starlings and house finches. Daily mean runway crossings during August and September 2002 documented about 48 crossings, primarily by horned larks.

During night observations, birds were only observed crossing the runway during two months of the assessment period. Most of these runway crossings occurred during April when an average of one bird was observed crossing the runway each night. No birds were observed roosting on the runway, but there were four areas in close proximity to the airfield where birds were observed staging or roosting. These areas were Seal Island (north of the airfield), Sea Test Facility (southeast of the airfield), West Cove (southwest of the airfield), and Seals Beach (north of the airfield).

Recommendations to reduce the bird/aircraft hazards on NALF SCI are included in this report, which include a discussion of habitat management, population control, dispersal techniques and integrated bird management. A Bird Aircraft Strike Hazard Plan will be developed for NALF SCI.

INTRODUCTION

Bird strikes to aircraft are a serious economic and safety problem in the United States, annually causing $200 million dollars in damage to civilian and military aircraft and the occasional loss of human life (Cleary et al. 1999). The most significant military aircraft disaster caused by birds in the United States occurred at Elmendorf Air Force Base, Anchorage, Alaska on September 22, 1995, when an E-3 Sentry Airborne Warning and Control System aircraft ingested several Canada geese (*Branta canadensis*) on take off and crashed, killing 24 people. Since 1950, military aviation has experienced 353 documented serious accidents with a minimum of 165 fatalities (Transport Canada 2001). The Navy has experienced approximately 20,000 bird strikes since 1980 resulting in 2 deaths, 25 aircraft destroyed, and over $300 million in damage (Naval Safety Center 2002a).

Naval Air Stations on islands or located along the coastal areas of the United States potentially have high risk for bird/aircraft strikes because of their location, the species of birds that are present on or around the airfield and the type of aircraft operations. Naval Auxiliary Landing Field San Clemente Island (NALF SCI) is no exception; it is located 57 miles off the California coast and is the southern most island in the California Channel Islands. Its habitats attract a wide variety of potentially high risk birds, i.e. gulls, pelicans, raptors, ravens and small passerines. The greatest concern has been from the presence of several species of small passerines that have been observed on the runway. On June 5, 2001 a C-12 struck a small bird (unknown species) at 0900 hrs at an altitude of 120 feet and on June 20, 2001 a C-12 struck a horned lark (*Eremophila alpestris*) at 1500 hrs at low altitude (during a VFR).

Bird/aircraft strike data is highly valuable information that can be used to determine potential high risk areas on the airfield, species of birds involved, and the time strikes may occur. On January 23, 2002 personnel with the USDA/Wildlife Services/National Wildlife Research Center assessed the need for a wildlife hazard assessment at NALF SCI. They observed several species of birds, specifically gulls, ravens, pelicans, raptors, shorebirds and small passerines in close proximity to SCI's only active runway 5-23. Movement of some of these birds was in the operational flight path of aircraft using the airfield. Because of their size, numbers, and movement patterns these birds present a potential risk to pilots and aircraft operating at NALF SCI.

Factors that attribute to NALF SCI's bird attractiveness are the abundant foraging opportunities in close proximity to the airfield, available habitat for birds to nest, forage, loaf, and roost on and around the airfield. In addition, NALF SCI lacks a current Bird Aircraft Strike Hazard Plan to provide direction on wildlife management and control strategies to reduce the aviation safety hazard to naval aviators at NALF SCI.

Commander Navy Region Southwest, Environmental Department (CNRS ED) is responsible for providing environmental support for NALF SCI. The mission of CNRS ED is to provide guidance and technical expertise that will enhance mission readiness and ensure environmental compliance and protection to all fleet and tenant commands under their jurisdiction. In compliance with Title 14, Code of Federal Regulations (CFR), Part 139 (14 CFR 139) Section 139.337, ecological studies (wildlife hazard assessment) must be conducted at airports when aircraft have experienced multiple bird strikes, or wildlife are of a size or in numbers capable of causing damage to aircraft and they have access to airfield flight patterns or movement area. Further, OPNAV Instruction 3750.6R, Naval Aviation Safety Program (NASP) requires the enhancement of naval operational readiness by preserving the human personnel and material resources used in accomplishing naval aviation missions. An essential component of the NASP is the detection and elimination of aircraft hazards such as wildlife, specifically birds. In accordance with OPNAV Instruction 5090.1B CH-22, the Environmental Division or Natural Resource Section of a Naval Air Station is responsible for preparing and implementing a Bird Aircraft Strike Hazard (BASH) plan, following the outcome of an ecological study (wildlife hazard assessment).

The purpose of the Wildlife Hazard Assessment (WHA) at NALF SCI is to establish a foundation of scientific data from which a more complete and site-specific understanding can be developed of the potential wildlife hazards on and around the airfield. In order to get a complete picture of all wildlife populations using the airfield, the WHA was conducted for 12 consecutive months. This period of time allows for the detection of any seasonal changes in wildlife abundance, behavior, and habitat changes. From the WHA we have made several recommendations designed to reduce the wildlife hazard at NALF SCI.

OBJECTIVES

The objectives of NALF SCI WHA were to:

1. Determine the species, numbers, locations, movements, and daily and seasonal occurrences of wildlife, specifically birds, observed in the environments on and around the airfield at NALF SCI.
2. Identify features on or near the airfield that attract wildlife or cause wildlife to concentrate that may cause hazardous conditions for airfield operations.
3. Describe the wildlife hazards relative to aircraft operations.
4. Summarize wildlife/aircraft strike by month for NALF SCI.
5. Provide management recommendations to reduce wildlife aircraft strike hazards at NALF SCI.

STUDY AREA

San Clemente Island is the southernmost of the California Channel Islands. It is approximately 57 miles from the nearest point on the mainland (Palos Verdes) and approximately 68 miles from San Diego. San Clemente is 21 miles long, varies in width from 1 ½ miles to 4 miles, and encompasses about 36,480 acres. The island is semi arid but supports an array of wildlife. The only operational airfield is located at the north end of the island and runs in an approximate southwest-northeast alignment. The runway is situated about 60 feet above seal level, however beach area and cliffs at either end of the runway offers nesting, foraging and loafing habitat to a wide variety of birds. Runway 5-23 is approximately 9,383 feet long. In 2002, there were a total of 15,310 air operations on NALF SCI. Eighty percent of the operations were Navy and Marine aircraft and the remainder were general aviation and other military aircraft.

METHODS

NALF SCI Bird Habitats

NWRC obtained maps of San Clemente Island displaying ecological units to identify areas on NALF SCI that attract wildlife (Figures 1 and 2). NWRC personnel used existing NALF SCI geographic information systems (GIS) maps that encompass the airfield to identify areas on NALF SCI that could potentially present a risk to aircraft operations. Areas were assigned a relative risk factor (high or moderate or low) based on bird numbers and species observed, habitat type, location, reported strikes, and operations (Figure 3).

Bird Use of NALF SCI

NWRC personnel conducted a series of monthly bird surveys beginning February 2002 through January 2003 to index the species and numbers of birds using NALF SCI. The surveys were designed to show trends in bird population numbers and bird runway crossings. Counts of both live and dead birds were made from stations and transects associated with the runway and aircraft flight paths. Starting February 21, 2002, once a month for four consecutive days the following surveys were conducted:

Station Counts: NWRC established six permanent stations, numbered consecutively, that encompassed the NALF SCI airfield (Figure 4). A route that connected each station was driven in the morning starting at sunrise, reversed in the evening starting about two hours before sunset, and reversed yet again at night starting about two hours after sunset (night vision equipment was used to document bird species and their movements). Generally, each survey route took two hours to complete. Each day the starting location was alternated between the first and last stations in order to reduce time bias. A map of the NALF SCI airfield and surrounding area was used for recording observational data (location, species, and activity of birds). One map was used for each separate observation period (four maps per day). On each map, observers recorded the date, time of day the observations began and ended, name of observer(s), prevailing weather conditions and other pertinent notes. The number, species of birds and their activities (e.g. flying, feeding, loafing, roosting, etc.) within the station boundaries, 1,000 feet in all directions from the observation point, were recorded.

Station counts were conducted for 10 minute intervals. The location, direction of flight and altitude above ground level (AGL) of birds observed were recorded on the base map. Symbols and abbreviations were used to prevent over crowding the map with details. For example, 2 HL within a circle with an arrow pointing northeast from the circle and a number 42 on the outer edge of the circle indicated 2 horned larks were flying northeast at an estimated height of 42 meters AGL (Figure 5). A circle without an arrow or outside number indicated the bird was fixed at that location. In addition, to determine bird activity during mid-day on or near runway 5-23, an observer was stationed near midfield and recorded bird activity for a 30 minute period.

Map data was transposed onto computer spreadsheets, which was used to tabulate data and create graphs. Detailed notes of daily observer activities were recorded in a notebook. The study protocol and any amendments were archived, as well as relevant correspondence between study participants and/or cooperators.

The mean number of birds on and around the airfield was calculated for each time period, which included the morning and evening observations as daily mean number of birds and the night observations as the nightly mean number of birds. The daily mean was determined for each month by adding together the number of birds observed each morning and evening from stations 1 to 6 and dividing by eight (two surveys per day times four assessment days). The nightly mean number of birds was calculated by summing the nightly totals from stations 1 to 6 for each day and dividing by four, the number of assessment days. The daily mean number of birds by survey station for each month was obtained by adding the daily totals by station and time period and dividing by eight (the number of surveys per day times the number of assessment days). For the entire assessment period, mean bird numbers by station were calculated by totaling the number of birds observed from each specific station and time period (day and night) and dividing by twelve (number of monthly surveys).

The mean number of runway crossings was determined for each time period, which included daily (morning, mid-day and evening surveys) and nightly surveys. The daily mean was determined for each month by adding together the number of birds observed crossing the runway each morning, mid-day and evening from stations 1 to 6 and dividing by twelve (three surveys per day times four survey days). The nightly mean number of runway crossings was calculated by summing the nightly totals from stations 1 to 6 for each day and dividing by four, the number of assessment days. The daily mean number of runway crossings by birds by survey station for each month was obtained by adding the daily totals by station and time period and dividing by twelve (the number of surveys per day times the number of assessment days). For the entire assessment period, mean runway crossings by station were calculated by totaling the number of mean birds observed from a specific station and time period (day and night) and dividing by twelve (number of monthly surveys).

Bird/Aircraft Strikes

During the station counts, NWRC personnel checked the runway and the overrun areas for dead or injured birds. In addition, NWRC personnel searched the entire overrun area on foot at the approach to runway 5 and 23 for dead or injured birds following morning bird observations. All remains (e.g. feathers, bones and carcasses) were collected, identified, labeled, recorded and frozen. Birds that could not be identified were sent to the Smithsonian Institute for identification. The location of each was recorded using a Geographic Positioning System (GPS) and recorded on a NALF SCI map. A BASH storage freezer located in Building 60044 was used for remains found by NALF SCI personnel. All NWRC personnel collected birds under a U.S. Fish and Wildlife Collecting/Salvage Permit (#MB693188-0) issued to NWRC.

NWRC personnel recorded the number of bird/aircraft strikes which occurred on NALF SCI during the study. A strike was defined as one or more birds found intact, and/or remains found at a location on the airfield. If possible, the type of aircraft was identified from records of flight operations.

Roosting Surveys

A transect was driven by NWRC personnel following each evening observation period to determine bird roosting locations in and around the airfield. The species, number and location of roosting birds were recorded on a NALF SCI map.

Interviews

NWRC personnel conducted interviews with experts and authorities as necessary to accomplish the wildlife hazard assessment, i.e. contacted NALF SCI Aviation Safety Officer and NALF SCI BASH Program Manager regarding bird strikes at NALF SCI.

NALF SCI Laws and Regulations

NWRC personnel complied with all federal, state and NBVC laws and regulations while conducting the wildlife hazard assessment on NALF SCI.

Federal and State Listed Species

NALF SCI primary client representatives furnished NWRC with a list of endangered species that could be found on NALF SCI. NWRC personnel observed western snowy plovers (*Charadrius alexandrinus nivosus*), a federally threatened bird, California brown pelicans (*Pelecanus occidentalis californicus*), a federally threatened bird, and San Clemente Island foxes (*Urocyon littoralis clementae*), a State of California threatened species, on NALF SCI while conducting bird surveys.

Environmental Conditions

Environmental conditions were not controlled. Observations were conducted in variable weather conditions (e.g. fog, rain, windy, clear).

Records

The study protocol, amendments, relevant correspondence, maps and all related data will be archived at NWRC and will be available for the Agreement and Station Representatives upon request.

RESULTS

NALF SCI Bird Habitats

NWRC personnel concluded that the Wildlife Hazard Assessment study area in its entirety attracts wildlife, specifically birds that could potentially represent a risk to flight crew members and/or cause damage to aircraft. However, the habitat types could not be identified because the area in and around the airfield has not been mapped into ecological units using the current mapping system (Figures 1 and 2). The relative risk of these areas was ranked high, moderate or low based on bird numbers, bird movement patterns, locations and habitat types (Figure 3). Areas representing a high risk attracted significant bird numbers, had numerous bird crossings and had habitat types that birds preferred for foraging, loafing and roosting. The Wildlife Hazard Assessment study area was divided into three areas and the habitat of each discussed.

Area 1: Approach end of Runway 23. This area encompasses portions of the runway at the approach to 23, the overrun area, which is a mixture of all types of vegetation found elsewhere on San Clemente Island, and the cliffs, beach and water in the approach path to runway 23. The overrun area attracts several species of birds, such as horned larks (*Eremophila alpestris*), western meadowlarks (*Sturnella neglecta*) and chukars (*Alectoris chukar*) which use this area for foraging, nesting and loafing. The cliffs attract several species of large birds such as western gulls (*Larus occidentalis*), California brown pelicans and red-tailed hawks (*Buteo jamaicensis*) that use this area for nesting, loafing and roosting. Also, the cliff area is used by small passerines such as house finches (*Carpodacus mexicanus*), house sparrows (*Passer domesticus*) on a regular basis and large flocks of European starlings (*Sturnus vulgaris*) during certain periods of the year for roosting. The open water under the approach to runway 23 is a flight corridor for several species of large birds moving from roosting sites to daily foraging areas. The open water is also foraging habitat for California brown pelicans, western gulls and double-crested cormorants (*Phalacrocorax auritus*). On occasion, western gull flocks foraging in this area exhibit “towering behavior” where birds will circle as a flock from water level to over 1000 feet AGL.

Area 2: Runway 5-23. This area includes the runway, taxiways, support structures and areas adjacent to the runway. Several species of birds have been observed in this area including small passerines such as horned larks, western meadowlarks, and house finches, red-tailed hawks, and common ravens (*Corvus corax*). Vegetation habitats in this area are a combination of all types of vegetation found elsewhere on San Clemente Island, and the cliffs that attract bird species for foraging, nesting and loafing. Also, within this area is a ramp used for aircraft parking. The pad-eyes used to tie down aircraft act as collection reservoirs for water and seeds which in turn attract small birds, such as horned larks.

Area 3: Approach end of Runway 5. This area encompasses portions of the runway at the approach to 5, the overrun area which is a mixture of all types of vegetation found elsewhere on San Clemente Island, and the cliffs, beach and water in the approach path to runway 5. This area also encompasses the West Cove, which attracts several species. Although West Cove is on the edge of the assessment area, birds from this area move across the runway to and from sites on the northeast side of the island.

These areas all represent various degrees of risk to flight operations at NALF SCI. In general, areas 1 and 3 can represent a high risk to pilots and aircraft based on bird numbers, species observed, bird movement patterns and habitat. Area 2 represents a moderate risk based on fewer large bird movements into flight patterns, bird numbers, bird species, and habitats (Figure 3).

In addition, red-tailed hawks, common ravens and American kestrels (*Falco sparverius*) are attracted to the airfield in search of prey. These species have all been observed foraging in and around the airfield by NWRC personnel as well as Institute for Wildlife Studies predator control team (Contract No.: N68711-99-C-6665, Figures 20-22). All of these species have been observed crossing the runway at various locations and altitudes. Biologists with Institute for Wildlife Services have documented red-tailed hawks nesting near the Sea Test Facility and West Cove Beach (Cooper et al. in prep). Common ravens have been documented nesting near the Navy Seals camp, in the vicinity of the Sea Test Field, and near West Cove Beach. American kestrels have been documented nesting near the Sea Test Facility (Cooper et al. in prep). Movements of these species from nest sites to foraging sites intersect the runway at various locations.

Bird Use of NALF SCI

Fifty-three bird species were observed on NALF SCI during the Wildlife Hazard Assessment period (Table 1). Bird observations indicated the greatest bird activity on the airfield (all stations) occurred between June and December 2002 (Figure 6). Peak bird activity was in August and November 2002 with daily bird counts averaging approximately 200 birds (Figure 6). The lowest bird activity occurred in March 2002, during which only a daily mean of 46 birds were observed (Figure 6). Most numerous birds observed during the assessment period were, in descending order, horned larks, European starlings, house finches and western meadowlarks (Figure 7).

Observations by station indicate that stations 3 and 5 had the greatest bird activity and station 4 had the least bird activity (Figure 8). Horned larks were the most abundant species observed at station 3 and 5 (Figure 9). The peak daily mean number of birds by station varied during the assessment period. For example, at station 1, bird numbers peaked in June and August 2002, at station 3 bird numbers peaked in August and October 2002, and at station 6 bird numbers peaked in July and December 2002 (Figure 10).

There was little evidence of bird activity at night in and around the airfield. The greatest bird numbers were observed during April when an average of two birds were observed on the runway each night (Figure 11). Of the birds that could be identified, barn owls (*Tyto alba*), western meadowlarks, western snowy plovers and burrowing owls (*Athene cunicularia*) were most commonly observed on and around the airfield during night surveys (Figure 12).

Runway crossings varied each month, and daily mean runway crossings were most abundant from May to November 2002 with the greatest number of runway crossings occurring in August and September 2002 (Figure 13). The lowest number of runway crossings occurred in March 2002 and January 2003, during which the daily mean number of birds crossing the runway was six. The greatest number of birds crossing the runway was, in descending order, horned larks, European starlings and house finches (Figure 14). Daily mean runway crossings during August and September 2002 documented about 48 crossings, primarily by horned larks (Figure 14).

Observations by station indicate that station 3 had the greatest number of crossings and station 5 had the least number of crossings (Figure 15). Horned larks were the most abundant species crossing the runway at stations 3 and 5 (Figure 16). The peak daily mean number of runway crossings by station varied during the assessment period. For example, at station 1, daily mean runway crossings peaked in July and August 2002, at station 3, runway crossings peaked in August 2002, and at station 6, runway crossings peaked in September, November, and December 2002 (Figure 17).

During night observations, birds were only observed crossing the runway during two months of the assessment period (Figure 18). Most of these runway crossings occurred during April when an average of one bird was observed crossing the runway each night (Figure 18). Of birds that could be identified, western meadowlarks were most commonly observed crossing the runway (Figure 19).

Bird/Aircraft Strikes

During the Wildlife Hazard Assessment period, three bird/aircraft strikes were reported to the Naval Safety Center which included a western meadowlark, a western gull and an unidentified small bird. Strikes occurred in March, April and August, respectively (Table 2). Of the three strikes, the small unidentified bird struck by an S-3 during final approach impacted the number one engine. Inspection revealed that the eleventh stage compressor blades cracked. The engine was removed and repaired.

In addition, NWRC personnel found eight dead birds during the Wildlife Hazard Assessment period which were determined as strikes and were informed by Berry Aviation of one other (Table 3). Of these, three were horned larks (Figure 23), one was a western meadowlark, one was a barn owl, one was a northern fulmar and the remaining three were unidentified. All of these birds were found in close proximity to the runway (Table 3).

Roosting Surveys

No birds were observed roosting on the runway, but there were four areas in close proximity to the airfield where birds were observed staging or roosting. These areas were Seal Island (north of the airfield), Sea Test Facility (southeast of the airfield), West Cove (southwest of the airfield), and Seals Beach (north of the airfield). Overall, double-crested cormorants (66%), unidentified gulls (11%), western gulls (10%), California brown pelicans (6%), European starlings (2%), and Heermann's gulls (*Larus heermanni*) (2%) were the most frequently observed species roosting at areas around the NALF SCI airfield. Of the birds observed on Seal Island, double-crested cormorants represented about 84%, western gulls represented 6%, and California brown pelicans represented 5% (Table 4). Of the birds observed roosting on concrete buoys and the cliffs near the Sea Test Facility, unidentified gulls represented about 44%, double-crested cormorants 25%, and European starlings 14% (Table 4). Of the birds observed roosting on West Cove, western gulls represented about 40%, Heermann's gulls 19%, and double-crested cormorants 16% (Table 4). Of the birds observed on Seals Beach, western gulls represented about 44%, California brown pelicans 18%, and Heermann's gulls 15% (Table 4). Movements of these birds are generally restricted to open water or along the Island's coastline just above water level. However, on occasion gull species have been observed flying or towering in the flight path of departing or landing aircraft.

DISCUSSION

Birds on and around NALF SCI airfield do represent a direct safety risk to aircraft operations. Every reasonable effort should be made to discourage birds from using NALF SCI habitat within the primary surface area of the airfield. Particular emphasis should be made to discourage birds from using habitat around and/or crossing the area near the approach to runway 23 and mid-field near station 3. This habitat attracts a wide variety of bird species. Of the birds observed on NALF SCI horned larks, European starlings, house finches, barn swallows (*Hirundo rustica*), red-tailed hawks, common ravens and western meadowlarks present the greatest risk to pilots and aircraft. An integrated management strategy directed at these species and others would have a large impact on aircraft safety and should be directed at the species itself, its foraging source and its loafing/roosting habitat.

Data gathered from the Wildlife Hazard Assessment indicates that habitat management, direct population control, innovative management techniques and dispersing birds from NALF SCI should significantly reduce the bird/aircraft hazard. Habitat management of the vegetation areas on either side of the runway could be the most effective measure to reduce the bird hazard on NALF SCI. The lack of a vegetation management plan on or around the airfield could result in a flight safety issue and compromise the operational readiness of the airfield. Horned lark, western meadowlark and chukar numbers could be greatly reduced by managing these areas with a covering material or mowing the vegetation to reduce seeding and/or bird cover. Making the airfield vegetation fairly uniform would also result in it being less attractive to wildlife species, especially birds.

Direct population control will be an effective short-term solution to reducing the bird/aircraft hazard at NALF SCI. Individual species could be targeted for management based upon their level of bird/aircraft strike risk. Small passerine birds, i.e. horned larks and house finches, European starlings, western meadowlarks, barn swallows, common ravens, red-tailed hawks and western gulls pose the greatest problems at NALF SCI and some species present a greater risk than others. Management of individual species should be based on population numbers, presence, movement patterns, size, weight, activities and habitat preference.

Dispersing birds with hazing techniques or developing innovative control measures to manage the bird/aircraft hazard at NALF SCI will require significantly more logistical support for a longer duration. For example, the presence of raptors and ravens around the airfield present a two-fold problem because they are large birds [red-tailed hawks: 1028-1224 g; ravens 1158-1240: g (Dunning 1984)] that are capable of causing significant damage to aircraft if struck. Dispersing these birds can be difficult, but not impossible. Eliminating nesting sites for either bird on the north side of the runway could reduce the number of runway crossings. Also, direct control of these species in and around the airfield would also alleviate the problem. Translocation of these species to other parts of the island would probably be ineffective. However, translocation of these species off the island to the mainland could be effective.

NALF SCI's peak operating times are 0800 to 1600 hours Monday through Friday. The aircraft vary from turbo prop engines to fighter jets, but the majority of traffic is from turbo prop engines. The greatest daily bird activity was observed from June through December 2002 at all stations, with the peak months being August and November 2002. During these months, efforts such as mowing/weeding, pyrotechnics and hazing techniques should be taken to decrease the number of birds on and around the airfield. The birds generating the greatest risk on NALF SCI are, in descending order, horned larks, European starlings, house finches and western gulls. Removal of loafing, foraging and nesting habitat from the vicinity of the airfield by the above management techniques would greatly decrease the bird/aircraft strike hazard. Although three of these bird species are small in size, they are capable of causing damage to aircraft. In fact, European starlings are considered "feathered bullets" as they have a body density 27% higher than herring gulls and a flock of European starlings caused a C-130 military aircraft to crash in Eindhoven, Netherlands in 1996, killing 34 people (Dolbeer 2002). Horned larks represent 27% of NALF SCI strikes.

Stations 3 and 5 had the greatest daily bird activity during the Wildlife Hazard Assessment period, but many of the birds at station 5 were observed on West Cove Beach, thus there were very few runway crossings at station 5. The greatest overall risk to aircraft operations is near station 3 (midfield between markers 3 and 4 on runway 5-23), where most bird runway crossings occur. Demolition of many of the buildings in station 3, installation of anti-perching devices to any remaining structures, and vacuuming the pad-eyes in the ramp area would greatly reduce the foraging, nesting and roosting habitat in this station.

The greatest number of daily runway crossings occurred from May to November 2002, with peak months being August and September 2002. During these months, efforts such as mowing/weeding, pyrotechnics, hazing teams and translocation of birds should be taken to decrease the number of birds on and around the airfield. The birds generating the greatest risk to aircraft regarding runway crossings on NALF SCI are, in descending order, horned larks, European starlings and house finches. Forty-five percent of strikes have been found in the overrun areas of the approach to runway 5-23 have involved both small and large birds (horned larks to Northern fulmars). Thirty-six percent of strikes have been found alongside runway 5-23 from stations 2 through 5 and have involved both small and large birds (horned larks, western meadowlarks and barn owls). Thus, it appears station 3 and station 5 (between markers 2 and 3 on Runway 5-23, West Cove and West Cove Beach) present areas where the majority of birds are observed, also presenting a high risk to aircraft. Efforts should be made, especially in these areas, to decrease bird use of NALF SCI airfield.

NALF SCI conducts night operations from 1800 to 2300 hours on a regular basis, with carrier deck landing being the most common. The greatest nightly bird activity was observed from February through March 2002, with the other months having no bird activity. Of birds observed, unidentified birds were most abundant (72%) with the rest consisting of barn owls (11%), burrowing owls, snowy plovers and western meadowlarks (5.5% each). Barn owls represent 10%, western meadowlarks represent 18% and the other species represent 0% of bird strikes on NALF SCI. Runway crossings by birds occurred in March and April during the WHA. Unidentified birds crossing the runway on NALF SCI represent 80% and western meadowlarks represent 20%. As mentioned before, western meadowlarks represent 18% and barn owls represent 9% of strikes on NALF SCI. However, nighttime bird activity is low therefore the meadowlark strike most likely occurred during daytime air operations.

Birds crossing the airfield from roosting areas did not appear to present a high risk to aircraft since these areas were some distance from the airfield. West Cove and West Cove Beach attract several species of gulls, double-crested cormorants and California brown pelicans, which may cause some risk to aircraft if these birds cross the airfield from roosting to foraging areas.

RECOMMENDATIONS

1. **Develop a bird/aircraft strike hazard plan.** The plan is currently being produced. It will outline procedures and set forth guidelines to address bird/aircraft strikes at NALF San Clemente Island. An outline in cooperation with NALF SCI, Tammy Conkle, BASH Project Manager has been developed.

2. **Implement a habitat management plan.**

    - Prioritize bird hazard areas on NALF SCI. We have prioritized these areas in Figure 3 based upon runway crossings, bird use, and bird strike locations.

- Conduct a plant survey around the airfield to ensure there are no threatened or endangered plant species on the airfield.
- Remove vegetation from either approach end of Runway 5-23; remove vegetation along the length between Runway 5-23 and Taxiway Alpha along the length of each; soil cement each area.
- If vegetation cannot be removed, mow and conduct weed maintenance on the above-mentioned areas.
- Remove/demolish unnecessary structures in the vicinity of the airfield (such as buildings and unexploited equipment in Station 3).
- Vacuum the pad-eyes in the ramp area on a regular basis.
- Install anti-loafing devices on structures remaining on or near the airfield, including buildings, equipment, markers and lights on the airfield and utility poles.
- Close lids of trash dumpsters around the airfield and in town.

3. **Continue to monitor and review BASH activities at NALF SCI.** Continue ongoing monitoring activities of wildlife by NALF SCI personnel. Apply these monitoring activities to high risk areas identified in this report.

4. **Establish a Bird Hazard Working Group.**

5. **Develop high bird strike hazard airfield operation procedures.** Develop a set of operational procedures for air traffic that takes into account risk of bird strikes

based on seasonal and daily variability in numbers of birds, species present and historic estimates of runway crossings based upon existing and future monitoring data.

6. **Provide information to all aircrews about the bird hazard at NALF SCI.** This report should be distributed to all personnel involved with aircraft and airfield operations. It should be a priority to have pilots, air operations, and ground personnel report any bird/aircraft related incidents, i.e. blood on the aircraft, bird parts on the runway or taxiway, damage to the aircraft, etc. Documentation is the key to increased safety.

7. **Implement a no bird/mammal feeding program.** Post no feeding signs at the air terminal and surrounding buildings. The signs should discuss the hazard. Police outside break and lunch areas for trash. Trash bins and dumpsters should always remain closed.

8. **Implement a species specific population control program.** Emphasis should be on small flocking birds. Use of techniques identified in this report and lethal control actions should be used to reduce runway crossing by species of concern.

    - Lethal control for populations of horned larks, European starlings, and house sparrows, when and where it can be legally implemented with traps.
    - Non-lethal control, removal, and dispersal when it is practical and effective using lasers, traps, mechanical devices and pyrotechnics.

9. Employ a wildlife specialist to implement and conduct wildlife, specifically bird control measures to reduce the bird/aircraft hazard.

10. Train Navy personnel in wildlife hazing procedures and species identification.

11. Adopt a policy of zero tolerance toward hazardous wildlife. A zero tolerance policy on the airfield should be adopted toward all potentially hazardous wildlife, waterfowl, shorebirds, raptors and gulls.

12. Continue BASH research. Continue research which improves on existing information and allows managers to accurately address BASH problems at NALF San Clemente Island.

13. Provide safety officer regular updates on BASH threats and program activities.

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ACKNOWLEDGEMENTS

We thank the U.S. Navy for their support and funding on this project. A special thanks to Cdr. S. Lilley, Ens. J. Gonzales, T. Conkle, R. Ebert, D. Flynn, R. Joseph, B. Sullivan, D. Cooper, E. Kershner, K. Brock, J. Larson, K. Roesch, S. Ruiz, S. Wright, K. Shively and Smithsonian Institute.

Table 1. Species of birds observed during the Wildlife Hazard Assessment on Naval Auxiliary Landing Field San Clemente Island February 2002 through January 2003.

Common Name	**Scientific Name**
American Kestrel	*Falco sparverius*
Barn Owl	*Tyto alba*
Barn Swallow	*Hirundo rustica*
Black Phoebe	*Sayornis nigricans*
Burrowing Owl	*Athene cunicularia*
Black Turnstone	*Arenaria melanocephala*
California brown pelican	*Pelecanus occidentalis californicus*
California Gull	*Larus californicus*
Chukar	*Alectoris chukar*
Common Raven	*Corvus corax*
Double-crested Cormorant	*Phalacrocorax auritus*
Dunlin	*Calidris alpina*
Eared Grebe	*Podiceps nigricollis*
Elegant Tern	*Sterna elegans*
European Starling	*Sturnus vulgaris*
Great Blue Heron	*Ardea herodias*
Heermann's Gull	*Larus heermanni*
Herring Gull	*Larus argentatus*
Horned Lark	*Eremophila alpestris*
House Finch	*Carpodacus mexicanus*
House Sparrow	*Passer domesticus*
House Wren	*Troglodytes aedon*
Long-billed Curlew	*Numenius americanus*
Marbled Godwit	*Limosa fedoa*
Merlin	*Falco columbarius*
Mountain Plover	*Charadrius montanus*
Mourning Dove	*Zenaida macroura*
Northern Mockingbird	*Mimus polyglottos*
Osprey	*Pandion halieatus*
Peregrine Falcon	*Falco peregrinus*
Red-tailed Hawk	*Buteo jamaicensis*
Ring-billed Gull	*Larus delawarensis*
Rock Dove (Pigeon)	*Columba livia*
Royal Tern	*Sterna maxima*
Ruddy Turnstone	*Arenaria interpres*
Rufous-crowned Sparrow	*Aimophila ruficeps*
Sanderling	*Calidris alba*
Sandpiper spp.	*Limosa* spp.
Savannah Sparrow	*Passerculus sandwichensis*
Say's Phoebe	*Sayornis saya*
Semipalmated Plover	*Charadrius semipalmatus*

Surfbird	*Aphriza virgata*
Western Grebe	*Aechmophorus occidentalis*
Western Gull	*Larus occidentalis*
Western Kingbird	*Tyrannus verticalis*
Western Meadowlark	*Sturnella neglecta*
Western Snowy Plover	*Charadrius alexandrinus nivosus*
Western Tanager	*Piranga ludoviciana*
Whimbrel	*Numenius phaeopus*
White-crowned sparrow	*Zonotrichia leucophrys*
Willet	*Catoptrophorus semipalmatus*
Wilson's Warbler	*Wilsonia pusilla*
Yellow-rumped Warbler	*Dendroica coronata*

Table 2. Strikes reported to the safety officer on Naval Auxiliary Landing Field San Clemente Island, California, during the Wildlife Hazard Assessment from February 2002 to January 2003.

Date	Time	Species	No.	Aircraft	Altitude (ft)	Location
Mar 11, 2002	1745	Western meadowlark	1	S-3	10	Short final approach to RW 23
Apr 4, 2002	unk	Western gull	2-10	C-9	1500	Over water on the approach to RW 23
Aug 28, 2002	1500	unk	1	S-3	100	Short final approach to RW 23

Table 3. Birds found on Naval Auxiliary Landing Field San Clemente Island, California, during the Wildlife Hazard Assessment from February 2002 to January 2003 that were determined to be strikes.

Date	Time	Species	No.	Aircraft	Location
Jan 25, 2002	0945	Unknown – black, pigeon sized	1	unknown	Overrun area at app to RW 23
Feb 21, 2002	1200	Unknown – brn & wht feathers, pelvic girdle	1	unknown	Overrun area at app to RW 5
Aug 22, 2002	1810	Horned lark	1	unknown	Edge of RW 5-23 at East arresting gear
Sept 6, 2002	0700	Unknown small bird	1	Berry Aviation - Metro	Approach to RW 23
Oct 19, 2002	1255	Horned lark	1	unknown	South edge of RW 5-23 at midfield
Oct 19, 2002	1330	Western meadowlark	1	unknown	South edge of RW 5-23 at #1 marker
Nov 23, 2002	1000	Barn owl	1	unknown	North edge of RW 5-23, 17 feet off runway
Dec 18, 2002	0835	Horned lark	1	unknown	Overrun area at approach to RW 5
Dec 18, 2002	0845	Northern fulmar	1	unknown	Overrun area at approach to RW 5

Table 4. Mean daily number of birds roosting on various areas around Naval Auxiliary Landing Field San Clemente Island, California, during the Wildlife Hazard Assessment from February 2002 to January 2003.

	Seal Island
Double-crested cormorant	125
Western gull	9
California brown pelican	8

	Sea Test Facility
Unidentified gull	11
Double-crested cormorant	6
European starling	3

	West Cove
Western gull	6
Heermann's gull	3
Double-crested cormorant	2

	Seals Beach
Western gull	19
California brown pelican	8
Heermann's gull	6

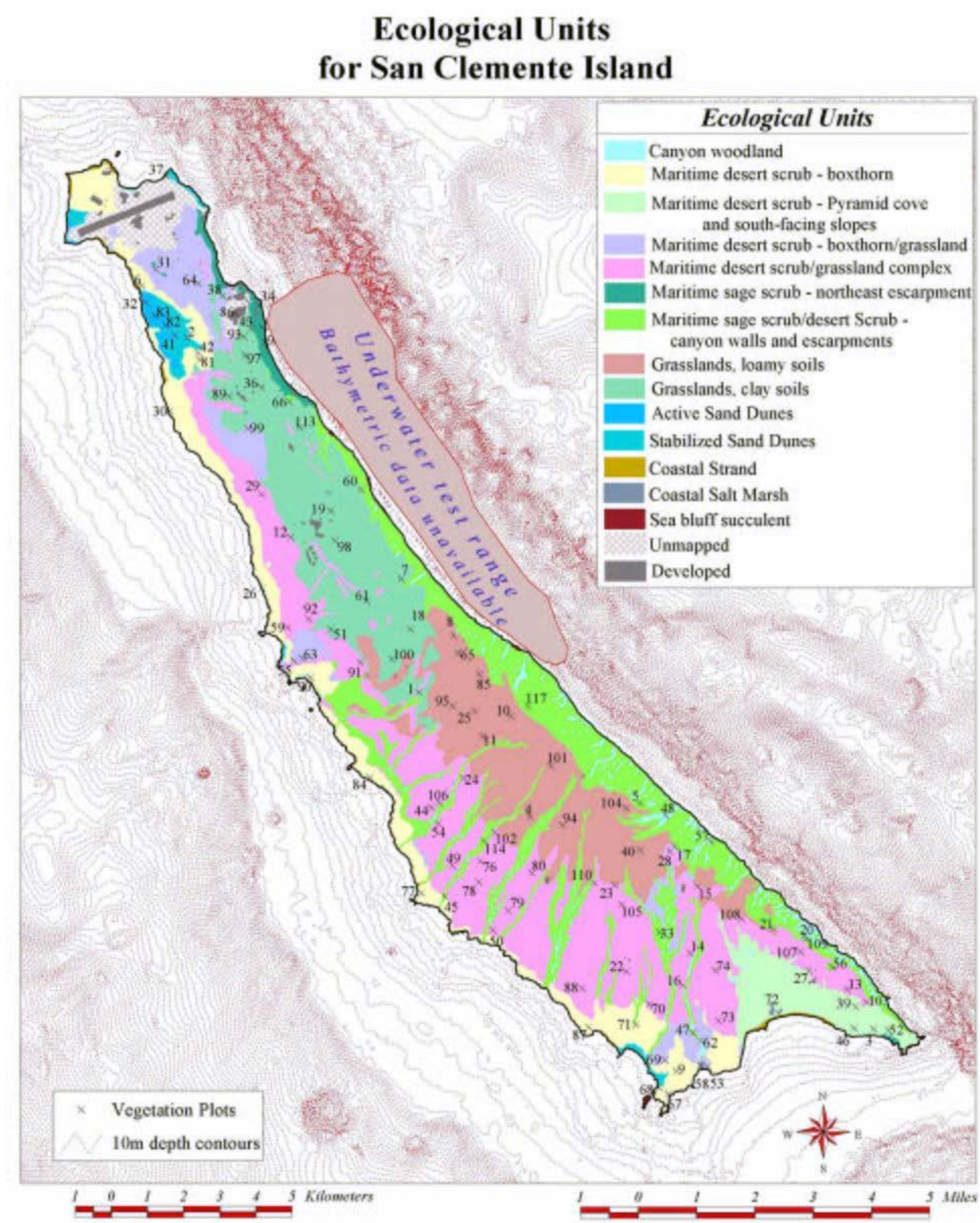


Figure 1. Ecological units for San Clemente Island illustrating the airfield is unmapped at this point. San Clemente Island Integrated Natural Resources Management Plan, Draft September 2001.

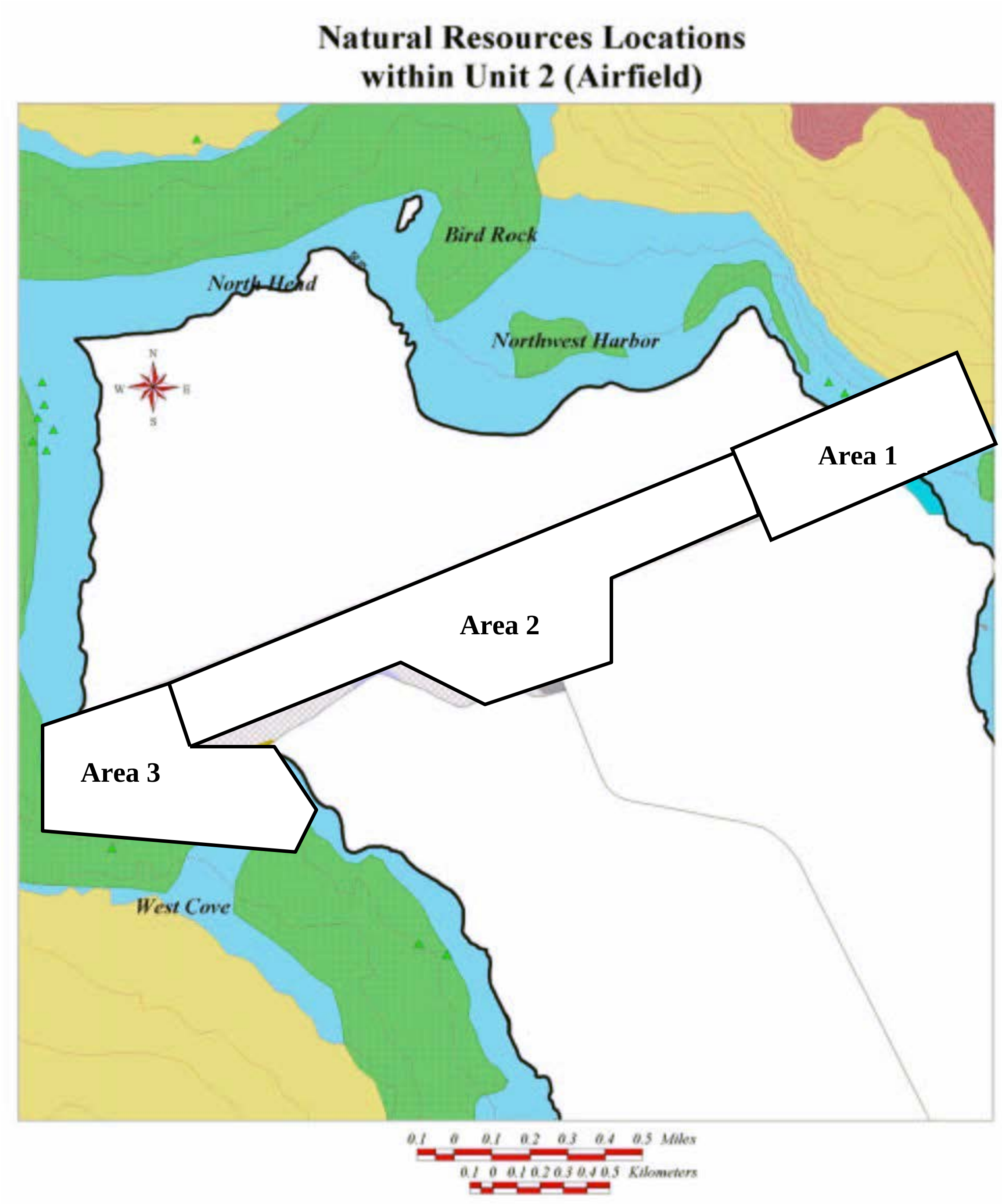


Figure 2. Area on and around the airfield. See map legend on next page. San Clemente Island Integrated Natural Resources Management Plan, Draft September 2001.

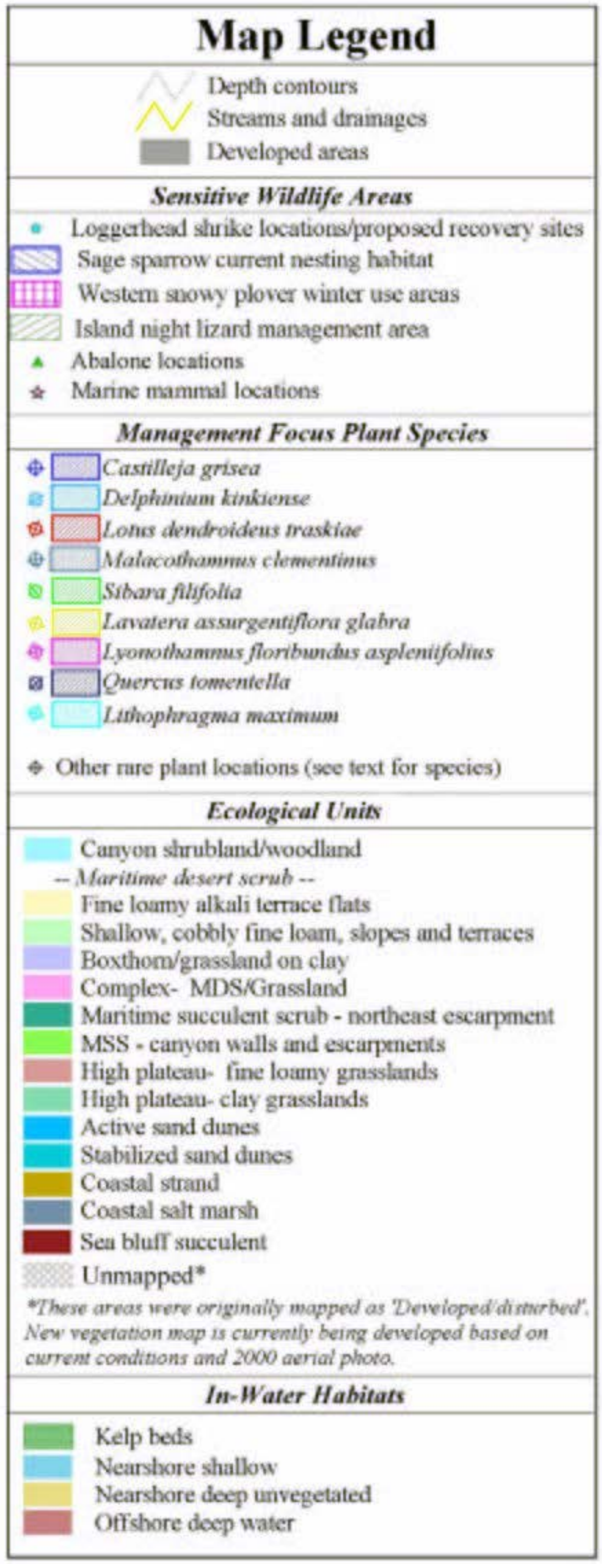


Figure 2 cont. Map legend of ecological units on and around the airfield. San Clemente Island Integrated Natural Resources Management Plan, Draft September 2001.

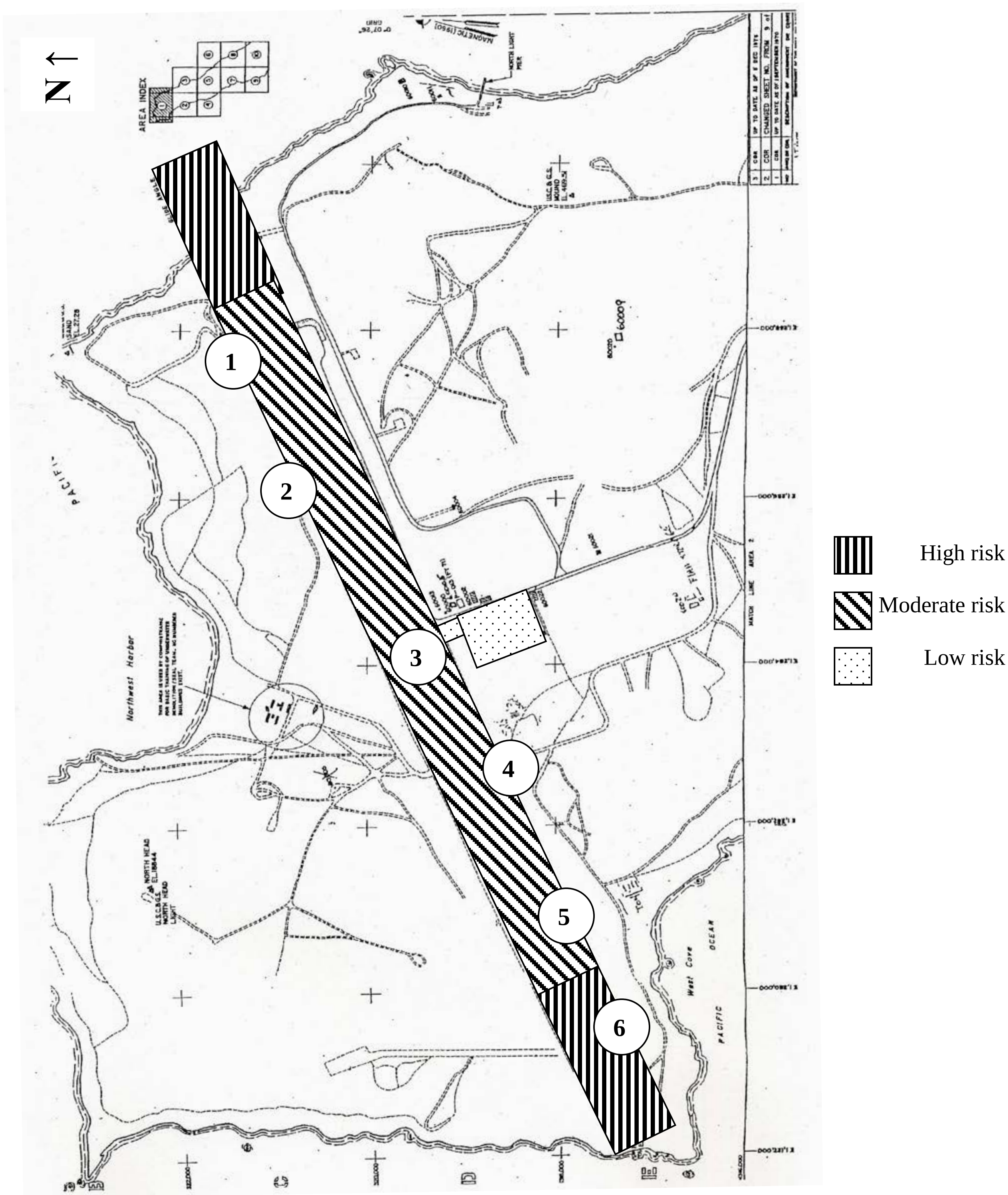


Figure 3. Areas on Naval Auxiliary Landing Field San Clemente Island, CA that presented a bird strike risk during the Wildlife Hazard Assessment from February 2002 to January 2003.

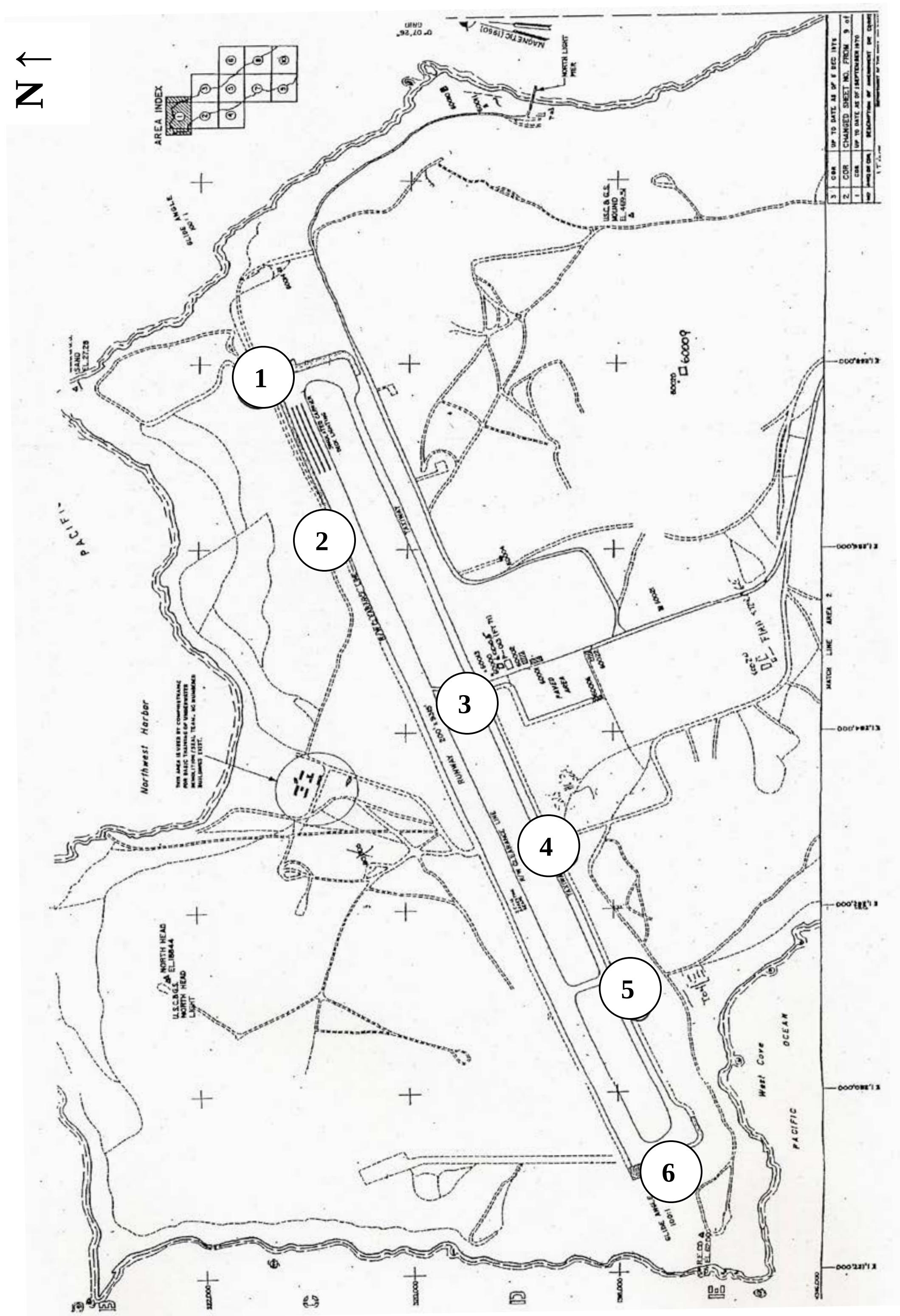


Figure 4. Wildlife Hazard Assessment Observation Stations 1 through 6 at Naval Auxiliary Landing Field San Clemente Island, California.

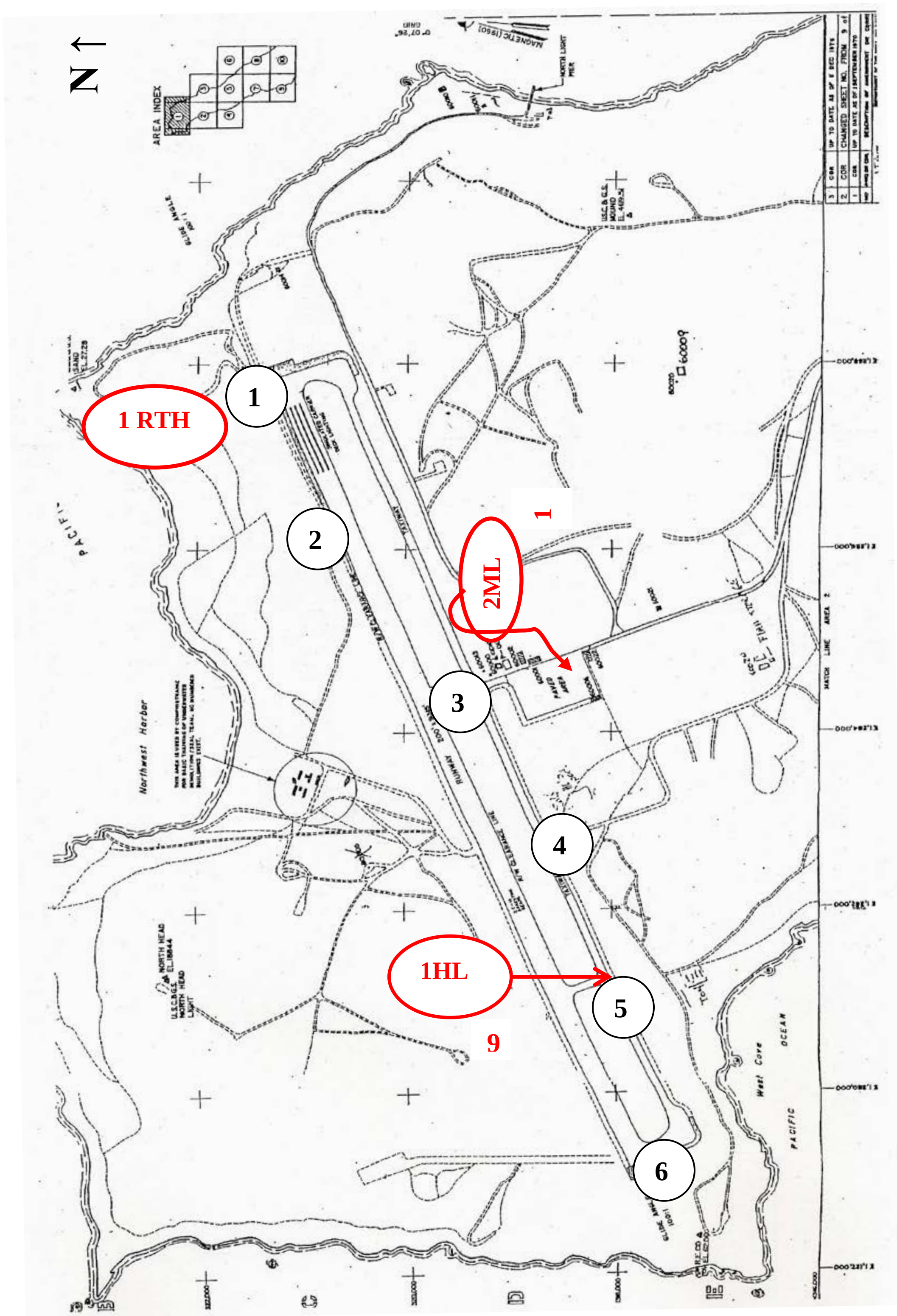


Figure 5. Naval Auxiliary Landing Field San Clemente Island, California map demonstrating procedure used to record bird activity.

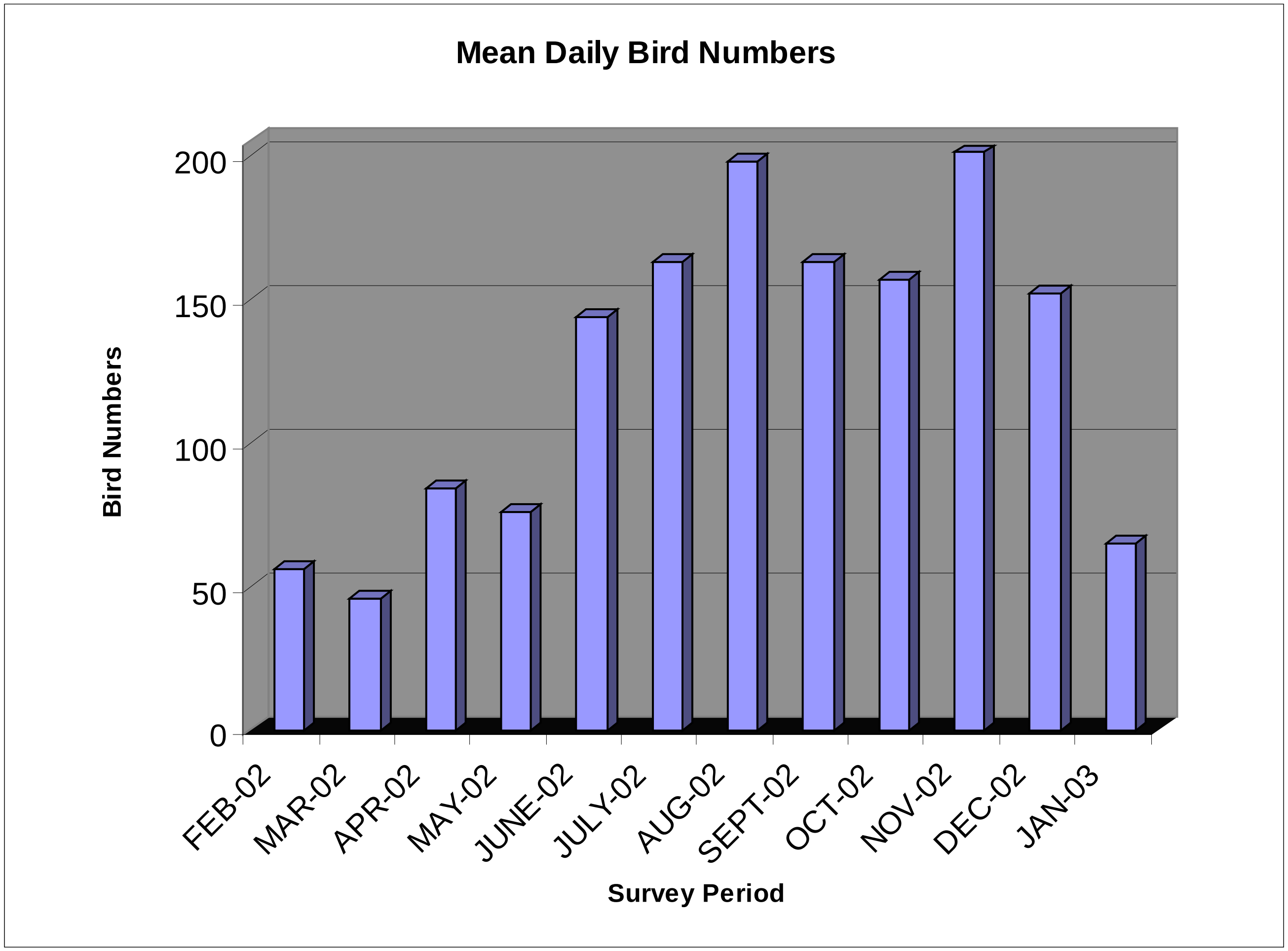


Figure 6. Daily mean number of birds observed on Naval Auxiliary Landing Field San Clemente Island, California, during the Wildlife Hazard Assessment from February 2002 through January 2003.

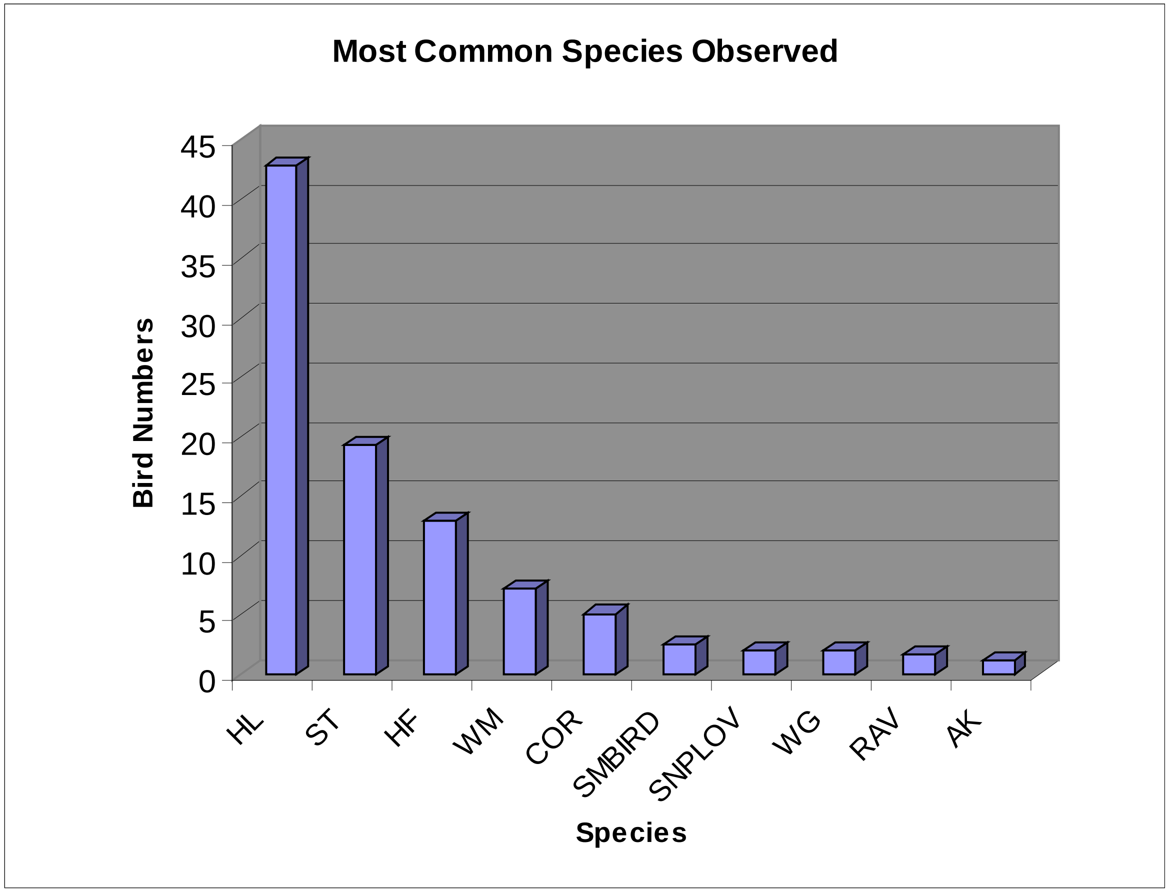


Figure 7. Daily mean number of most common birds observed on NALF SCI airfield during the Wildlife Hazard Assessment from February 2002 through January 2003. HL = horned lark; ST = European starling; HF = house finch; WM = western meadowlark; COR = double-crested cormorant; SMALLBIRD = unidentified small bird; SNPLOV = western snowy plover (threatened species); WG = western gull; RAV = common raven; AK = American kestrel.

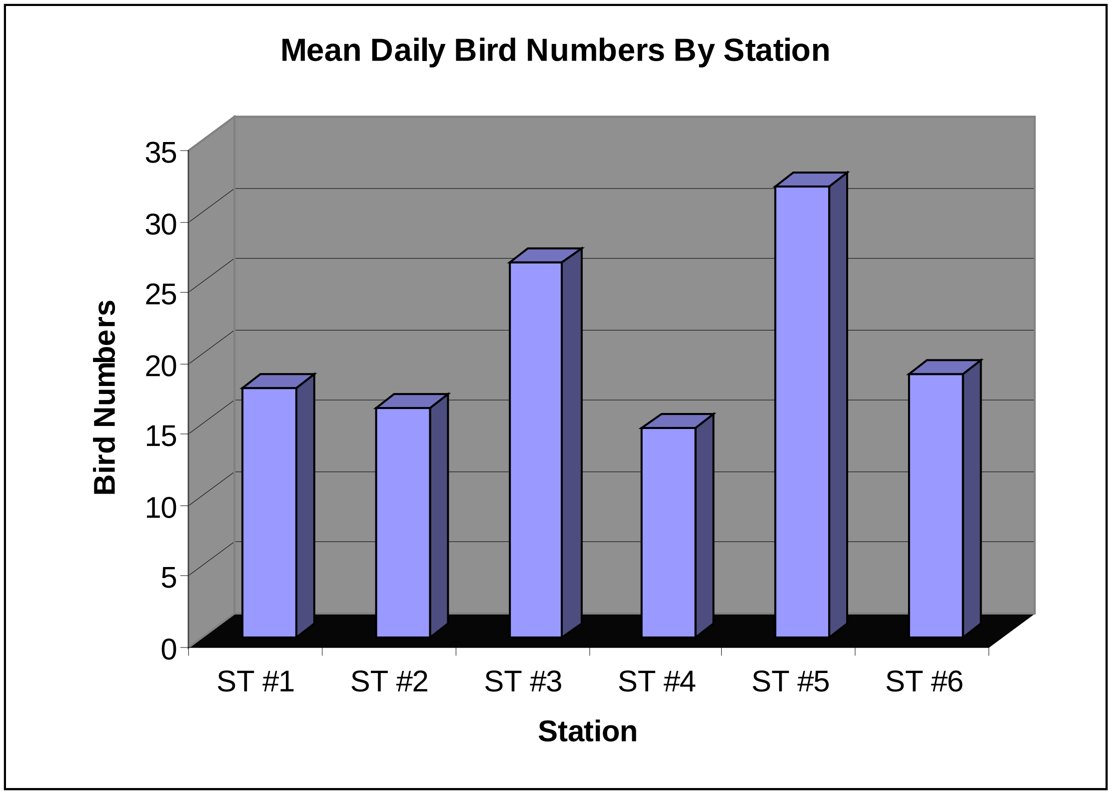
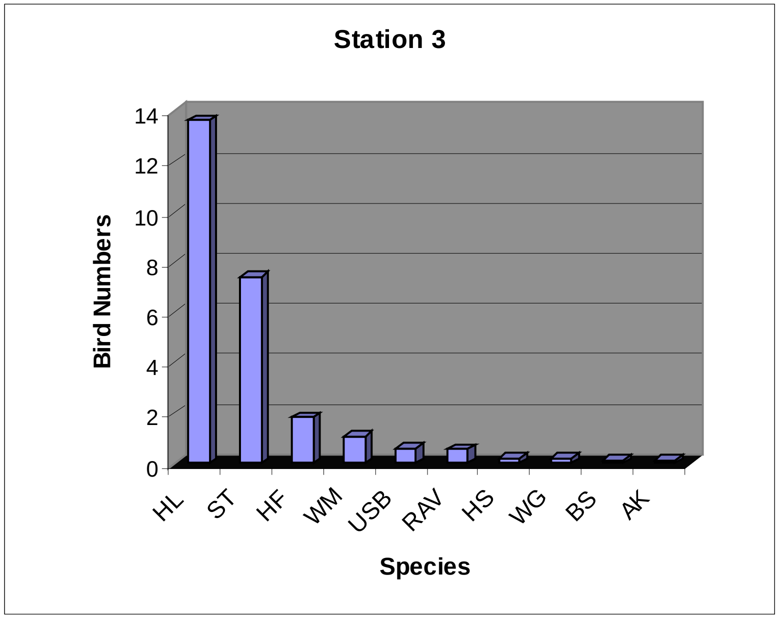


Figure 8. Daily mean number of birds observed by station on Naval Auxiliary Landing Field San Clemente Island, California, during the Wildlife Hazard Assessment from February 2002 through January 2003.



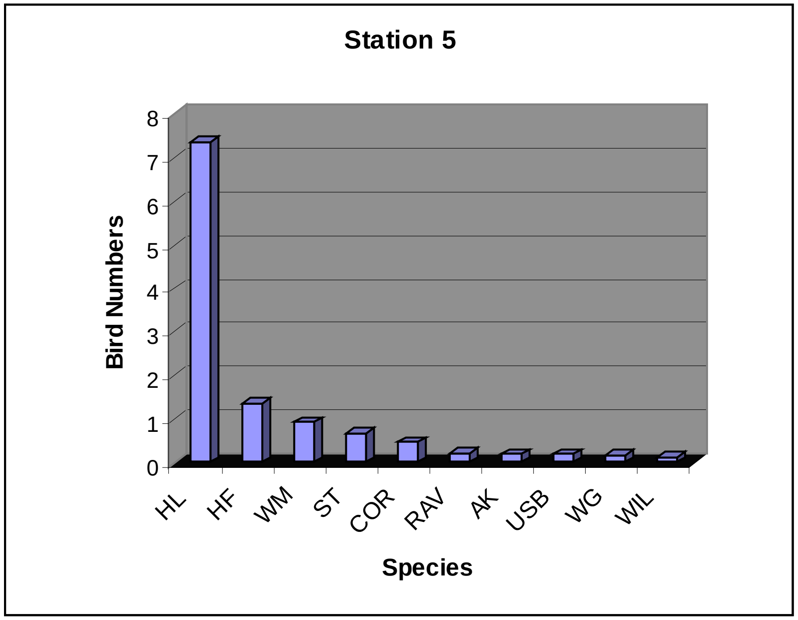


Figure 9. Daily mean number of most common birds observed at Station 3 on NALF SCI during the Wildlife Hazard Assessment from February 2002 through January 2003. HL = horned lark; ST = European starling; HF = house finch; WM = western meadowlark; USB = small bird; RAV = common raven; HS = house sparrow; WG = western gull; BS = barn swallow; AK = American kestrel; COR = double-crested cormorant; WIL = willet.

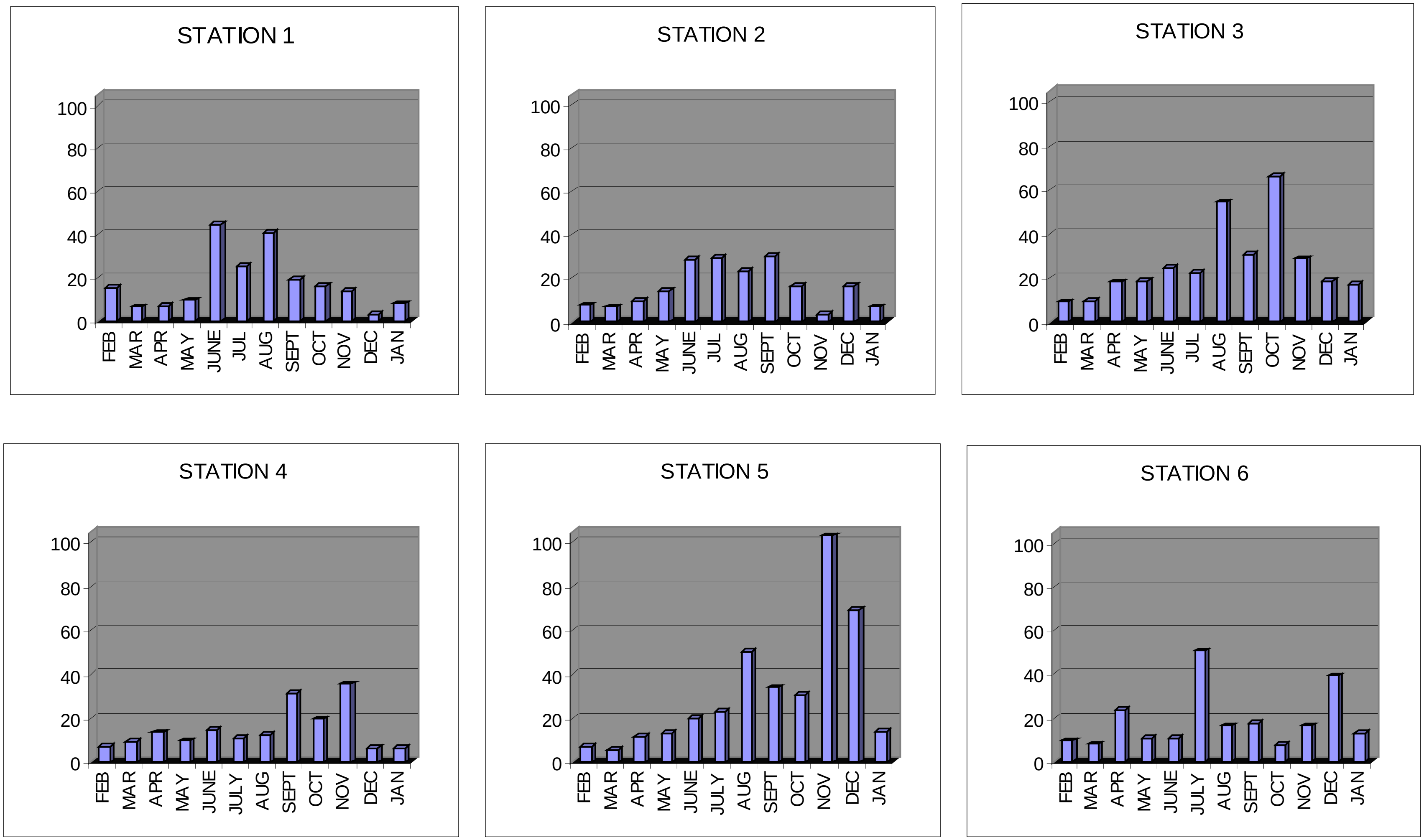


Figure 10. Daily mean number of birds by bird survey station on Naval Auxiliary Landing Field San Clemente Island, California, during the Wildlife Hazard Assessment from February 2002 through January 2003.

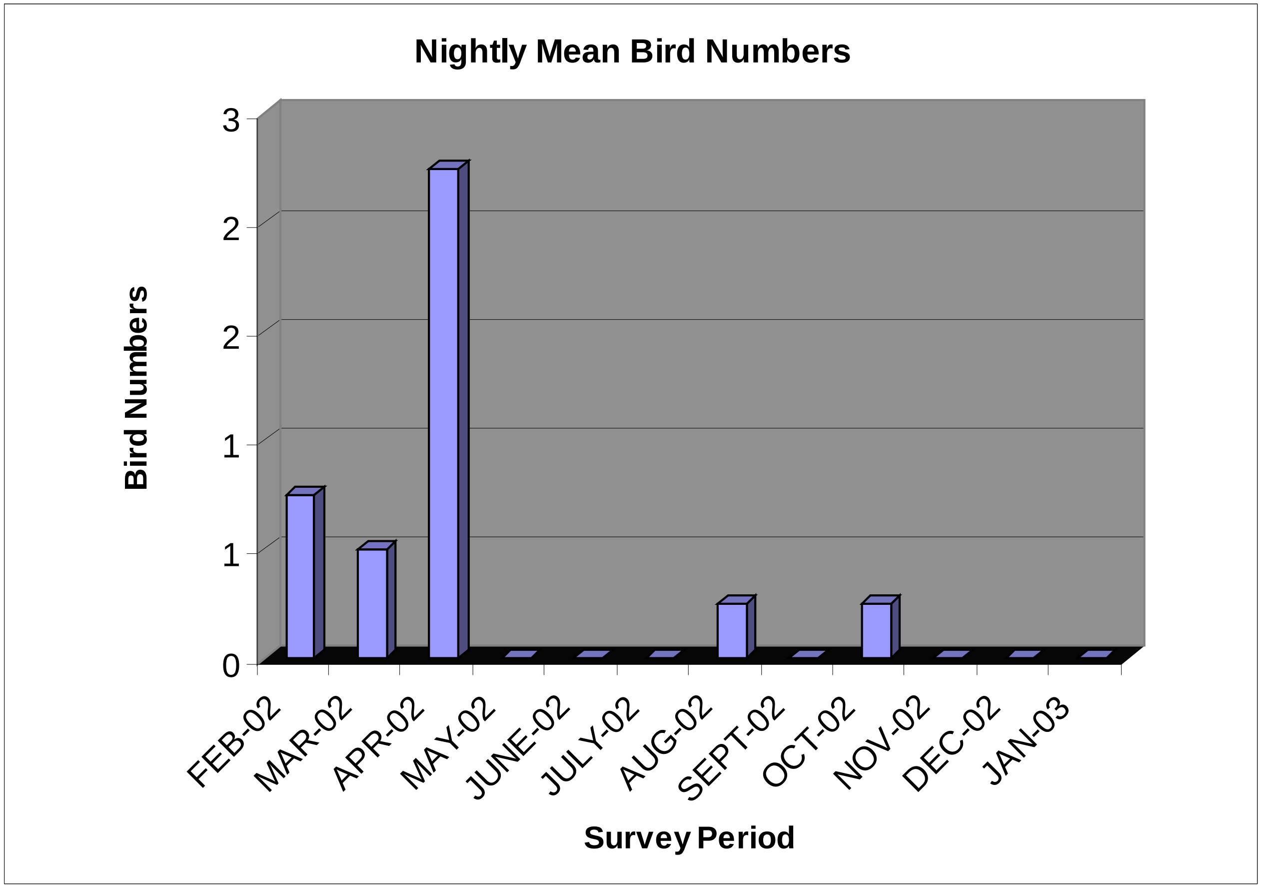


Figure 11. Nightly mean number of birds observed on Naval Auxiliary Landing Field San Clemente Island, California, during the Wildlife Hazard Assessment from February 2002 through January 2003.

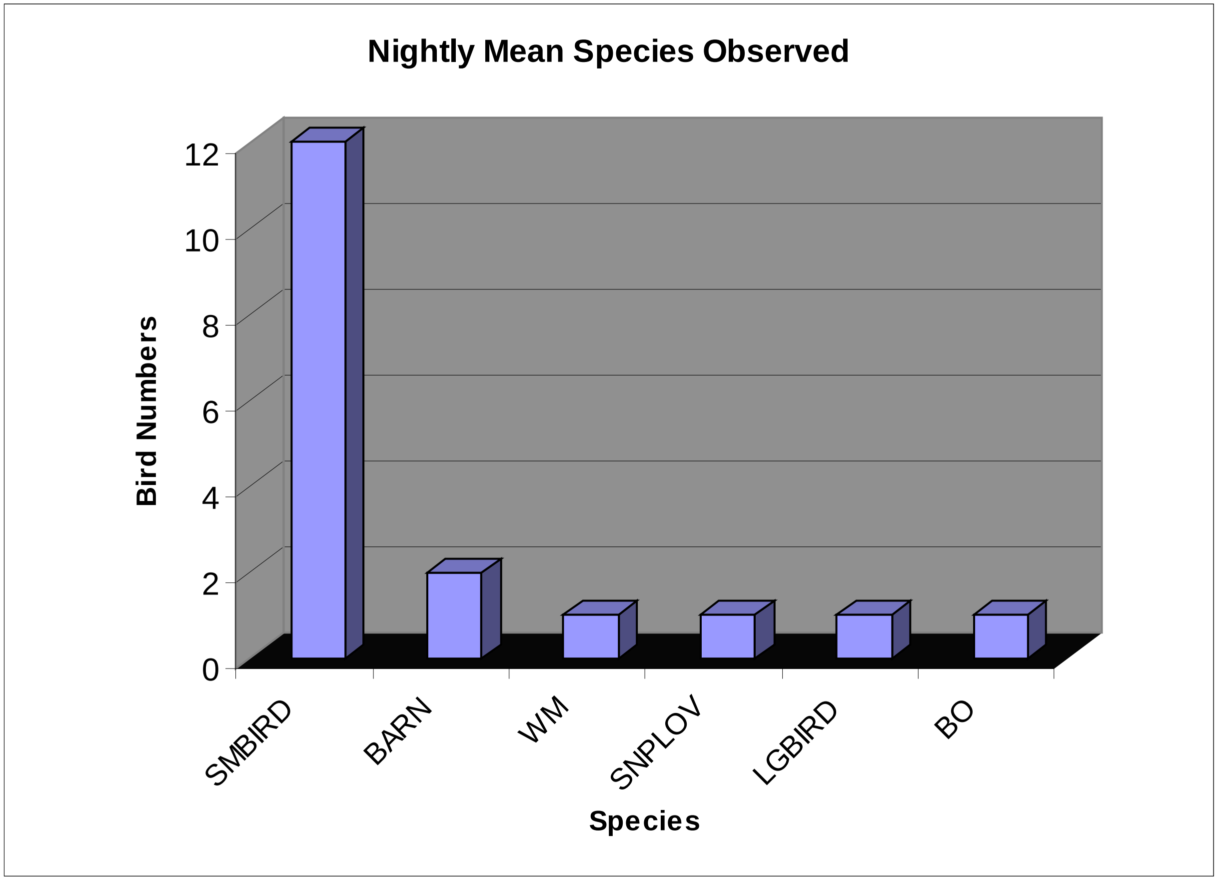


Figure 12. Nightly mean number of each species seen on the airfield during night surveys on NALF SCI during the Wildlife Hazard Assessment from February 2002 through January 2003. SMBIRD = unidentified small bird; BARN = barn owl; WM = western meadowlark; SNPLOV = western snowy plover (threatened species); LGBIRD = unidentified large bird; BO = burrowing owl.

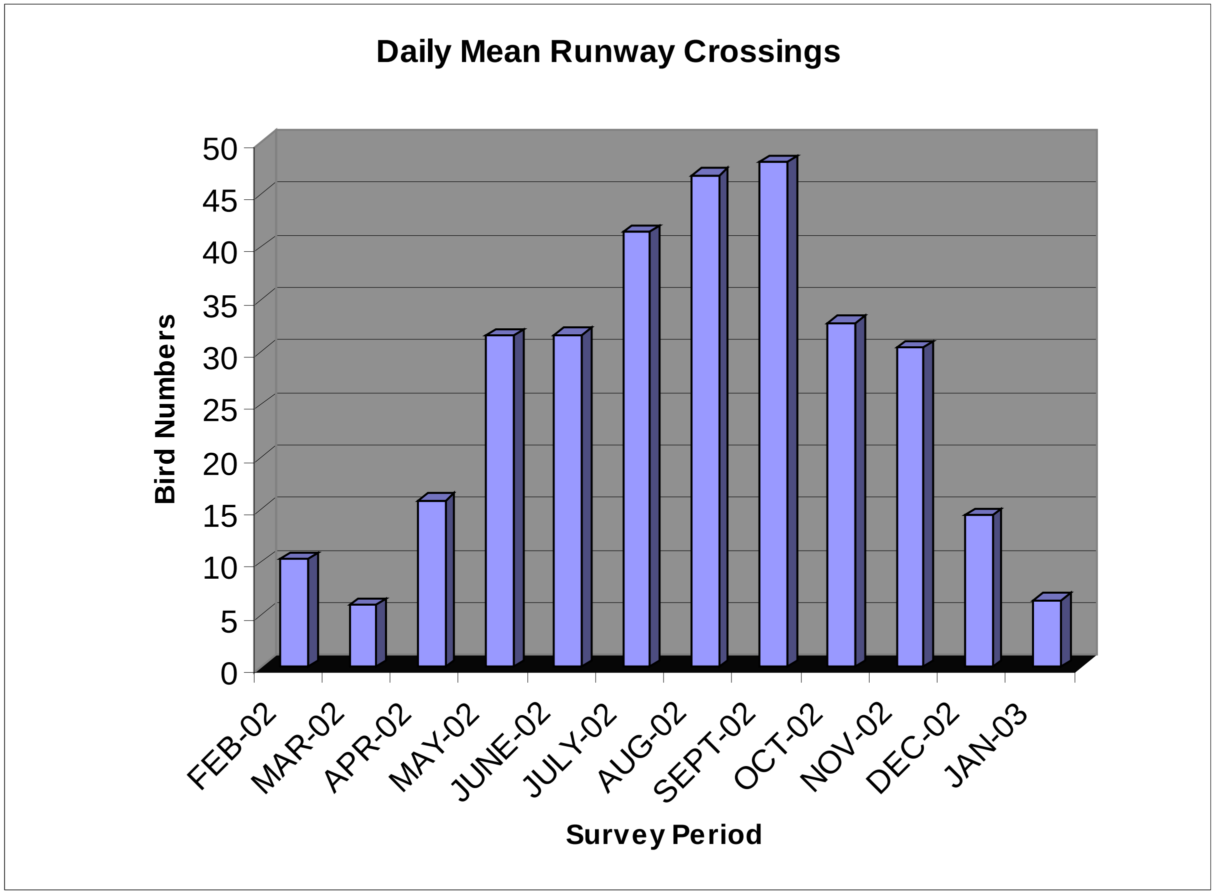


Figure 13. Daily mean number of runway crossings by birds on Naval Auxiliary Landing Field San Clemente Island, California, during the Wildlife Hazard Assessment from February 2002 through January 2003.

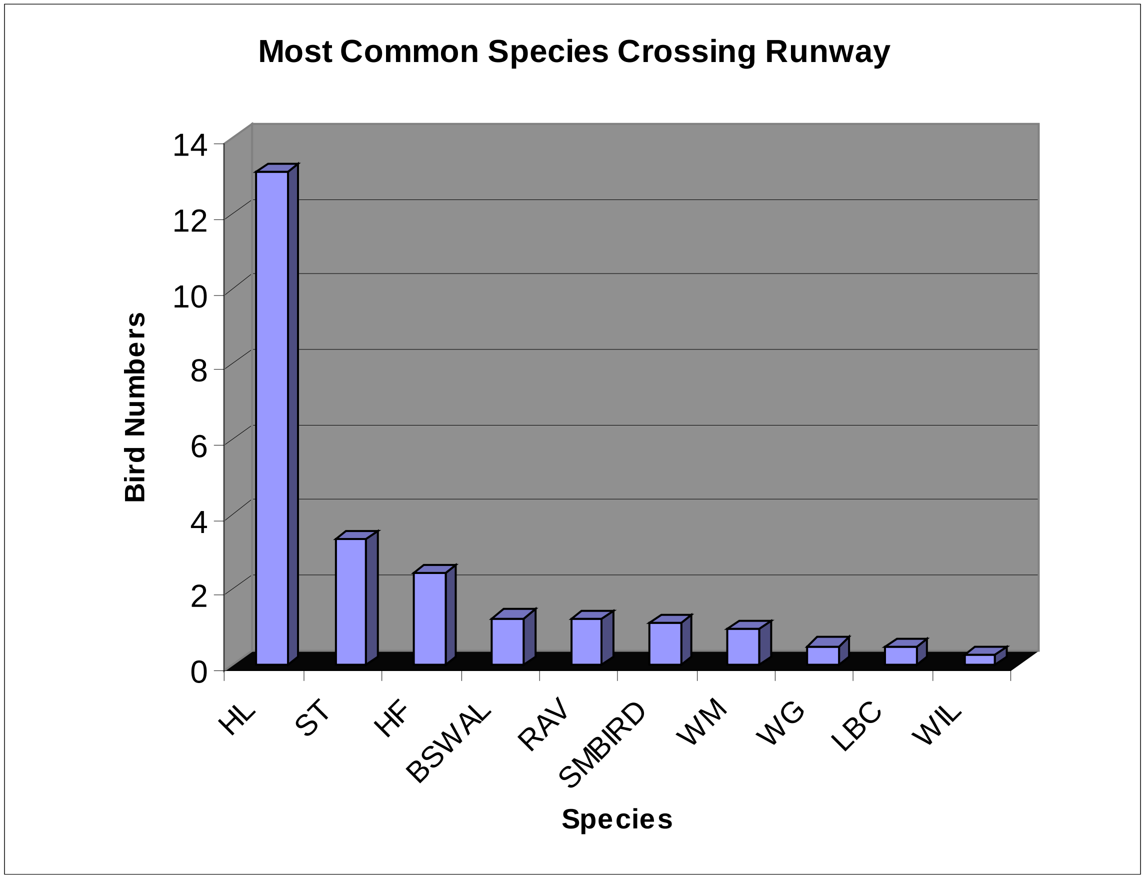


Figure 14. Daily mean number of most common birds crossing the runway on NALF SCI airfield during the Wildlife Hazard Assessment from February 2002 through January 2003. HL = horned lark; ST = European starling; HF = house finch; BSWAL = barn swallow; RAV = common raven; SM BIRD = small bird; WM = western meadowlark; LBC = long-billed curlew; WIL = willet.

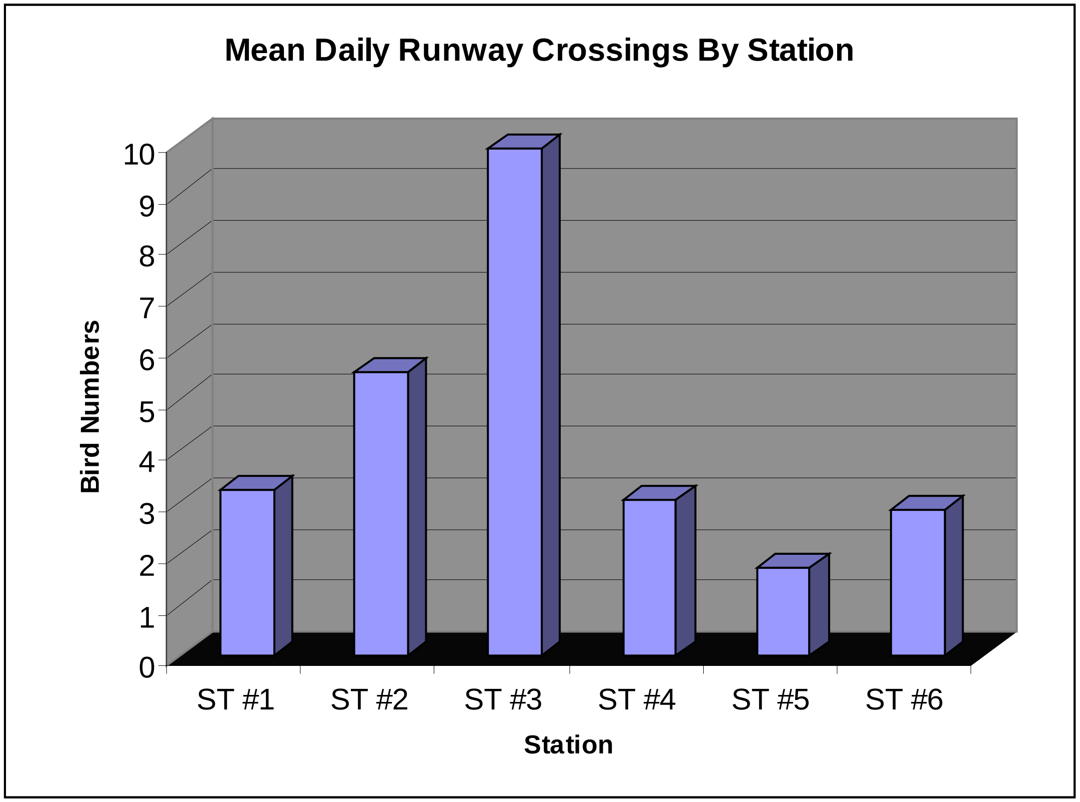


Figure 15. Daily mean airfield crossings by birds by station on Naval Auxiliary Landing Field San Clemente Island, California, during the Wildlife Hazard Assessment from February 2002 through January 2003.

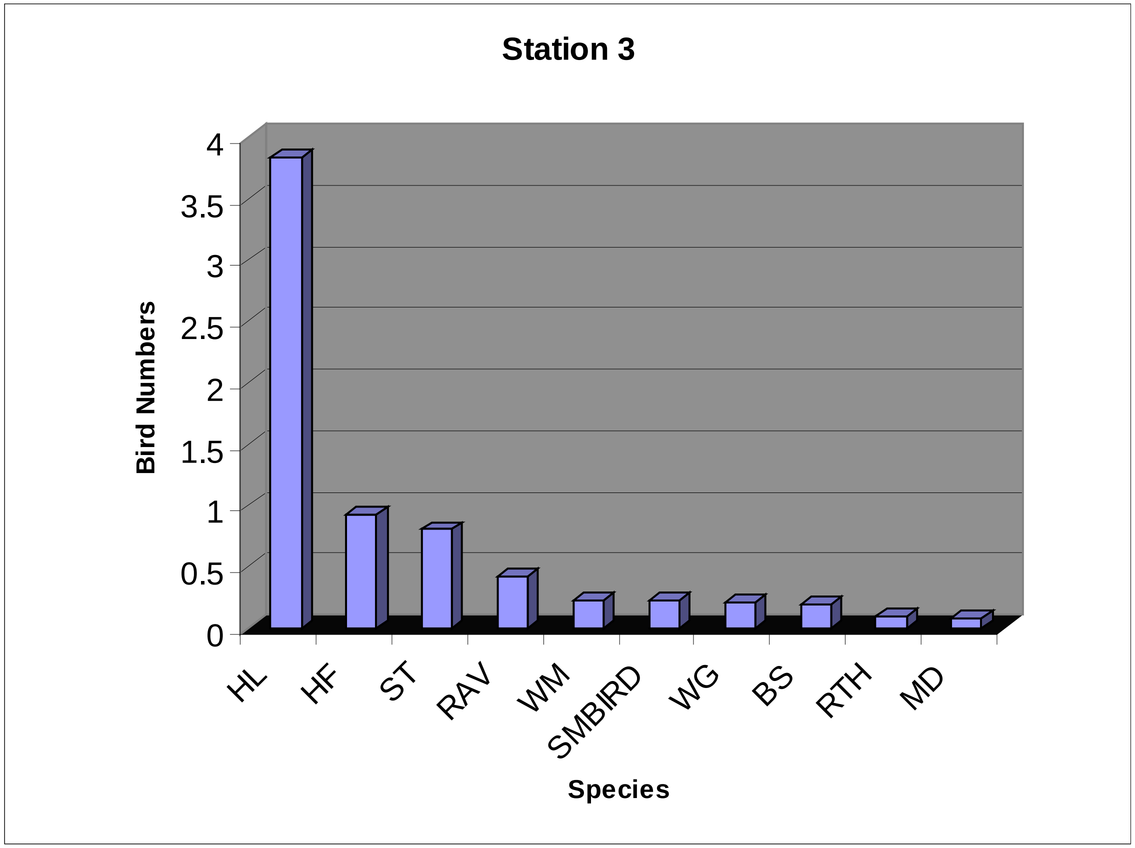


Figure 16. Daily mean number of most common birds crossing the runway at Station 3 on NALF SCI during the Wildlife Hazard Assessment from February 2002 through January 2003. HL = horned lark; HF = house finch; ST = European starling; RAV = common raven; WM = western meadowlark; SMBIRD = unidentified small bird; WG = western gull; BS = barn swallow; RTH = red-tailed hawk; MD = mourning dove.

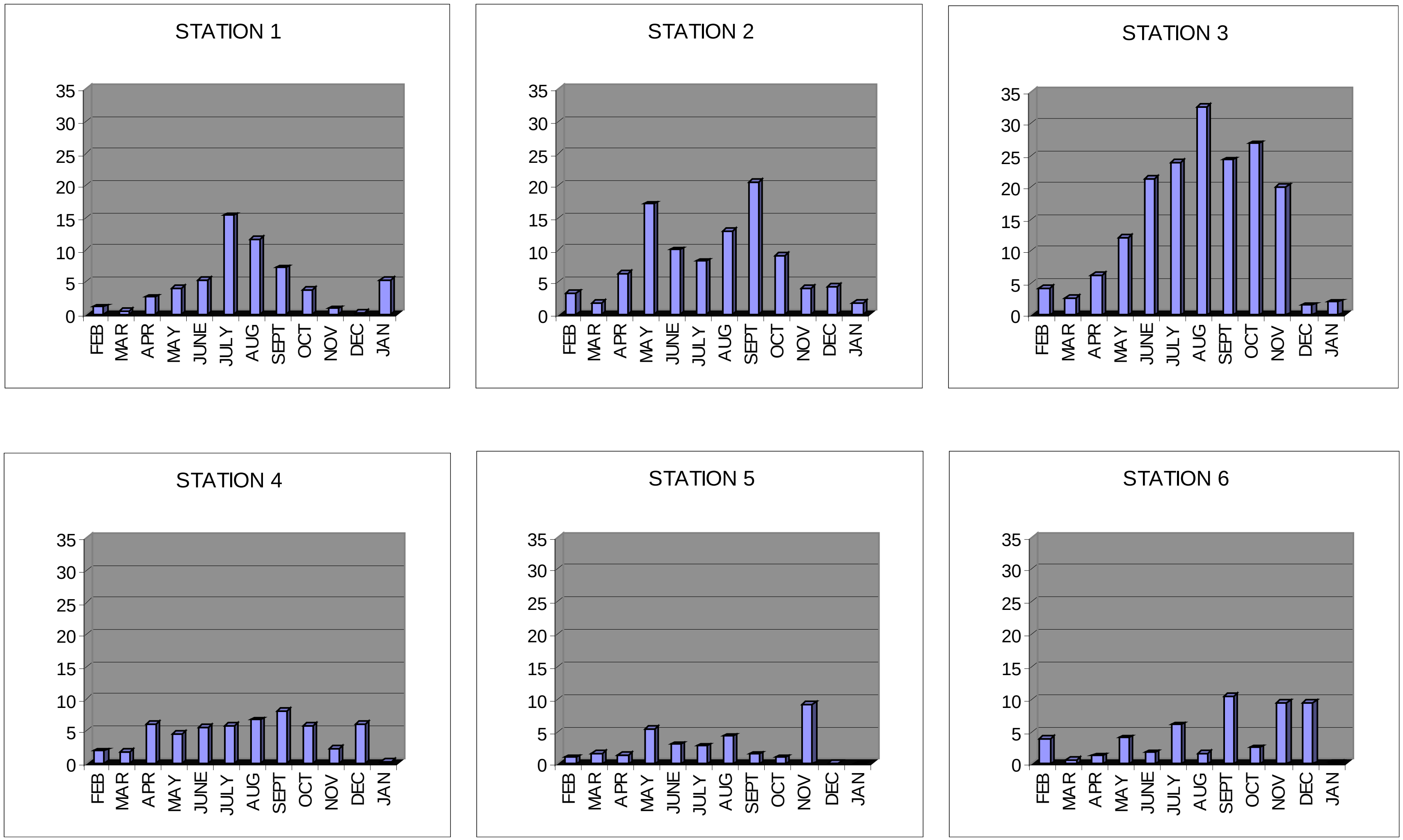


Figure 17. Daily mean runway crossings by bird survey station on Naval Auxiliary Landing Field San Clemente Island, California, during the Wildlife Hazard Assessment from February 2002 through January 2003.

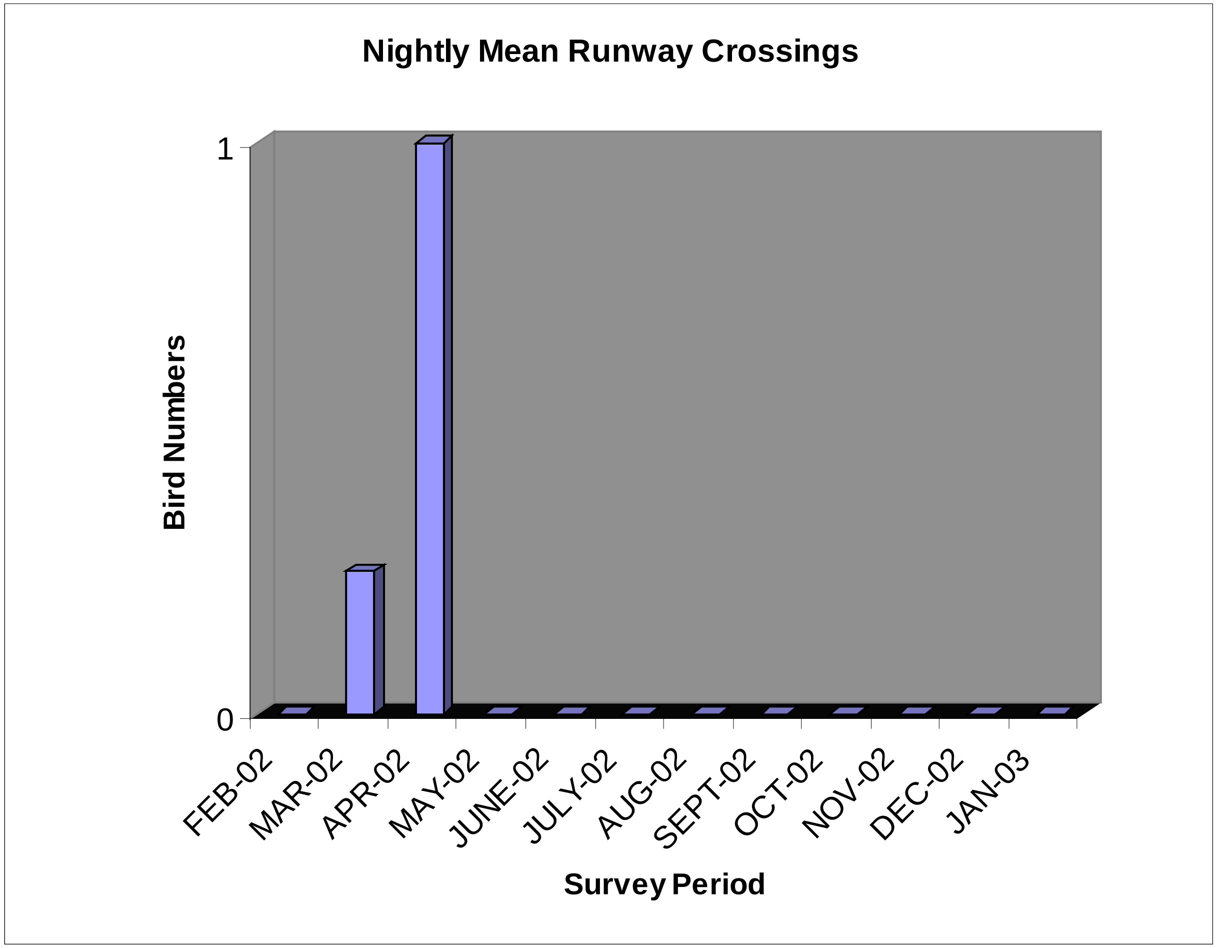


Figure 18. Nightly mean number of runway crossings by birds on Naval Auxiliary Landing Field San Clemente Island, California, during the Wildlife Hazard Assessment from February 2002 through January 2003.

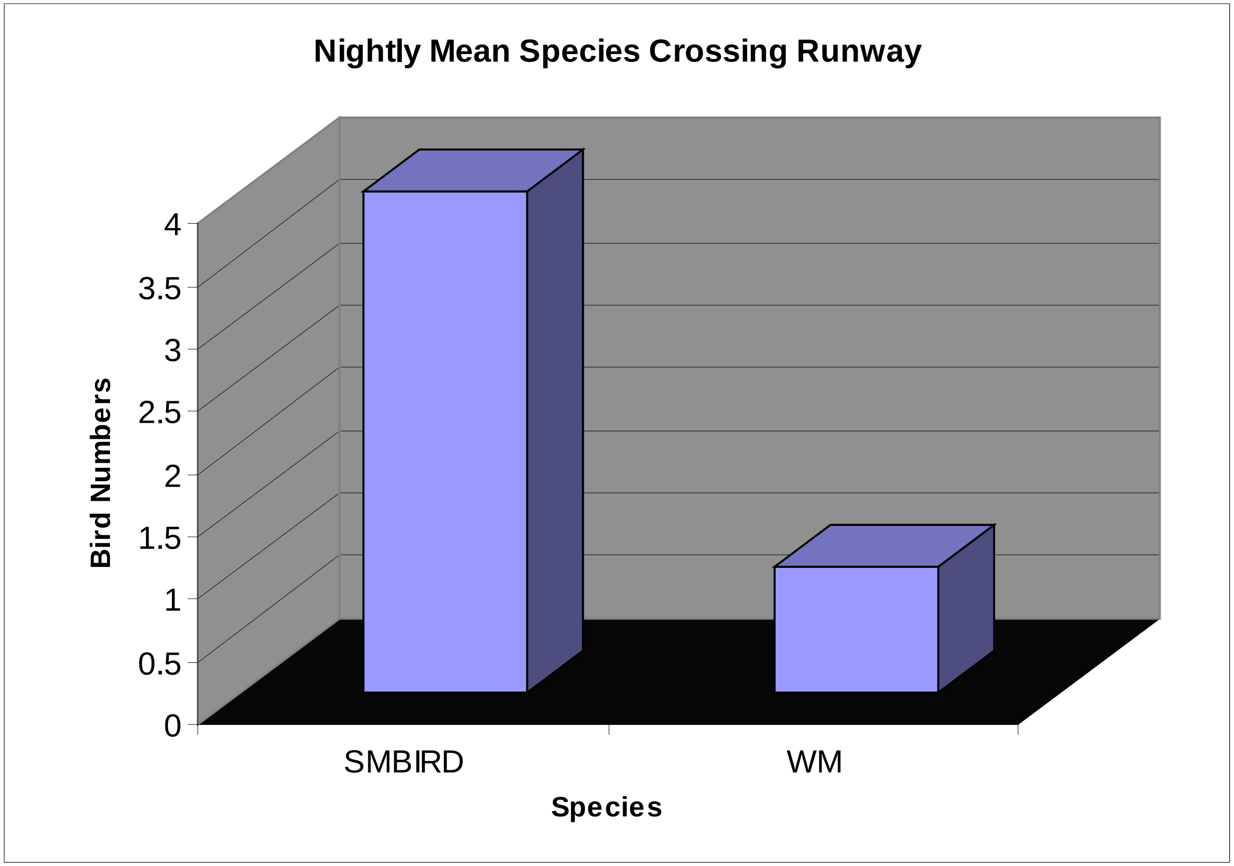


Figure 19. Nightly mean number of each species observed crossing the runway during night surveys on Naval Auxiliary Landing Field San Clemente Island, California, during the Wildlife Hazard Assessment from February 2002 through January 2003. SMBIRD = unidentified small bird; WM = western meadowlark.

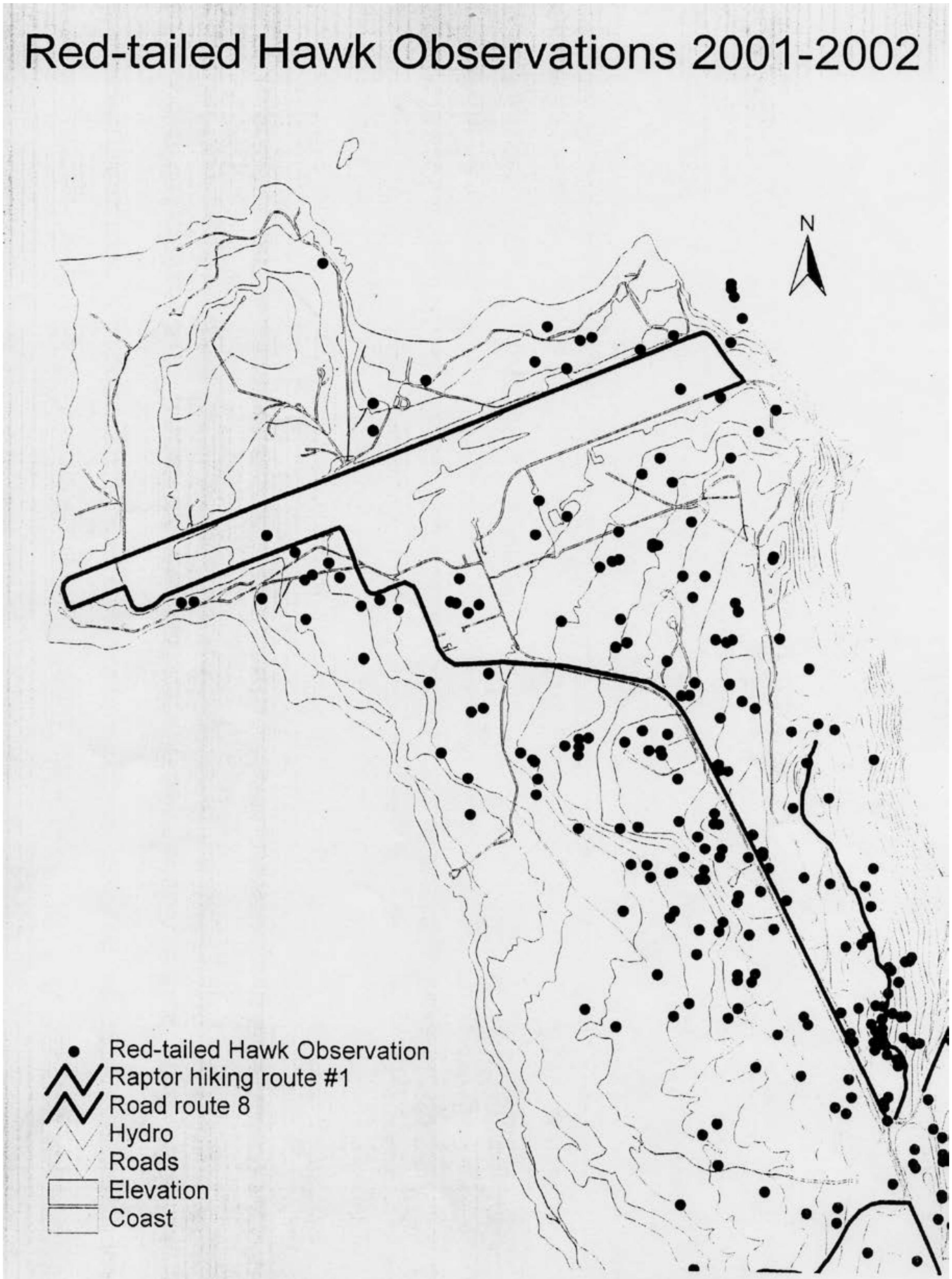


Figure 20. Red-tailed hawk 2001-2002 observations on San Clemente Island near Naval Auxiliary Landing Field (Cooper et al. in prep).

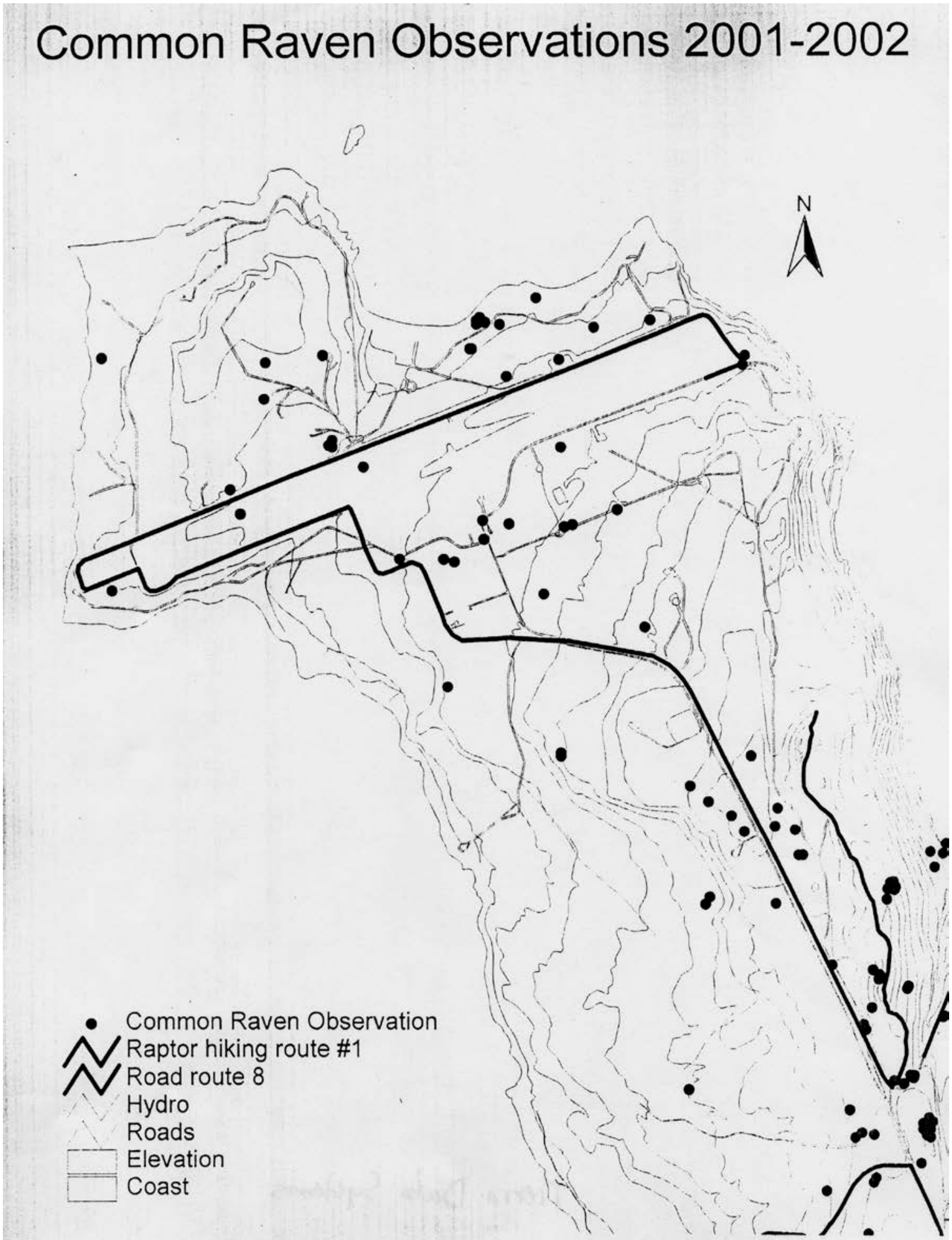


Figure 21. Common raven 2001-2002 observations on San Clemente Island near Naval Auxiliary Landing Field (Cooper et al. in prep).

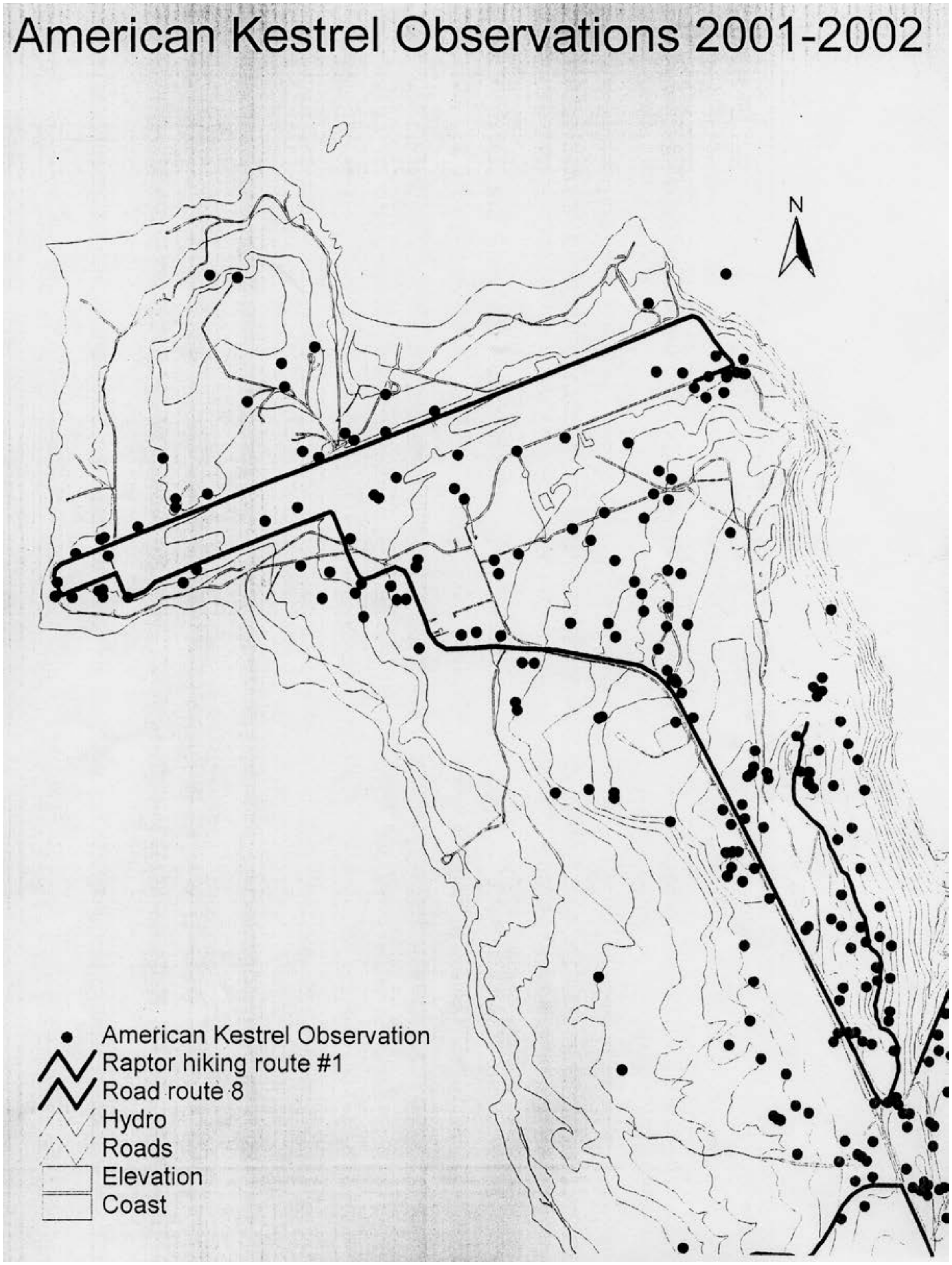


Figure 22. American kestrel 2001-2002 observations on San Clemente Island near Naval Auxiliary Landing Field (Cooper et al. in prep).

Figure 23. Horned lark strike (top) found near the east arresting gear (bottom) by NWRC personnel on August 22, 2002 at Naval Auxiliary Landing Field, San Diego, California.

APPENDIX 7: WHA NOLF IB 1999-2000

WILDLIFE HAZARD ASSESSMENT FOR NAVAL OUTLYING LANDING FIELD, IMPERIAL BEACH SAN DIEGO COUNTY, CALIFORNIA

(November 1999 to October 2000)

Prepared for:

Department of the Navy, Naval Air Station, North Island
Under Letter of Agreement # N68711-99-LT-90047
Tammy Conkle, Technical Representative

Submitted by:

United States Department of Agriculture
Animal and Plant Health Inspection Service
Wildlife Services
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Kevin C. Lansford
Assistant District Supervisor/Wildlife Biologist

Project was monitored by John Turman, South District Supervisor

Table of Contents

APPENDICES

LIST OF ACRONYMS

AC	Advisory Circular
AGL	Above Ground Level
AOA	Air Operating Area
BASH	Bird/Animal Aircraft Strike Hazard (a designation commonly used by the U.S. Military)
BEZ	Bird Exclusion Zone
BWC	Bird Watch Condition
CFR	Codes of Federal Regulation
DoD	Department of Defense
ESA	Endangered Species Act
EPA	U.S. Environmental Protection Agency
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulations
FIFRA	Federal Insecticide, Fungicide, Rodenticide Act
FOD	Foreign Object Debris/Damage
ILS	Instrument Landing Systems
MBTA	Migratory Bird Treaty Act
MOU	Memorandum of Understanding
MSL	Mean Sea Level
NASNI	Naval Air Station North Island, Naval Base Coronado
NOTAM	Notice to Airmen
NOLFIB	Naval Outlying Landing Field Imperial Beach, Naval Base Coronado
T&E	Threatened and Endangered Species
USCG	United States Coast Guard
USN	United States Navy
USFWS	U.S. Department of Interior, Fish and Wildlife Service
WHMIS	Wildlife Hazard Management Information System
WHMP	Wildlife Hazard Management Plan
USDA, APHIS, WS	U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services

ACKNOWLEDGMENTS

This is dedicated to the memory of our friend and co-worker,
John Q. Adams
whose efforts on the NASNI BASH program has made the
lives of Navy pilots much safer.

Several people provided assistance and logistical support throughout the course of this Wildlife Hazard Assessment. First and foremost I would like to thank Tammy Conkle for her support throughout the study and Steve Barnhill for his initial involvement. Noel Meyers for the time, effort, and insights he gave on initiating the assessment. I would also like to thank Mike Linnell, Corey Rossi, and Bill Wilmoth on their patience and expertise in the field of data collection, analysis, and their unparalleled knowledge in the field of Wildlife Hazard Assessments. Thanks also goes out to John Turman for Ataking up the slack@ and allowing me the freedom to accomplish the project and Sam Lemmon for his initial work on the project. At this point I would also like to thank Lt. Max Wettstein, NASNI Aviation Safety Officer, for his loyal support and appreciation for the work Wildlife Services is trying to accomplish. Also, thanks to the authors and illustrators of APrevention and Control of Wildlife Damage@ manual published by the Cooperative Extension, University of Nebraska, for references and information used in this document. In conclusion, we wish to offer a special thanks to all the pilots, airport, and Navy personnel who take it upon themselves to insure that wildlife hazards on airfields are diminished and that airfields remain a safe place from which to operate.

1.0. INTRODUCTION

1.1_ OVERVIEW OF WILDLIFE HAZARDS TO AIRCRAFT

Collisions between aircraft and wildlife are a concern throughout the world because they threaten passenger safety (Thorpe 1997), result in lost revenue and costly repairs to aircraft (Milsom and Horton 1990, Linnell 1996, Robinson 1997), and can erode public confidence in the air transport industry as a whole (Conover et al. 1995). Military aircraft are especially susceptible to bird strikes because many exercises involve high speeds at low altitudes where birds are commonly present, and losses to military aircraft have been numerous and costly (Blokpoel 1996). According to the Naval Safety Center data shows that 65% of all bird strikes occur within the airfield environment. For the period of March 1995 to March 1997, Naval aviators reported 1,420 bird strikes which resulted in 107 aircraft mishaps, 302 engines lost to foreign object debris (FOD), and more than $108 million in damages. The Naval Safety Center also estimates that only approximately 1 out of every 4 bird strikes are reported. One analysis indicates that less than 20% of all US civil aircraft strikes are reported, suggesting that even a larger hazard exist (Cleary et al. 1996, 1997; Dolbeer et al. 1995). At Naval Outlying Landing Field Imperial Beach, California on April 10, 1984, upon approach an unidentified bird contacted the front windshield of a H-3 helicopter leaving a six inch hole through it, no injuries were reported. Also on March 18, 1986 an unidentified bird struck a H-60 helicopters 1^{st} stage compressor forcing the helicopter to land, also no injuries were reported. No monetary damages were reported but were most likely extensive. These examples illustrate that the threat to helicopters due to wildlife strikes are very real. In several other instances, wildlife-aircraft collisions in the United States have resulted in human fatalities, the most recent of which occurred in 1995 when an Air Force E-3B AWACS (Airborne Warning Control System) aircraft collided with a flock of Canada geese on Elmondorf Air Force Base, Alaska, killing all 24 passengers and crew (Gresh 1996, Ohashi et al. 1996). This is of course, an extreme example and most wildlife strikes do not result in fatalities, but the safety hazards are very real and the proportion of wildlife strikes that result in damage is often substantial enough to merit closer scrutiny by the United States Navy (USN).

There are many actions that can be taken to decrease wildlife hazards, depending on the species, time of year, why they are using the airfield, habitat characteristics on and around the airfield, and a host of other variables. It is therefore, a necessity to fully understand an animal's biology, (particularly in relation to specific environmental characteristics) before establishing a wildlife control program. Wildlife hazard assessments (WHA) provide the framework through which a more complete and site-specific understanding of wildlife hazards on an airport are developed. These studies typically last a year because wildlife populations, especially migratory birds, exhibit seasonal fluctuations in behavior and abundance. On completion of the assessment, recommendations to reduce wildlife hazards can be made which are based on an analysis of the data collected. The wildlife hazard assessment provides the basis from which the management plan is developed and/or revised. Civil wildlife hazard management plans are written in accordance with the Code of Federal Regulations (CFR) Title 14, Part 139.337, subpart (c), (d) and (e) (Appendix 4) and are the responsibility of the airport. This information is provided as a reference to how civil airports view the importance of a WHA to base a management plan. Navy management plans are outlined in the individual base instructional manual (Appendix 5), but are not always based on information that is collected from a WHA.

1.2 LEGAL AUTHORITY OF WILDLIFE SERVICES

The U.S. Department of Agriculture, Wildlife Services (WS) program has a Memorandum of Understanding (MOU) with the Department of Defense (DOD) (Appendix 6), to resolve various wildlife issues. The MOU establishes that Wildlife Services has the expertise and will provide technical and operational assistance (if funded) to help identify and alleviate wildlife related issues. WS may conduct a wildlife hazard assessment to serve as a basis for, or the revision of, the wildlife hazard management plan contained in the NASNI Instructional Manual, but the responsibility of development, approval, and implementation of the wildlife hazard management plan still lies with the United States Navy.

The primary statutory authority by which WS operates is the Animal Damage Control Act of March 2, 1931, as amended (7 U.S.C. 426-426c; 46 Stat. 1468). WS has the authority to manage migratory bird damage as specified in the Code of Federal Regulations. In addition, the Rural Development, Agriculture, and Related Agencies

Appropriations Act of 1988 authorizes and directs the Secretary of Agriculture to cooperate with states, individuals, public and private agencies, organizations, and institutions in the control of nuisance mammals and birds deemed injurious to the public.

The MOU and legislation allows WS to conduct initial on-site investigations, biological assessments (short-term studies), wildlife hazard assessments, wildlife management operations, and complete wildlife hazard management plans for airports. On September 28, 1999 the Naval Outlying Landing Field, Imperial Beach (hereafter referred to as NOLFIB) entered into a cooperative agreement with WS to conduct a WHA.

2.0. OBJECTIVES

The objectives of this wildlife hazard assessment were to:

1. Review available wildlife strike records.
2. Determine wildlife population parameters such as abundance and periods of activity, with a particular emphasis on the species most threatening to aircraft safety.
3. Identify and quantify attractive wildlife features and land-use practices at NOLFIB to surrounding areas that may contribute to wildlife hazards on the airfield.
4. Provide management recommendations for reducing wildlife hazards at NOLFIB to serve as a framework in the development of a Wildlife Hazard Management Plan or Bird Aircraft Strike Hazard (BASH) plan.

3.0. BACKGROUND

3.1. Naval Outlying Landing Field, Imperial Beach

NOLFIB airfield is a 1,373 acre facility located in the City of Imperial Beach, San Diego County, California. NOLFIB is west of Interstate 5 (I-5) at the south end of 13th street in Imperial Beach, California at 32E, 34' North Latitude and 117E, 07' West Longitude, (NAD 83 / WGS 84). It is bordered on its west, and south sides by the endpoint of the Tijuana Estuary system, consisting of the Tijuana Slough National Wildlife Refuge, and on its north and east sides by the City of Imperial Beach. The Otay valley dump is located seven driving miles away south off I-5. NOLFIB lies at an elevation of 24 feet above mean sea level (MSL), the tower itself rises only 200 feet above MSL. Local climatic conditions are characterized by warm, dry summers and rather mild, moist winters. Daily temperatures average 63E F with monthly average highs in July or August at 78EF to lows in January at 45EF. The average annual rainfall on the airfield is about ten inches per year. The airport is situated in the southwestern tip of San Diego County, and is within eyesight of the United States and Mexico border.

Wildlife hazards on the airfield are a primary safety concern, and therefore, must be addressed. In an effort to insure the safety of its pilots and airfield personnel, the Navy requested that WS conduct an on-site inspection of wildlife hazards. The request for the wildlife hazard assessment was not the result from any one strike specifically, but a combination of bird strikes that had occurred over time. The Navy elected to conduct an WHA to better understand the severity and factors contributing to wildlife hazards at NOLFIB. The intent is to use the findings from this assessment to identify the wildlife hazards present and to provide management recommendations to reduce them.

3.2. AIRCRAFT OPERATIONS

NOLFIB is a military airfield serving military aircraft. In 1999, NOLFIB had 226,883 operations (an operation was defined as any takeoff or landing by an aircraft), 99% of these operations involved Navy rotary wing aircraft, 1% involved U.S. Coastguard and U.S. Marine Corps aircraft. NOLFIB is still utilized as an emergency alternative landing site for smaller fixed-winged aircraft.

The number of aviation operations varied by month at NOLFIB. The hours of flight operations are in accordance with Chapter 9 of the NASNI Instruction 3710.7S, Section 9.2.2 (Appendix 5) The busiest hours of flight operations occurred between 1600 and 1900 hours.

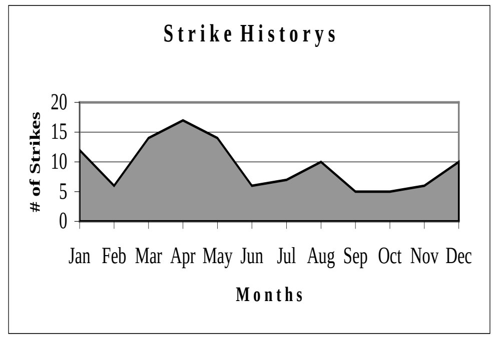
3.3. WILDLIFE STRIKE ANALYSIS

Bird Strike Committee Canada (Transport Canada 1992) developed a bird strike definition that has since been adopted by the Federal Aviation Administration (FAA), International Civil Aviation Organization (ICAO), Bird Strike Committee USA, Bird Strike Committee Europe, and the U.S. Air Force. Under this definition, a wildlife strike is considered to have occurred if:

1. A pilot reports a wildlife strike,
2. Aircraft maintenance personnel identify damage as having been caused by a bird or mammal strike,
3. Personnel on the ground report seeing an aircraft strike one or more birds or mammals,
4. Bird or mammal remains, in whole or part, are found on any air-side pavement area or within 200 feet of a runway, unless another reason for the bird or mammal death is identified. ....

Wildlife strike data provides valuable information on wildlife hazards at airports, including the species that are struck, seasonality, and time of day. National statistics for the period of 1992-1999 based on pilot-reported strikes indicated that gulls (29%), waterfowl (12%), pigeons/doves (12%), raptors (11%), blackbirds/starlings (11%), swallows (3%), shorebirds (3%) and corvids (crows, ravens, magpies, etc. [2%]) were responsible for the majority of strikes (Cleary et al. 2000). Of these strikes, waterfowl damaged aircraft 47% of the time, raptors 23%, gulls 18%, doves 10%, and blackbirds 7%. Fifty-five percent of the strikes occurred at altitudes #100 feet and 78% occurred at #1000 feet - an altitude which approximates the height at which aircraft are clear of the airport property. The data also indicated that most bird strikes occurred during the late spring through early fall (July - October) with the fewest strikes occurring during the winter months of December through February. Conversely, mammal strikes were most abundant during the late summer and fall months of July through November. Finally, most of the strikes occurred during the day (65%), followed by night (26%), then dawn/dusk (9%). These data should be interpreted cautiously, however, because it has been demonstrated that pilots are less likely to report strikes around the crepuscular periods of dawn and dusk (Linnell et al. in press), presumably due to decreased visibility.

Wildlife strike rates, the number of strikes per 10,000 aircraft movements, provides a useful index for assessing the severity of wildlife hazards at a given airfield and for monitoring hazard abatement efforts. Consequently, the number of aircraft operations, coupled with the accurate collection of bird strike data should be a priority for airport managers. Bird strike statistics based solely on pilot reports are generally unreliable and yield incomplete information because most pilots do not report strikes for various reasons. By collecting the remains of dead birds found on runways during routine runway searches, airport managers can obtain information that would have otherwise been unavailable (Linnell et al. 1996), augmenting a more accurate assessment of the actual wildlife strike situation. This is because the proportion of strikes reported by pilots often vary due to factors such as decreased pilot acuity towards birds during critical phases of flight, size of the bird, flock size, weather conditions, time of day, or heightened pilot awareness during migratory seasons (Linnell et al. in press). In the future, pilots, tower, and airport personnel should be strongly encouraged to complete and submit the Strike Report Form every time a collision with wildlife occurs or the remains of a dead bird(s) is found on the runway. The Navy has a system for reporting strikes via the internet at the following address: ***www.safetycenter.navy.mil*** for those with internet access.



All bird remains that are found should be retained until they can be positively identified by a qualified individual, or if the remains are unidentifiable, feel free to send them to us for identification. If we are unable to determine the type of bird, we will send them to the Smithsonian Institute (Division of Birds, NHBE-605 MRC 116, Washington, D.C. 20560) for microscopic feather identification.

Wildlife strike records for NOLFIB were obtained from the Naval Safety Center database and are summarized graphically in Figure 1, and listed individually in Appendix 9. A total of 112 strikes were recorded at NOLFIB for the reporting period of April 15, 1981 - October 2000. This may be misleading due to the fact that from 1997 through 1999 only one strike was reported. During the assessment, five strikes were reported to Wildlife Services personnel, all occurring in the year 2000. Two involved western gulls (*Laurus occidentalis),* one white-tailed kite *(Elanus leucurus)*, one American pipit *(Anthus rubescens)*, and one multiple unknown birds. Forty percent of the 112 strikes were recorded in the months of March through May, 25% from December through February, 21% from June through August, and 14% from September through November. Unfortunately, the identification of the struck species from 1981-1998 was only reported on five strikes. They were one pelican, one unidentified white bird, two sparrows, and one owl.

NOLFIB is classified as a class AD@ airspace (NASNIINST 3710.7S, Chapt. 9, 9.1.1, Appendix 5) and has a vertical limit of 1500 feet (as defined in NASNIINST 3710.7R, Chapt. 4, illustration 24, Appendix 5). This would indicate that the majority, if not all, of air strikes occurring at NOLFIB are under this altitude. Taking into account that from 1981 to 1996 ninety six strikes were reported, and assuming that the number of operations per year has remained constant, this would indicate a strike rate of .26 per 10,000 operations. Ordinarily, this may be considered an acceptable rate, assuming reporting rates are accurate, but we know strikes are under-reported. Furthermore, the level of acceptability is also dependant on a host of other variables, particularly the wildlife species that is involved.
The data from Figure 1 indicate that most strikes at NOLFIB were in the early spring months of March through May, with a second peak in December and January. The peak in August probably corresponds to the recruitment of juveniles into the world of flying. However, due to the relatively low number of reported strikes, the associated species, and coupled with an absence of strike data obtained through runway sweeps, we were unable to make robust statistical inferences, and all conclusions were interpreted very loosely. Interviews with pilots and other personnel associated with the airfield substantiated the assumption that strikes occurred more frequently than was reported which is typical of most airports (Linnell et al. 1996).

3.4. CURRENT WILDLIFE HAZARD MANAGEMENT

As of October 2000, NOLFIB has no formal wildlife damage control program in place to minimize wildlife-aircraft hazards. This WHA is being performed as a result and will be the guideline to which a management plan can be written. Execution of the plan will be based upon hazards from both local and seasonal wildlife populations. Currently, wildlife hazards are dealt with in a reactionary manner and only when hazards or potential problems are reported by pilots or control tower personnel. Also, wildlife hazards are reported to airfield maintenance personnel. Upon receiving a report of a hazard it is their responsibility to respond to the situation. When dispersal efforts are initiated (usually consisting of vehicle harassment), they are directed only at the larger, more visible wildlife species such as gulls. While it is generally true that large birds are more likely to damage an aircraft, collisions with small, flocking birds still represent a damage threat and should not be disregarded.

There are many actions that can be taken to decrease wildlife hazards, depending on the species, time of year, why they are using the airfield, habitat characteristics on and around the airfield, and a host of other variables. It is therefore, a necessity to fully consider an animal’s biology, particularly in relation to its environment when establishing a wildlife control program. A variety of methods are available for managing hazardous wildlife species found on and around NOLFIB (see results section for a species by species discussion of some available techniques), but this list is by no means limiting. Refer to Hygnstrom et al. (1994) for a detailed and comprehensive two-volume manual of prevention and control of wildlife damage. It is important to remember that a little imagination and persistence greatly augments the duration and effectiveness of any bird hazard reduction measure.

4.0. LEGAL STATUS OF WILDLIFE SPECIES

Most forms of wildlife and/or their habitat are protected by one or more federal, state, and/or municipal laws. Before administering any control action at NOLFIB, whether lethal or not, the legal status of the target species should first be determined and potential non-target animals identified. Many of the agencies involved in regulating wildlife will require permits to harass or lethally control some forms of wildlife, and will issue these permits depending on the species and method of control involved. NOLFIB, or the technical representative, is responsible for adhering to the current regulations regarding wildlife control and for obtaining the appropriate permits to take and/or harass specific types of wildlife. Refer to Appendix 10 for a directory of agencies responsible for various aspects of wildlife management .

4.1. FEDERAL REGULATIONS

The U.S. Government has passed several Acts for the protection of wildlife including the Migratory Bird Treaty Act (MBTA), the Lacey Act, the Endangered Species Act, Bald Eagle Protection Act, the National Environmental Policy Act, and the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). These are the basis of most wildlife regulations that have been issued in the Codes of Federal Regulations (CFR). Several agencies are responsible for implementing these regulations and many of these regulations affect wildlife control operations at airports. Federal wildlife laws are mostly administered by the U.S. Fish and Wildlife Service (USFWS), and involve primarily migratory birds protected under the MBTA and federal threatened and endangered (T&E) species. Permits from the USFWS must be updated annually unless otherwise stated on the permit. NOLFIB does not currently possess depredation permits from either the federal or state government, but efforts should be made to do so. WS can assist NOLFIB by filling out a ADC Form 37, Migratory Bird Damage Report to be submitted along with the application for a USFWS Depredation Permit (Appendix 7).

4.2. STATE AND LOCAL REGULATIONS

The State of California accepts the federal depredation permit for non-game bird species, but requires a special permit for certain mammals and game birds. Several agencies have regulations that may affect wildlife control at airports in the state of California. These regulations and statutes are primarily contained in the Code of Federal Regulations and California Department of Fish and Game (CDF&G) Code. The CDF&G, the agency responsible for administering wildlife enforcement in California, publishes these statutes in a booklet (Fish and Game code) which is available from them upon request. San

Diego county and Imperial Beach municipality regulations (see directory in Appendix 10) may also affect NOLFIB wildlife control operations, consequently, the technical or contracted representative should check the city and county regulations prior to conducting operational control measures.

5.0. DESCRIPTION OF STUDY SITE AT NOLFIB

This ecological study identified wildlife hazards within a general zone that covered a five-mile radius of the airport because most strikes occur when aircraft are at low altitudes, typically within five miles of the airfield or less. A particular emphasis was placed on areas within a two-mile radius of the runway centerline (hereafter referred to as the critical zone) because many forms of wildlife, especially birds, will readily travel this distance in a short period of time. Turbine powered aircraft are generally at least 2,000 feet above ground level (AGL) by the time they reach the 2-mile threshold, and are into the airspace in which most birds are found. Helicopters can be much lower (AGL) for longer distances approaching an airfield, although generally at much lower speeds. At NOLFIB the number of helicopters utilizing the airspace at the same time, at altitudes where birds are readily present, is a much higher number than winged aircraft.

5.1. FACILITIES

NOLFIB has two runways 9/27 and 8/26 (Appendix 8). These runways run parallel to each other stretching east to west. Runway 9/27 is a 4,999 feet long and 350 feet wide. Runway 8/26 is 2,339 feet long and 150 feet wide. Both runways are constructed of concrete and are daytime use only runways, primarily used for stop-and-go or full-stop landing exercises by rotary wing aircraft. Both runways 8/26 and 9/27 are divided into sections for simultaneous operations. On runway 8/26 the west end of the runway is approach 26 and the east end is approach 8. On runway 9/27 the west end is approach 27 and the east end is approach 9. NOLFIB also has five helicopter pads located south of runway 9/27 approximately mid-field. They are on a north/south line numbered 1-5 from south to north. Distance between centers of adjacent pads is 400 feet. All pads are 100 feet square constructed of cement. Area between pads and 100 feet east and west of pads is asphalt concrete. Pads may be reserved for hoist operations or heavy external load practice day or night, air-traffic permitting. The airport's administration office and tower are located 1,100 feet northwest of the approach end of runway 27. There is a radar unit 650 feet south of runway centerline at approach end of runway 9. A chain link perimeter fence surrounds the entire airfield. The firehouse is located 1000 feet west of the tower. North of the NOLFIB airfield is a large parking lot. A commissary, defense re-authorization management office warehouse, exchange, and subway sandwich shop are located there. The City of Imperial Beach borders NOLFIB on the north and west sides. These facilities were monitored for wildlife activity because they can provide nesting habitat, loafing areas, and food resources for a number of birds.

5.2. WILDLIFE

NOLFIB and the surrounding area have an abundant diversity of terrestrial vertebrates. Of these, several are responsible for creating wildlife hazards at airports and were observed on the NOLFIB airfield at some point during this assessment (Appendix 1). Large birds such as gulls and waterfowl are usually considered the greatest threats to aviation, but smaller species like starlings (*Sturnus vulgaris)*, horned larks (*Eremophila alpestris)*, meadowlarks (*Sturnella neglecta)*, and pigeons (*Columba livia)* can also present significant hazards because of their propensity to form tight flocks comprised of sometimes hundreds of individuals. Solitary birds such as hawks and owls also present a concern because of their soaring and hovering behavior. NOLFIB has representatives from each of these categories that frequent the airfield and surrounding areas at some point during the year (Appendix 1).

5.3. HABITATS

Food, water, and cover are powerful attractants to wildlife, and are typically found on most airfields in varying degrees. Habitat management, when carefully planned and selected, provides the most effective long term solution for excluding wildlife populations because it eliminates the attractants. Before implementing habitat modification, however, careful consideration should be given to secondary effects because decreasing the attractiveness for one species may increase its attractiveness to another potentially hazardous species. In addition, wildlife displaced from one area due to habitat alteration may frequent more hazardous areas on the airfield. For this reason, it is important to identify existing habitat characteristics on the airfield and determine how they relate to wildlife use patterns. The habitats in the area surrounding NOLFIB can be divided into riparian, wetland, coastal salt marsh, coastal dunes, maritime succulent scrub, coastal sage scrub, agricultural fields, and urban/industrial habitats.

Water. The Tijuana River is located directly south of NOLFIB. The Pacific Ocean is also visible from the western side of NOLFIB. The combination of both marine and fresh water systems has created the Tijuana Estuary system. The Estuary is a combination of riparian, wetland and coastal habitats. The diverse habitat of the Estuary is a major attractant for several species of hawks, owls, waterfowl, herons and egrets, a multitude of shorebirds, and several species of gulls. Several federally listed species are also present in the Tijuana Estuary system. These species include California least tern *(Sterna antillarum)*, western snowy plover *(Charadrius alexandrinus)* , light-footed clapper rail *(Rallus longirostris)*, least Bell’s vireo *(Vireo bellii)*, and the willow flycatcher *(Empidonax traillii)*. It is also home to species of special consideration. Such as burrowing owl *(Athene cunicularia)*, and gull-billed terns *(Sterna nilotica)* (Zedler, 1992). During times of rain, standing pools of water collect on the runways. Large numbers of gulls utilize these pools especially at the west and east endpoints of runways 26 and 27.

Vegetation. Vegetation provides much of the food and cover requirements for wildlife. The areas of greatest concern, in terms of bird hazards, are wetlands, and edge areas (where two or more habitat types are juxtaposed). Edge areas are most prominent along the south and west perimeters of NOLFIB where it borders the Tijuana Slough National Wildlife Refuge (Refuge). The Refuge in this area is a wetland and coastal dune ecosystem. Edge-effect is a concern because it is typically where the greatest number and diversity of animals are supported. There are also a number of trees located around and adjacent to the airfield. On the north side of the airfield, outside of the perimeter fence and off base, there is a number of palm trees and other assorted species of trees in a residential area that supports congregations of birds that also utilize the airfield. Also, the south side is bordered by a number of different species of trees located in the Refuge that serve the same purpose. There are several tall salt cedar Asnags@ (dead standing trees) located in the Refuge, in particular, that serve as excellent perch points for raptors.

Structures. There are a number of man-made structures at NOLFIB that serve as perching, loafing, and nesting habitat for birds. The perimeter fence, light poles, power lines and telephone poles, mainly on the north side of NOLFIB, are commonly utilized by birds. There are also the tower, buildings, runway markers, wind socks, bunkers, and warehouses that are utilized by birds. The commissary and exchange provide opportunities for a multitude of bird species to find loafing and foraging areas, mainly due to trash clutter in the parking lot. Civilian housing on the north side of NOLFIB also provides very attractive habitat for many bird species.

Soils. The soils found on the airfield are fairly well drained sandy loam. The entire airfield is comprised of fill dirt, that covers the original wetlands that comprised OLFIB. The depth of the fill is unknown and most likely variable.

5.4. THREATENED AND ENDANGERED SPECIES

San Diego county has several federally listed species that are granted protection under the auspices of Federal or State regulations (Appendix 2). Because NOLFIB is situated in close proximity to the Tijuana Slough National Wildlife Refuge, potential impacts to sensitive species from this area must also be considered when conducting wildlife hazard abatement procedures. The list will need to be updated regularly because the status of species may change. The USFWS and CDFG should be contacted at least once per year to obtain a current listing of species status. This list should be reviewed prior to conducting operational control work such as hazing, shooting, or habitat manipulation to ensure that NOLFIB remains in compliance with federal and state wildlife regulations. NOLFIB may be required to mitigate for actions that destroy or negatively alter habitat deemed critical to any of these species, which is why it is important to be aware of all potentially affected species.

6.0. METHODS

6.1. BIRD SURVEYS

Bird abundance and activity patterns on the airfield were surveyed using time-area counts and opportunistic observations-incidental sightings obtained while conducting other activities. Thirteen separate bird surveys were conducted per month at approximate three-week intervals from November 1999 through March 2000. Due to funding restraints, and as stipulated in the Letter of Contingency dated September 8, 1999, the surveys were cut back to 10 surveys per month from April 2000 to October 2000 to assure the projects completion without additional funding. The start-time of each count varied, with an emphasis on morning, mid-day and evening periods. The staggered survey times were also used to determine peak periods of bird use throughout the day. Time-area counts were conducted at eight stations (see map in Appendix 8) on the outlying edges of NOLFIB. Survey points were selectively chosen based on their ability to represent key habitats throughout the airfield, ease of access, and area of coverage. Each station was surveyed for a 5-minute period using the naked eye, and all birds seen within 1/4 mile radius were recorded on data sheets. Binoculars were used only to verify observations and to key-out questionable species. The activity (e.g. flying, loafing, nesting, etc.), habitat type, number seen, and any other pertinent observations were also noted. There are some underlying assumptions associated with this survey method, one of which is that all birds within the plot are detected by the observer. Due to the size of our plots, this assumption was likely violated, with the number of small, solitary birds being underestimated in favor of the larger, more visible flocking birds. We considered this an acceptable indiscretion because our objective was not to obtain an absolute density estimate for every species, but rather to establish an index for estimating abundance and activity patterns of the most hazardous species. Furthermore, data collected during these surveys will serve as a baseline for comparison of wildlife activity in subsequent years, enabling NOLFIB management to assess the efficacy of new wildlife control methods.

In addition to time-area counts, wildlife frequently observed while en-route between survey points, and other incidental observations, were also noted. While these informal observations could not be used to quantify population dynamics, they did provide useful insights into the general habitat-use characteristics and behavioral attributes of birds on the airfield.

6.2. MAMMAL SURVEYS

Mammals were included in the time-area counts, but were probably underestimated because these counts were designed primarily for diurnal birds (active during daylight hours). Because most mammals at NOLFIB are active in the late evening through early morning hours, spotlight counts were used to give a more representative estimate of their abundance and activity patterns. These counts consisted of driving the same route described for time-area counts (Appendix 8), using a spotlight to detect mammals on either side of the vehicle in what amounted to a modified strip count. The effective width of the strip (the distance from the observer at which all target animals are assumed to be detectable) was approximately 40 yards on either side of the vehicle. There were a total of 12 night surveys conducted from November 1999 through October 2000.

6.3. ANALYSIS OF DATA

For analysis purposes we categorized wildlife into groups called guilds (Appendix 1). Species were placed into their respective guilds based on similar behavioral characteristics, not on phylogenetic (ancestral) or taxonomic relationships, although the guilds often paralleled taxonomic lines. This approach was selected because behavioral attributes play a significant role in predisposing some species of wildlife to collisions with aircraft. In addition, wildlife control strategies are often selected based on their ability to exploit an animal's specific behavior(s), therefore, species that exhibit similar behaviors and life history attributes generally require similar control methods.

Time-area count data from each survey station (Appendix 8 for a map of stations) was used to identify wildlife abundance at various locations throughout the airfield. The average number of animals per survey station (pooled across months) was determined for each major guild and for each of the critical species. To facilitate interpretation and comparison among stations, the data is displayed graphically for each guild.

6.4. SURVEY AND EVALUATION OF WILDLIFE ATTRACTANTS

Wildlife are attracted to different habitats because they can meet the requirements for one or more of their basic needs for food, water, and cover. Water sources can be lakes, streams, ditches, and temporary pools formed by rain. Food sources may consist of vegetation, seeds/mast, insects, earthworms, rodents, rabbits, and discarded refuse. Wildlife find cover and nesting habitat in trees, weedy fields, tall grass, urban structures, burrows, and stream-side vegetation. Identifying and eliminating wildlife attractants on and around the airfield is an essential first step in reducing wildlife hazards.

Habitat management provides the most effective long term remedial measure for reducing wildlife hazards on or near airports. Habitat modification includes the physical removal, exclusion, or manipulation of cover, nesting habitat, or food items that attract wildlife. The ultimate goal is to make the environment unappealing to the species posing the greatest hazards to air traffic. This is most easily accomplished by promoting an airport environment with habitat that is monotypic (uniform) throughout.

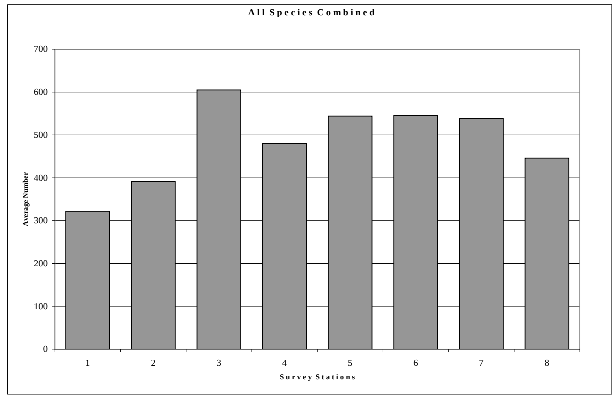
Specific types of habitat and food sources were identified at NOLFIB with the goal of altering their attractiveness to wildlife posing a hazard. Habitat alterations on property owned by NOLFIB can be accomplished by the Navy, provided impacts to federally listed species are not impacted. It may also be necessary to meet with the land owners of adjacent properties to obtain their support. In some cases the landowner(s) or manager(s) may be unwilling to cooperate with NOLFIB, in which case the airport should still continue to monitor land-use activities off airport property and continue to pursue cooperation..

7.0. RESULTS AND DISCUSSION

7.1. BIRD SURVEYS

7.1.1 ALL SPECIES COMBINED

The overall bird population at NOLFIB was higher during the winter months of November through January with a second peak beginning in March lasting through May (Figure 2). These overall trends may be somewhat misleading due to the fact that increases in overall numbers of birds may not reflect an overall increase in the threat to aircraft. Specific increases in certain species are what can constitute the higher threat. This will become more evident as we break down seasonal trends of individual guilds in relation to their strike histories and damage threat to aircraft. For instance, several species exhibited higher densities during the fall and winter months such as flocking birds, like American pipits, increasing overall numbers on the airfield, but their overall threat to aircraft compared to gulls, which decline during that time of year, is much less.



The overall bird-use pattern for all species combined was fairly consistent across stations (the term station and zone are hereafter used synonymously) on the airfield at NOLFIB (Figure 3). However, there were individual differences in geographical use-patterns for several species that will be discussed subsequently. It is important to realize that while the overall frequency may have been similar for all stations, the total number of individuals at each station may have varied greatly because of the gregarious (flocking) nature of some species and the solitary behavior of others. Figure 2 summarizes the total number of birds from each of the major species and gives the mean (average) number of observed each month. When comparing the peaks in bird numbers (Figure 2) with the peaks in bird strikes (Figure 1), the match almost correlates exactly with one another.

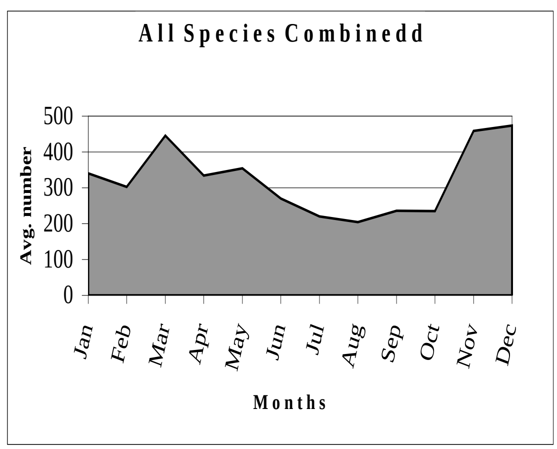
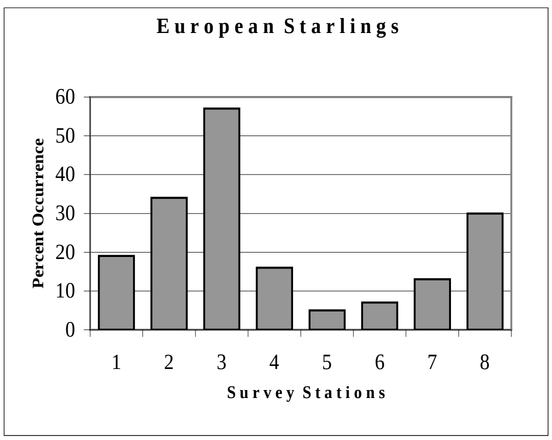


Table 1. Most prominent guilds, time of year present, and possible resolutions to hazardous wildlife on NOLFIB.

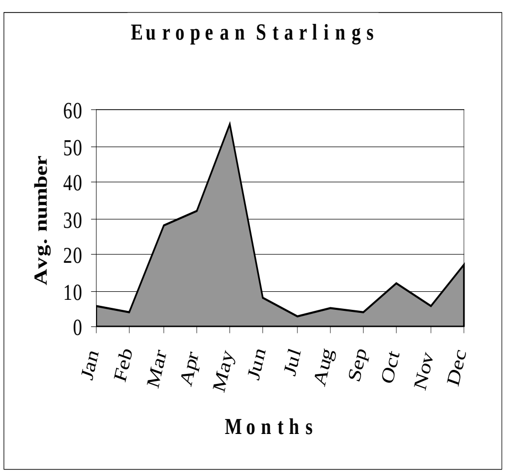
GUILD	SPECIES	Time of Year	Resolution Options
Gulls	Western	Spring/Summer/Fall	Haze/Exclude/Water/Remove

GUILD	SPECIES	Time of Year	Resolution Options
	Ca./Ring-bill	Fall/Winter	Haze/Exclude/Water/Remove
Hawks	Red-tail/Kestrel	Summer/Fall/ Winter/ Year around	Habitat/Rodent/Perch/Relocate
	Kites	Spring/Summer	Habitat/Rodent/Perch/Relocate
	Owl spp.	Year around	Habitat/Rodent/Perch/Relocate
	Turkey vultures	Summer/Fall/Year around	Habitat/Rodent
Columbids	Pigeons/Doves	Year around	Habitat/Exclude/Remove
Wading and Shore birds	Herons	Winter/Spring/Year around	Habitat/Rodent/Haze
	Egrets/Godwits/Curlews	Spring/Summer/Year around	Habitat/Haze
Blackbirds/Starlings	Blackbirds/Starlings	Spring/Summer/Year around	Habitat/Remove/Haze
Sparrows/Finches	Sparrows/Finches	Spring/Summer/Year around	Habitat

7.1.2 STARLINGS AND BLACKBIRDS



Description. Blackbirds are medium sized songbirds with heavy bills. They have iridescent black feathers and medium length tails. Starlings are similar in size, but appear stockier with a shorter tail and are heavily speckled in winter. They were introduced into North America from Europe. Starlings are cavity nesters and will use any structure with holes for nesting. All are gregarious, especially in winter when they form roosts in the thousands, sometimes comprised of mixed species. They have a very dense composition for their size making them a larger hazard than their size would indicate. All blackbirds and starlings are diurnal (active during daylight hours).



General Abundance at NOLFIB. Blackbirds and starlings are common residents throughout San Diego County. Of the many blackbird species that are found in San Diego County, only Brewer's (*Euphagus cyanocephalus)* and red-winged blackbirds (*Agelaius phoeniceus)* were observed with any regularity or abundance on the airfield at NOLFIB. Brewer's were mostly observed in the commissary parking lot and seldom seen on the actual airfield. Red-winged blackbirds were observed in relatively small numbers overall, mainly in the marsh to the west of the airfield in cattail stands. They were also seldom observed on the actual airfield. However, red-winged blackbirds were observed in flight lines over the marsh.

Starlings, while not technically classified as blackbirds, were lumped in the same category due to similarities in behavioral and morphological characteristics, especially as it relates to bird strike hazards. Blackbirds and starlings were observed along the north perimeter fence at NOLFIB. They were most commonly observed perching on the housing, warehouse, telephone lines and utilizing the short grass areas for foraging. They were relatively frequent visitors throughout most of the year. Starlings exhibited high numbers during the months of February through June (Figure 4) with average densities ranging from 10 to 30 birds per each time they were observed.

While starlings were observed intermittently at all stations throughout the airfield (Figure 5), they were most frequently seen at Stations 2, 3, and 4, all of which are on the airfield=s northwestern perimeter (Appendix 8). While starlings were common in this area, they were generally in small flocks of fewer than 30 birds. The exceptionally large flocks all occurred between the end of February and beginning of June, a period during which starlings traditionally building nest and foraging to feed young. It would be wise to reduce or remove these flocks by trapping to reduce starling and blackbird populations. A more in-depth discussion of control techniques is presented in the subsequent section on control measures.

Attractants. Blackbirds are primarily granivorous, whereas starlings require a higher protein diet consisting of mainly fruits, insects, and some grains. Blackbirds are attracted to a variety of habitats depending on the species. Brewer's blackbirds and starlings are attracted to urban areas such as the airport, grass and weedy fields, and fallow croplands. Brown-headed cowbirds are found in similar environments, but can also be found in open forests. These species form roosts in winter where cover and warmth is provided. Red-winged and yellow-headed blackbirds are attracted to croplands and weedy fields, and roost and nest in marshy areas, especially cattails.

Damage. Blackbirds and starlings are considered a great threat to aviation because of the large flocks they form. In addition, winter roosts present a nuisance because of their noise and droppings which corrode and damage buildings and property. If allowed to build up, their droppings can become a source of several infectious diseases (see Appendix 11 for a list of some wildlife diseases). In addition, nesting starlings can create a fire hazard in combustible structures because they continually deposit flammable nesting materials (primarily dried grasses and twigs) in the same nesting spaces (e.g. attics, awnings, etc.) year after year.

Legal Status. European starlings are completely unprotected and can be taken at any time without a permit. Blackbirds are classified as migratory nongame birds, and afforded protection as such, however, can be taken without a Federal permit when they are ... Afound committing or about to commit depredations upon ornamental or shade trees, agricultural crops, livestock, or wildlife, or when concentrated in such numbers and manner as to constitute a health hazard or other nuisance...@ (50 CFR Ch. 1 ' 21.43). The State of California recognizes the Federal regulations and does not require a state permit under the conditions previously mentioned

Control Measures. Feeding flocks can be dispersed with pyrotechnics, propane cannons, bioacoustics, and visual repellents, but often the birds simply move to another location on the airfield. Wildlife control personnel need to be persistent in their endeavors and concentrate their efforts in the early morning and late afternoon hours when the birds are most active. Shooting may become a necessary reinforcement technique if the birds become habituated (accustomed to) pyrotechnic hazing, but it is not the most effective method of reducing blackbird and starling populations if flocks are large (thousands of birds). Trapping can be an effective population control measure for large flocks, but if not properly planned, it may draw additional birds into critical areas. Long grass management (6 to 10 inches) will also help reduce the number of starlings/blackbirds from the airfield. Long grass management reduces bird access to forage materials(insects, seeds, etc.) and denies good visual contact with flock members. However, if grasses are allowed to grow higher, they may attract ground-nesting birds and provide habitat for small mammals that attract predators.

5. Mechanical/Habitat Control at NOLFIB. NOLFIB had seasonal flocks of 10 - 100 starlings and red-winged blackbirds that fed in the grass on and around the airport operation area (AOA). Prior to the departure or arrival of aircraft, pyrotechnics should be used to haze these flocks from the airfield, thus reducing the hazards they present. While long-grass management may be difficult at NOLFIB due to vegetative constraints, it should be realized that a habitat management approach typically provides the best long-term method of precluding blackbird and starling flocks. Mylar tape stretched at 5-10 foot intervals across the infield also provides a short-term deterrent to feeding flocks, but can create a FOD (foreign object debris) hazard to aircraft if it breaks due to strong winds.

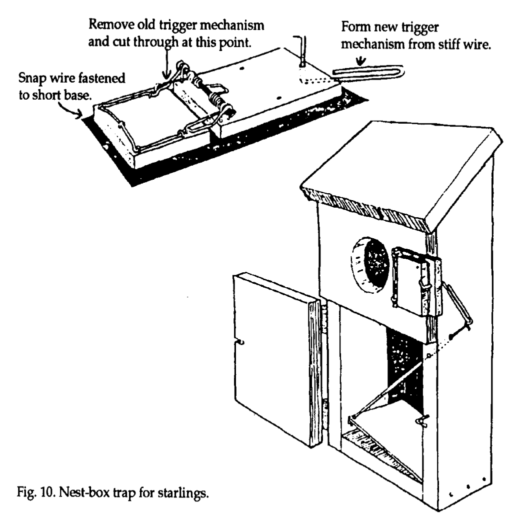


Fig. 10. Nest-box trap for starlings.

2. ***Starling Nests.*** Starlings commonly nest in the cavities of man-made structures and trees and should be discouraged from doing so where applicable. Aircraft engines should be covered if they are stored for any extended period to prevent birds from nesting. To exclude starlings securely fasten quarter inch wire mesh over holes or entrances to exclude them from structures. If this is not feasible, nest box traps (Figure 6) can be used to capture offending individuals by placing the trap near the cavity that starlings are using or are expected to use. Clean out historical or new nests and then hang the trap near the cavity being used. Inspect the trap frequently during the day, especially early in the nesting season which will commence around early to mid-March. Remove any trapped starlings and euthanize them with an acceptable and humane method such as cervical dislocation (breaking the neck) or using carbon dioxide gas (American Veterinary Medical Association 1993). If non-target species are caught, they should be freed immediately.

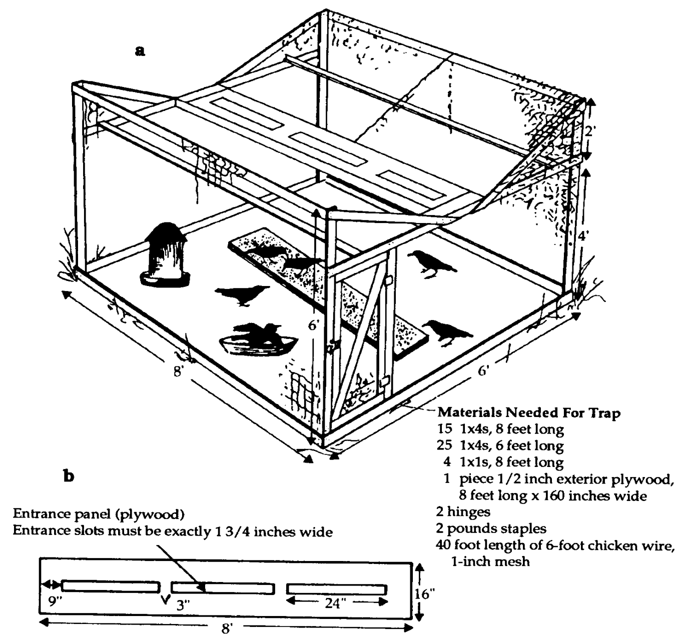
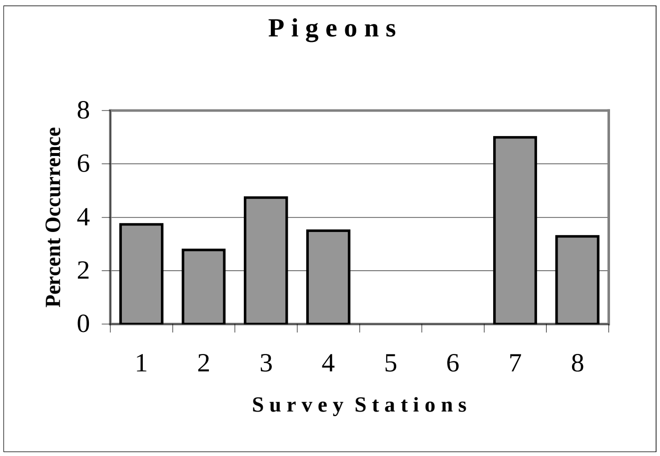


Fig. 11. Starling decoy trap: (a) assembled view and (b) details of the entrance panel. Side and end panels are covered with wire on the outside; top panels are covered on the inside of the frame.

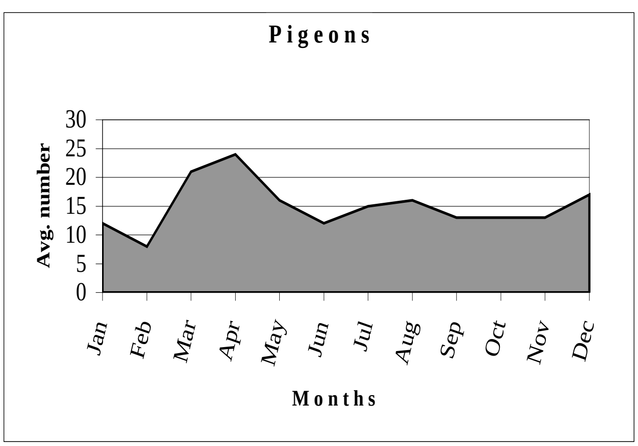
3. ***Decoy Traps.*** Blackbirds and starlings can be caught in decoy traps. The primary trap used is a modified Australian crow trap (Figure 7). This trap can capture starlings or blackbirds on the airfield or on top of the terminals where they are roosting. However, this method is somewhat labor intensive and only effective for removing a small percentage of the total population in a short period of time. If non-targets are caught, they can be immediately released. When trapping for starlings or blackbirds, a 1.75-inch wide opening in the slot-board (entrance panel) should be used, whereas a 6 x six-inch square opening should be used if trapping for crows. This trap, which should be checked daily, works best after a few target birds are captured to decoy others. Remove all but two birds from the trap and make sure an adequate supply of food and water is provided. These traps can be baited with old potato chips, french fries, apples, grain, or other type of bait that can readily be obtained as excess waste from factories or plants that produce such products. Trapping is most effective when other food is relatively unavailable and birds are flocking in large numbers (fall and winter).

7.1.3 COLUMBIDS (Pigeons and Doves)

Description. Rock doves *(Columba livia)* , commonly referred to as pigeons, are familiar birds that are abundant in rural and urban settings throughout California. Mourning doves (*Zenaida macroura)* are also widespread throughout California. Doves are powerful fliers with robust bodies, small heads, and short beaks. Mourning doves typically fly close to the ground near cover as they travel between feeding and roosting areas, whereas rock doves tend to fly at higher altitudes, descending to their destinations in a rapid circling pattern with wings spread back. Although both species are primarily granivorous, they will occasionally consume protein-rich animal material such as insect larvae, and pigeons are known for readily accepting handouts from humans.



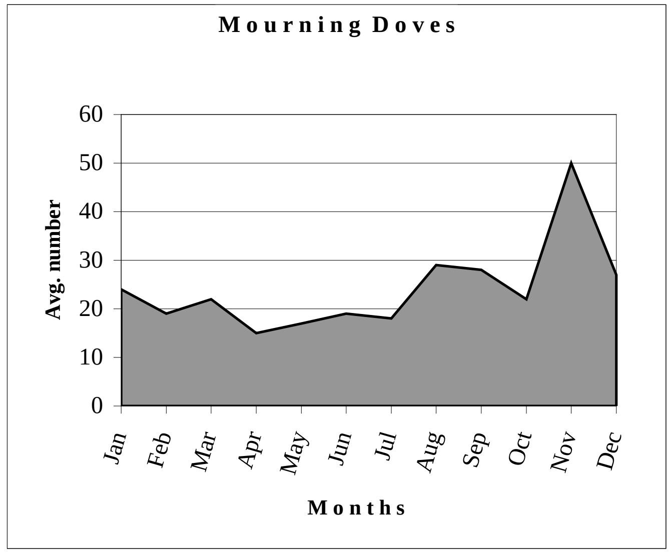
General Abundance at NOLFIB. Pigeons and mourning doves are both very common at NOLFIB, with pigeons utilizing many of the structures on the airport property for night roosting and nesting activities. Pigeons were present at NOLFIB throughout the year. The City of Imperial Beach supports a large pigeon population. Literally hundreds of these birds can be observed at numerous locations at any time of day and year. Located about a half mile away from NOLFIB, on the corner of 13th and Palm street is a major pigeon roosting and loafing site. Several hundred pigeons are utilizing the housing and commercial structures in the area. Pigeons were most frequently observed in the urbanized areas (Stations 1, 2, 3, and 8. [Figure 9 and Appendix 8]) that contained buildings capable of supporting roosting and nesting activities. Birds were frequently seen flying to and from several structures near stations 1, 2, and 3. The average flock size at these stations was relatively constant throughout the year ranging in size from 3 -7 birds (Figure 8).



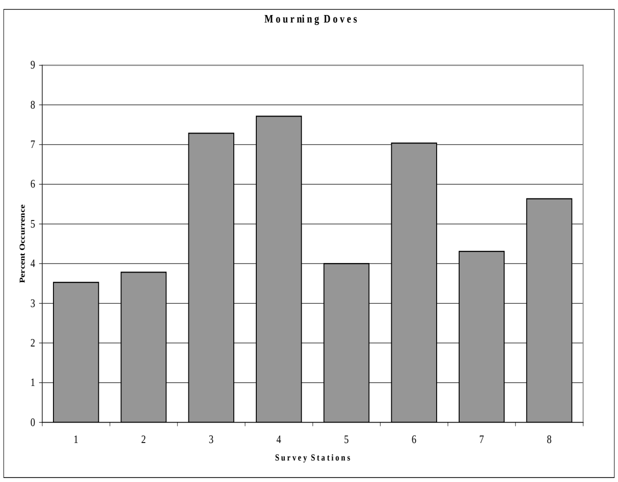
Morning doves were present throughout the NOLFIB airfield. They are particularly common along the north side of NOLFIB, roosting on the telephone wires and perimeter fence and utilizing the concrete and asphalt fringes for foraging. They were observed at every station on the airfield, and were usually flying to some off-site destination or perching on a wire or structure, or feeding in the open areas. Doves were observed at Stations 3, 4, and 6 with greater frequency

(Figure 11). Doves were present year around with slight increases observed in the Fall of the year (Figure 10).

Attractants. Mourning doves are common near wooded streams, in agricultural and weedy fields, and in urban areas. Pigeons on the other hand, are found in urban and agricultural areas, generally in close association with man. Buildings often provide desirable nesting areas (e.g. flat surfaces and ledges, metal I-beams in hangars, etc.). Currently, the pigeon population at NOLFIB is highest near and around the buildings on the north side of the airfield as shown in Figure 11.



Damage. Pigeons present enough of a threat to aviation safety at NOLFIB to merit control measures. Although pigeons are not as large as many other species considered detrimental to aviation safety (e.g. waterfowl, gulls, raptors), they are still a concern because of their loose flocking behavior, overall abundance, and dense body structure, all of which increases their potential to damage an aircraft. Pigeons also damage property such as buildings and airplanes with their droppings, which are corrosive to painted metal surfaces and electronic equipment. Pigeons (and their droppings) are vectors for several infectious diseases (McLean 1994) such as psittacosis and histoplasmosis (Appendix 11), therefore, populations should not be allowed to build up.



Legal Status. Feral pigeons are not regulated by federal or state laws and can be taken at any time. Mourning doves, however, are migratory game birds and are regulated by federal and state regulations and permits are required for lethal control actions.

Control Measures. Habitat modification such as eliminating seed producing vegetation and reducing available water sources helps reduce the number of dove using the airfield. New structures that are constructed should be designed to preclude nesting by pigeons; and old buildings should be retrofitted, where feasible, with exclusionary netting or types of barriers to block access to eaves and beams. Installation of wire slinky coils, porcupine wire, or some other tactile repellent can be applied to their favorite roosts. Aircraft engines should be covered if they are stored for any extended period to prevent birds from nesting. Exclusionary techniques are most effective when birds are initially attempting to colonize an area.

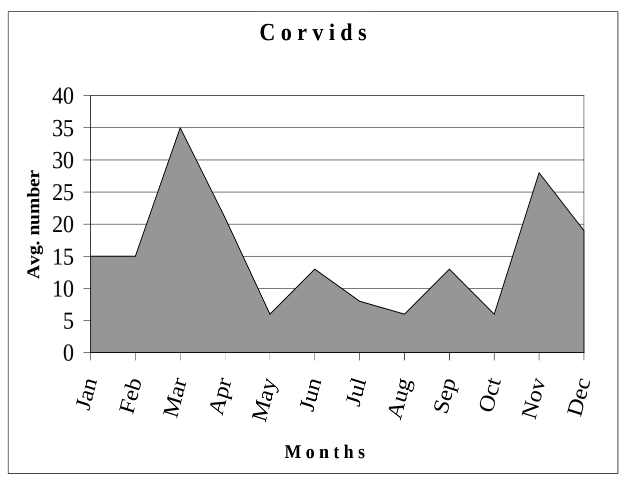
Because many of the pigeons at NOLFIB are already established, the population should be removed with traps, nets, shotguns, and/or air-rifles (pellet guns). Once reduced to a maintenance level, it is relatively easy to prevent pigeons from re-invading hangars and other structures by using air-rifles and exclusionary methods previously discussed. It is important to follow-up with these periodic maintenance measures, because if left unchecked, a few pigeons will return and decoy additional birds to site.

Avitrol (Appendix 12), a chemical frightening agent, is also available for pigeons, but it is not recommended for use near airports because the birds respond unpredictable ways before they die, possibly creating a greater hazard to aircraft.

In addition to shooting, feral pigeon populations can be significantly reduced using decoy traps or walk-in traps that utilize a swinging door. These are effective after the first few birds are captured and allowed to remain in the trap as a visual decoy for other pigeons. To catch the first birds, bait, corn or other grain, should be lightly scattered in front of the trap entrances. Once the first few birds are caught, check the trap daily, put in fresh water and bait, and remove all, but two to five birds. For ease of portability, the trap can be modified into a low profile design without a smaller roosting compartment, although it has the capacity to hold fewer birds. Entrances into the trap should be put on opposite, or all, sides of the trap. The best locations to trap pigeons are at their feeding sites or loafing areas. Watering sites are effective during dry times of the year. Pre-baiting an area for three to four days before using the trap will make it more effective. Move the trap as necessary if birds are no longer being caught. The euthanasia and disposal of trapped birds, should be quick and humane. Carbon dioxide chambers are effective for large-scale projects.

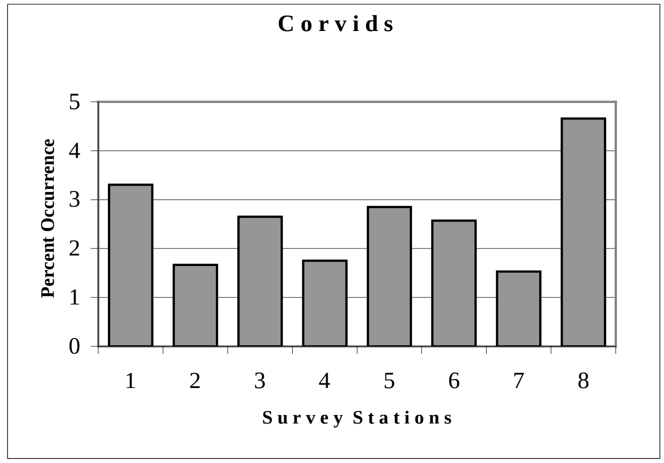
7.1.4 CORVIDS (Crows and Ravens)

Description. Crows (*Corvus brachyrhynchos)*, and ravens *(Corvus corax)*, are well-known, boisterous birds of exceptional intelligence, and are very social. Crows and ravens are medium to large sized black birds that are omnivorous in their diet as they feed on a wide range of food items including crops, insects, and refuse at landfills. Crows tend to be less wary of humans than ravens, and are more likely to be found at airfields.



General Abundance at NOLFIB. Both crows and ravens were observed on and around the airfield. Crows were generally observed in larger groups at the airfield. Ravens were generally observed in groups of 1 to 3 birds as opposed to crows 1-25. (Figure 12 & 13).

Attractions. Crows and ravens commonly feed in open areas, especially when there is dense cover nearby such as trees or brush. Activities such as mowing serve as a attractant to ravens or crows because of the insects that are exposed. Such activities should be coordinated with the NOLFIB technical representative and airfield operations personnel prior to their initiation so that birds can be dispersed before they have the opportunity to land and feed.



Damage. Crows and ravens are medium to large sized birds and can inflict severe damage to aircraft. Fortunately, most are somewhat adept when it comes to avoiding aircraft, and are generally not considered a great threat to aviation. However, this does not mean they can be dismissed as a hazard altogether because they did comprise about 2% of the total strikes reported in the United States (Cleary et al. 2000). Furthermore, crows exhibit a tendency to form larger flocks during the winter, which increases the potential for damage if they are struck.

Legal Status. Corvids are migratory birds and afforded protection as such, however, crows, blackbirds (rusty, yellow-headed, Brewer's, and red-winged), and magpies can be taken without a federal permit when they are Afound committing or about to commit depredations upon ornamental or shade trees, agricultural crops, livestock, or wildlife, or when concentrated in such numbers and manner as to constitute a health hazard or other nuisance...@ (50 CFR Ch. 1 ' 21.43). The State of California recognizes the federal regulations and does not require a state permit under the conditions previously mentioned . Lethal control of ravens does require a federal permit.

Control Measures. Habitat modifications are helpful in reducing the number of corvids, on an airfield. This is most effectively accomplished through prey-base reduction and the removal of dense tree stands, refuse, and carrion from runways. Agricultural activities such as plowing, mowing, or irrigating can attract corvids, and should therefore, be carefully managed or eliminated. Corvids can easily be hazed using pyrotechnics, propane cannons, bioacoustics, and visual repellents, but soon habituate (grow accustomed) to these devices if not enhanced by lethal control. Pyrotechnics are especially effective when supplemented with shooting. Shooting with a pellet gun or shotgun can be useful in removing small populations of corvids from an airfield.

1. <u>Roost Control.</u> If a roost forms on or near the airport, it can be removed by thinning the trees and/or hazing with pyrotechnics, bioacoustics, and free floating helium-filled balloons. In addition, a few should be shot for reinforcement. If a hazing effort is conducted, it needs to be done intensively until the roost disperses, usually for 3-4

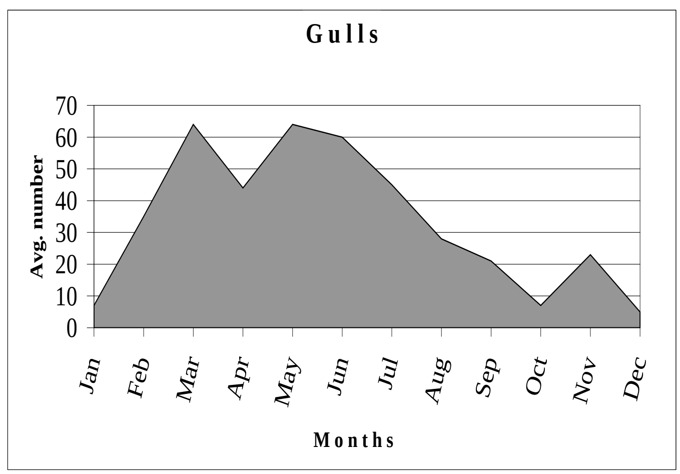
days. Birds may not return, but if they do, the process should be repeated immediately upon their return.

2. ***Modified Australian Crow Trap.*** This is a decoy trap (Figure 7) similar to that used for starlings and blackbirds, except the entrance slots are enlarged 6 x 6-inch openings. The traps should be baited inside and out with red dog food or old potato chips until the first few individuals are caught. As with the starlings, this trap is most effective during the winter months when food is scarce and flocks are large. A few individuals should be left in the trap (along with an adequate supply of food and water) to act as decoys for other birds. Cheetos7 or a similar product have been found to be particularly effective if an adequate supply can be obtained from a local distributor.

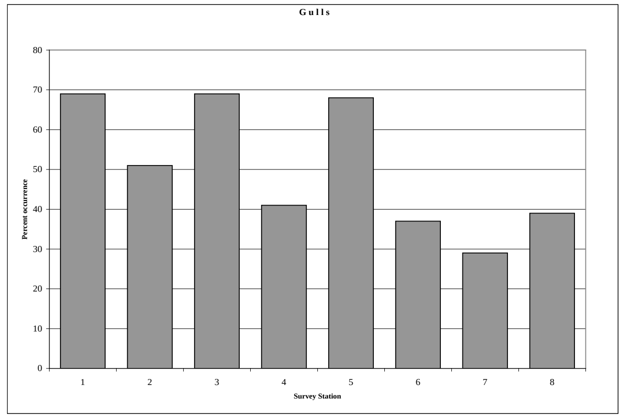
7.1.5 GULLS

Description. Gulls are robust birds with webbed feet, long pointed wings, a stout, slightly-hooked bill. Most adult gulls are white with gray backs and black wing tips, whereas juveniles are typically a mottled brown color with black bills for the first two to three years.

General Abundance at NOLFIB. While other gull species are periodically observed in San Diego county, the ring-billed *(Larus delawarensis)*, western, and Heerman's (*Larus heermanni)* gulls are the most abundant. Flocks of ring-billed, California, and western gulls were generally observed on the airfield at NOLFIB throughout the year, although the composition of the individual species varied seasonally (Figure 14). The use of the actual airfield was relatively uncommon. The threat was in their daily movements to and from the Tijuana Slough National Wildlife Refuge to other locations, creating, at times, multiple crossings in short periods of time. The approach ends of runways 26 and 27 were the areas of heaviest activity. The approach to any runway is considered a critical area , and the frequency of gulls at the approaches and ends of runways 26 and 27 after rains should be of great concern. At least one of the western gull strikes at NOLFIB in February 2000 was attributed to their congregating around standing water on the airfield.



Large numbers of gulls reside along the shoreline in the Tijuana Slough National Wildlife Refuge, sometimes estimated at over a thousand individuals. NOLFIB lies between Imperial Beach and the coastline making it in line for the gulls flyway when they are crossing into Imperial Beach to forage for food and ultimately back to the refuge. As mentioned earlier in this report, the Otay Valley dump is also located seven driving miles away. This distance is less in flying miles. Large numbers of gulls have been seen utilizing this site. It was not noted as being a major reason for airfield crossings of gulls. The majority of gull crossing occurred from a north/northeast to south/southwest direction, and vice-versa, mostly concentrated on the western half of the airfield, specifically from point 1 to point 6 west (Appendix 8) (Figure 15).



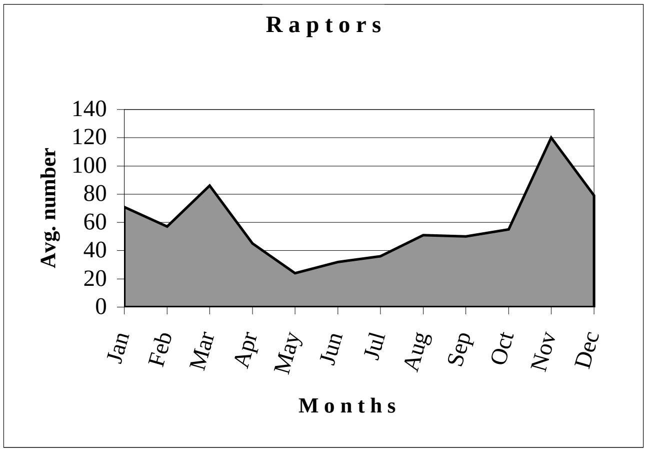
Attractants. Gulls are attracted to water or food including refuse from dumpsters and landfills, earthworms, insects, and carrion. They are also attracted to airports because they often provide ideal loafing sites. NOLFIB has gulls present virtually year-round. As earlier indicated, most of the gulls fly over the airfield from roosting and feeding sites northeast of the airport, but some stop and frequent the airport operating area.

Damage. Gulls are considered a primary hazard because of their size, abundance, wide and expanding distribution, flocking behavior, relatively slow flight characteristics, and general tendency to concentrate at airports. Several have reportedly been struck at NOLFIB as indicated in Table 1, and it is possible that more strikes occurred that were not reported.

Legal Status. Gulls are classified as migratory nongame birds and can be controlled with a USFWS depredation permit.

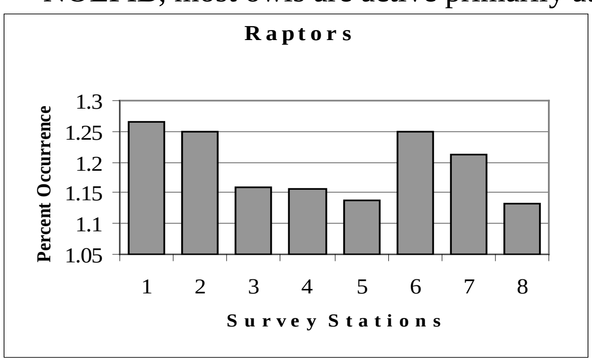
Control. Habitat modifications are the best methods to control gulls. Longer grass regimes of 8 to 12 inches for most species, removal of refuse, fast clean-up of carrion (dead animal carcasses) from the airfield, elimination of standing water (increased drainage), or installation of wire grids with 10-30 foot spacings over open water will reduce most gull populations (depending on their motivation and if the measures are supplemented with an active dispersal program). Gulls habituate rather quickly to hazing (pyrotechnics, propane cannons, bioacoustics and visual scare devices) and several individuals may need to be shot to reinforce nonlethal techniques. Gulls respond favorably to dispersal efforts when hazing is coupled with lethal reinforcement, especially if shooting is used as the primary method of lethal control (Dolbeer et al. 1993). The gulls lethally removed can be displayed (belly up, wings spread) near the spot they frequent for a few days. This is often effective at scaring away flocks if they return, but may also attract carrion-eating predators such as eagles, ravens, and coyotes. This type of secondary hazard should be carefully considered before adopting this approach.

7.1.6 HAWKS, FALCONS, AND BURROWING OWLS



Description. Raptors are predatory birds and scavengers that possess hooked beaks and talons to capture and feed on prey. Raptors include vultures, eagles, hawks (osprey, kites, harriers, accipiters, buteos, and falcons), and owls. Raptors range in size from as small as the 8-inch long American kestrel or 9-inch burrowing owl to as large a 36-inch long golden eagle. Most species have characteristic hunting styles such as soaring (vultures, eagles, red-tailed hawks), low-flying (harriers) and dense forest (accipiters) ambush, hovering (white-tailed kite, kestrel), and watching from perches (buteos, owls).

General Abundance at NOLFIB. Unlike the hawks and falcons encountered at NOLFIB, most owls are active primarily at night. However, because the burrowing owl (*Athene cunicularia)* is largely diurnal (active in the daytime) it was included in this category for sake of discussion. Burrowing owls were only observed two times on the airfield, and no burrows were discovered, making their threat to aircraft minimal. Other raptors (primarily American kestrels *(Falco sparverius)* and red-tailed hawks (*Buteo jamaicensis)*, northern harriers (*Circus cyaneus)* and ospreys *(Pandion haliaetus)* were observed throughout the year, especially in the fall (Table 1) (Figure 16). Hawks and American kestrels were observed hunting at every observation station at NOLFIB (Figure 17). The abundance of short grass areas at NOLFIB has created ideal habitat for ground squirrels, mice, pocket gophers, and rabbits. Large numbers of these small mammals were observed at NOLFIB and is the primary reason for the large attractant to the raptor species.



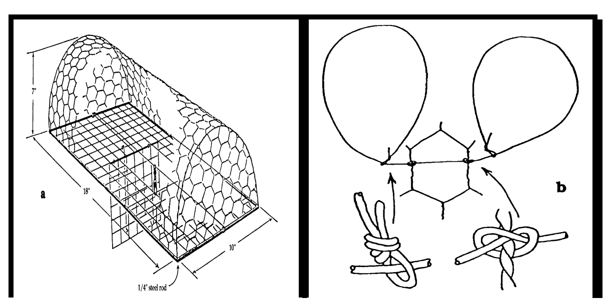
Attractants. Abundant insects, small mammal populations and other bird species, open spaces, and roosting and perching structures provide ideal habitat and prey for most raptors. Habitat modifications and prey-base control at NOLFIB will reduce the attractiveness to raptors. .

Damage. Raptors represent a significant hazard to aircraft because they are typically large in size and because their hunting and soaring behavior predisposes them to collisions with aircraft. There have been previous strikes at NOLFIB between raptors and helicopters.

Legal Status. Raptors are protected as migratory birds and eagles, specifically, are protected under the Bald Eagle Protection Act and require an additional permit to harass or take. The peregrine falcon is afforded protection under California State laws (see Appendix 2 for a listing of current status) and the respective regulating agencies (Appendix 10) should be consulted prior to implementing any control action that may affect them. Wildlife control personnel should be aware of these species and avoid potential impacts to them. Other species such as the burrowing owl (Appendix 2) are species of special concern and/or candidates for the state or federal endangered species list and should be avoided where feasible. This list should be reviewed and updated at least once per year because their status may change.

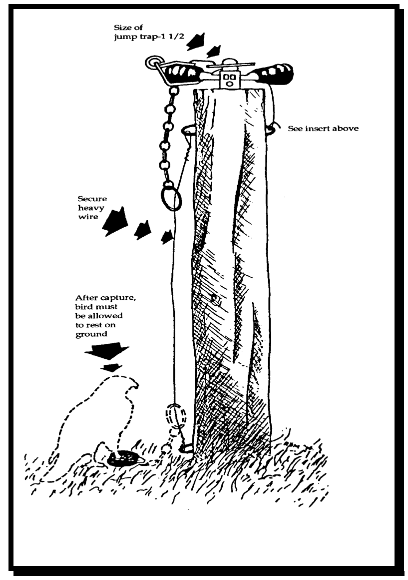
Control Measures. Habitat modifications, specifically vegetation, structure, and prey-base management, will have profound effects on the number of raptors found at NOLFIB. If raptors still persist to remain on the airfield, hazing (pyrotechnics) can be used to deter birds. The most non-respondent individuals may have to be trapped or shot. Raptors can be captured using several styles of traps including bal-chatri, padded-jaw leghold, and Swedish goshawk. Most of these can be used to take and relocate specific individuals. If a hawk becomes trap shy, it may have to be shot if it poses a significant risk to air operations. The appropriate permit must be obtained prior to control since many raptors are sensitive species.

1. ***Bal-chatri trap.*** These traps are relatively small and are shaped into a semi-cylindrical form (Figure 18). They can be modified to trap specific types of raptors. Live bait is used to lure raptors and nylon nooses entangle their feet, holding the birds. Traps are made of 1 inch chicken wire (2 to 3 inch mesh hardware cloth if mice are used for bait), formed into quonset-huts, 18 inches long, ten inches wide, and seven inches high. Floors are 1 inch wire mesh or smaller, depending on bait. Tops are covered with about 100-150 nooses made with 20# test monofilament line (Figure 19). Pigeons, starlings, and house mice can be used for bait. Traps should be attached to a three to four pound weight to keep birds from dragging them off or breaking the nooses. These traps must be monitored continuously when used.



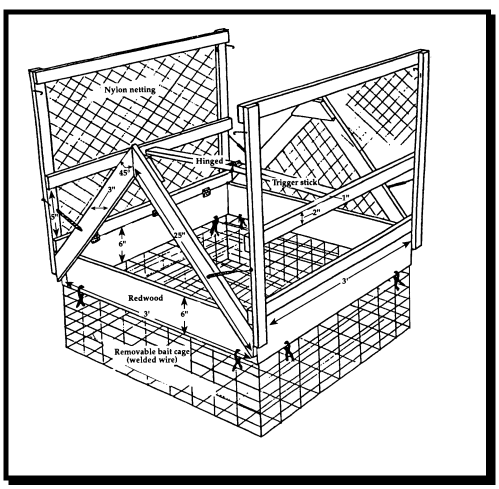
2. Padded-jaw Leghold Trap. Problem raptors can be caught with a modified padded jaw leghold trap (pole trap) atop five to ten foot poles (Figue 20). Each trap is equipped with a swivel and a short length of heavy-duty cable attaching it to the pole to allow the bird to fall to the ground while the trap remains attached to the pole. Place modified # 1 or 12 coil spring traps on top of the poles where hawks are seen frequenting. Jaws must be padded with rubber pads. These traps must be inspected a minimum of twice daily.

3. Swedish Goshawk Trap. These are relatively large traps that can be used to capture all types of perching raptors (Figure 21). They consist of 3 foot x3 foot x1 foot bait cages made of 1 inch wire mesh with traps mounted on top that consist of wooden A-frames, nylon net panels, and a trigger mechanism. The trigger mechanism is a hinged stick that snugly fits between the panels and collapses when a raptor lands on it. Pigeons, starlings, rats and mice can be used as bait, but the bait cage needs smaller wire mesh for mice.

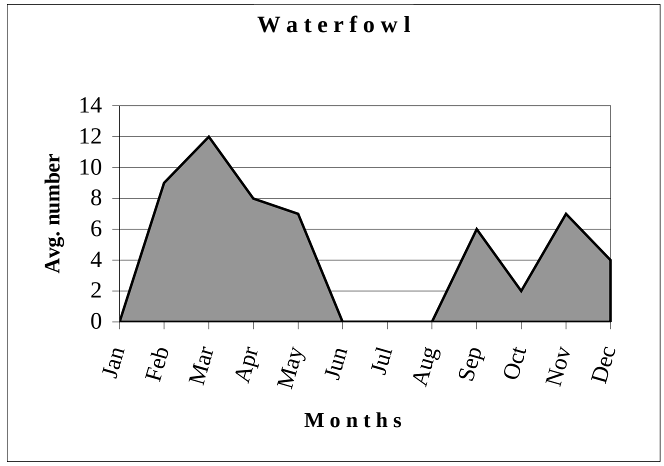


7.1.7 WATERFOWL (Ducks and Coots)

Description. Waterfowl are aquatic birds with webbed feet, flattened bills, narrow pointed wings, and short legs. This guild includes ducks, geese, and swans. Ducks are further divided into divers and dabblers (surface feeding ducks). As well, coots are generally included in the same guild as other waterfowl. Coots are slaty black with short tails and stubby, rounded wings, lobed toes and a short, whitish beak with a black band near the tip. Due to their large size, waterfowl can easily damage or down an aircraft. The hazard is exasperated by their propensity to form flocks, possibly resulting in multiple engine ingestion and subsequent failure. Ducks and coots both were seen flying in the Tijuana Slough National Wildlife Refuge surrounding NOLFIB.

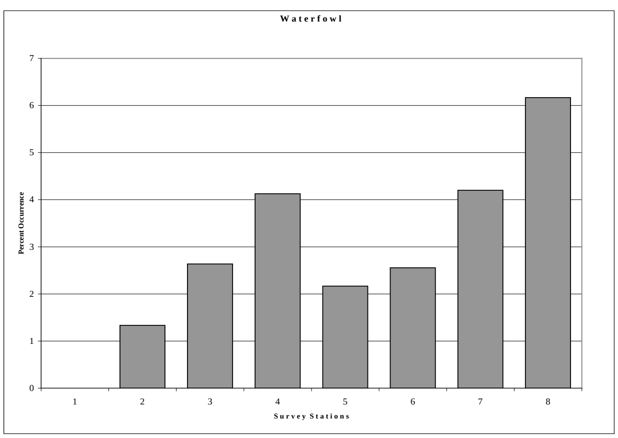


General Abundance at NOLFIB. During times of rain mallards *(Anas platyrhynchos)* were seen loafing around pools of standing water at the east and west ends of runways 26 and 27 near stations 4, 7, and 8 (Figure 23). Mallards and assorted waterfowl were also recorded crossing the airfield and runways. Efforts must be taken to abate these hazards, through a hazing program during the fall and winter months, and habitat manipulation to make the airfield less attractive, especially during periods of rain fall (Figure 22).



Attractants. Waterfowl are attracted to wetlands to feed, nest, loaf, and escape predators. They also utilize the Tijuana River where they feed on aquatic vegetation. Geese, swans, and to a lesser extent, widgeons and coots, will also frequent grass fields, parks and golf courses to graze. Also, other waterfowl species, especially the divers, are attracted to open water where they feed on fish and submerged aquatic vegetation. Unfortunately, wetland habitat is very abundant surrounding NOLFIB.

Damage. Waterfowl can be particularly hazardous to aircraft because of their size and weight, flocking behavior, and relative abundance. As discussed in the introduction, the potential for damage by waterfowl was most tragically illustrated in September 1995 when an Air Force jet crashed in Alaska after striking a flock of Canada geese on takeoff, killing all 24 crew members.

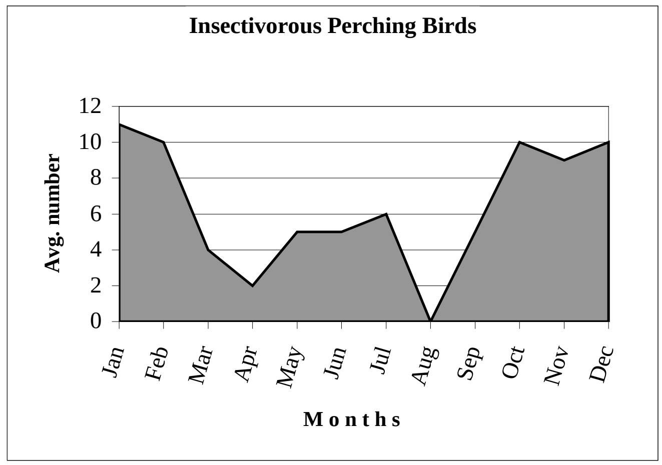


Legal Status. Waterfowl are protected as migratory game birds by federal and state laws, and require a USFWS permit for lethal take.

Control Measures. The best method of control for waterfowl is the removal or exclusion of attractive wetland habitat and agricultural crops. Wire grids are effective at 10-20 foot intervals over ponds and other wetlands. Mylar tape stretched between 2 stakes, 50-100 feet apart at 25 foot intervals are effective for feeding areas. Using long grass management (8 - 12 inches) or an unpalatable ground cover can effectively preclude wide variety of birds (Linnell et al. in press), including geese, from feeding on airfields. Pyrotechnics work well for most waterfowl, especially during the hunting season. If they habituate to hazing efforts, it may become necessary to shoot a few individuals to reinforce these methods. Habituation to hazing techniques is most often noticeable with resident birds, but may also occur in migrants a few weeks after the regular hunting season closes. Waterfowl are also affected by the use of visual repellents in conjunction with pyrotechnics. A coyote effigy can be an effective deterrent for keeping waterfowl from feeding areas, especially if the birds are migrants just passing through.

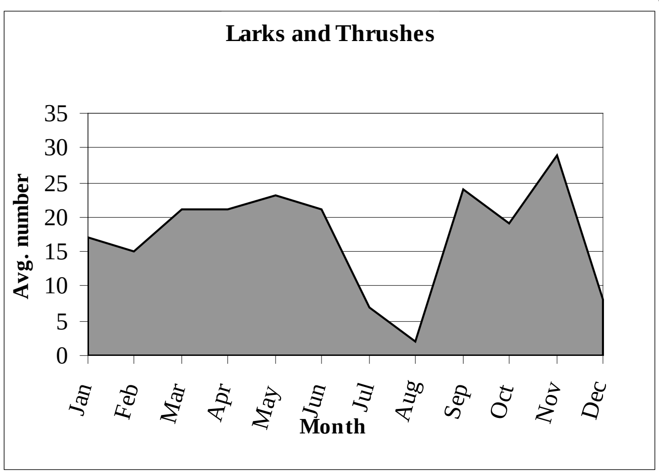
In addition to implementing direct control actions, pilots and ground personnel responsible for reducing wildlife hazards should be made aware of potential hazards at NOLFIB, especially during the fall and winter months when waterfowl are plentiful. The issuance of a NOTAM would be an effective way to disseminate this information to pilots.

7.1.8 INSECTIVOROUS PERCHING BIRDS (Shrikes and Kingbirds)



Description. This guild contains birds that consume insects primarily from a perched position. Loggerhead shrikes *(Lanius ludovicianus)* and western kingbirds (*Tyrannus verticalis)* are somewhat diverse in the habitat they prefer, but both are commonly found on airfields. Kingbirds will often take insects on the wing, whereas shrikes typically capture larger ground dwelling insects which they impel on a thorn or barbed-wire fence before eating them.

General Abundance at NOLFIB. Shrikes and kingbirds are typically solitary foragers that frequent grassy areas interspersed with stands of shrubs and brush. They are small enough that they are usually not considered a major threat to aviation safety, unless they are present throughout the airfield in large numbers. Loggerhead shrikes and kingbirds were on the airfield at NOLFIB both in low densities. Both species were observed at stations throughout the airfield, but rarely were they observed more than once at the same station (Figures 24 and 25). They were often seen perching somewhere along the perimeter fence. Neither of these species were observed in any numbers and are not considered a significant hazard to aircraft operating out of NOLFIB.

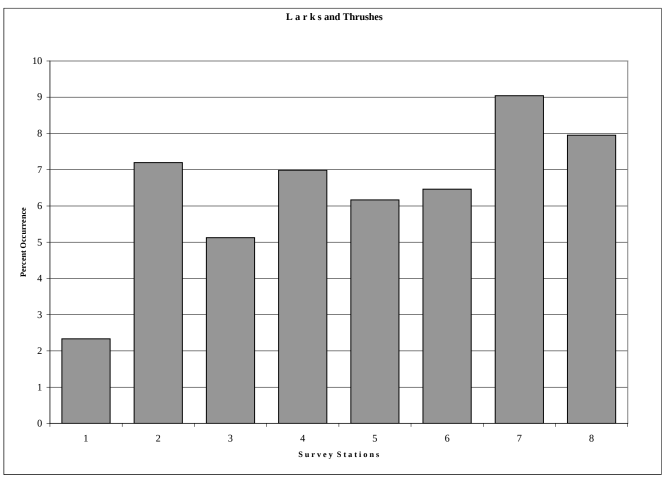


Legal Status. Both shrikes and kingbirds are protected as migratory nongame birds, and a federal permit is required to take them.

Control. Habitat management is the most practical method of controlling these species. Eliminating perch sites, particularly trees can greatly reduce the attractiveness of an airfield to these birds. Porcupine wire can be attached to structures such as instrument landing systems, approach lights, or weather towers if the birds are using these structures as perches. In situations where an outbreak of insects attracts an unusually high number of birds to the airfield, applying an EPA-approved insecticide may provide temporary relief from the hazard.

7.1.9 LARKS AND THRUSHES (Meadowlarks and Horned Larks)

Description. Western meadowlarks are similar in size and appearance to starlings except they are light brown with black Vs on their breasts and yellow underparts and have white outer tail feathers. The horned lark is a ground dweller of open fields. It is a small bird with distinctive black Ahorns@ on either side of a yellow face. Larks are slender billed seed and insect eaters.

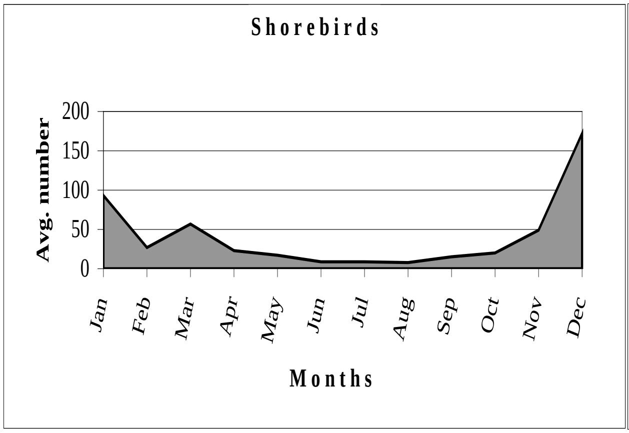


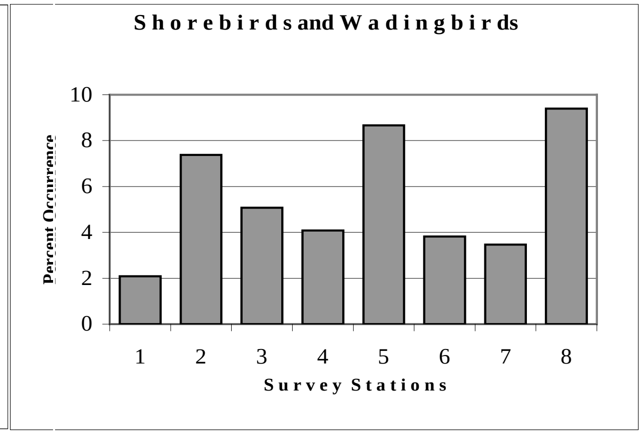
General Abundance at NOLFIB. Western meadowlarks and horned larks are common grassland species at NOLFIB. Both were present throughout the year and seasonally in high densities (Figures 26 and 27). Horned larks and meadowlarks were visible from all the survey points on the airfield and at times were seen in groups as high as 75 horned larks and 25 meadowlarks.

Attractants. These species are attracted to various short grasses and agricultural fields where seeds and insects are abundant. They tend to stay near the ground, however, meadowlarks will use perches such as tree stumps, telephone wires, and fenceposts.

Damage. These birds, particularly meadowlarks, are common in open grassland fields such as those found at airports. They flock during winter and are occasionally struck by aircraft when crossing runways to feed in new fields.

Legal Status. Larks are migratory nongame birds and require a USFWS permit for lethal take.





Control Measures. Long grass management (8 inches plus) will help reduce populations of these species. Pyrotechnics combined with periodic shooting is effective in moving them from one area to another. Visual repellents, especially raptor kites, helium balloons, and stretched mylar tape, will add to the effectiveness of hazing.

7.1.10 SHOREBIRDS AND WADING BIRDS (Curlews, Godwits, Whimbrel, Killdeer, Herons, and Egrets)

Description. For this discussion we have lumped several species together. Shorebirds are a general term for an assortment of birds associated with water and shoreline habitats. For the most part only a few species ventured from the beach or the Tijuana Estuary onto the airfield, but several utilized airfield habitat and warrant discussion. These species were; marbled godwits (*Limosa fedoa)*, long-billed curlews (*Numenius americanus)*, and whimbrels *(Numenius phaeopus)*. All three species are relatively tall, long-legged birds ranging from 18 inches to 24 inches in length and have long bills of which the godwit curves slightly upward and the curlew and whimbrel slightly down. Killdeer (*Charadrius vociferus)* are a small plover (10 inch in length) with a brown back, white belly, and two black breast bands. Killdeer frequent open grassy areas typical of airfields and may be found in flocks, but are more often found alone or in pairs.

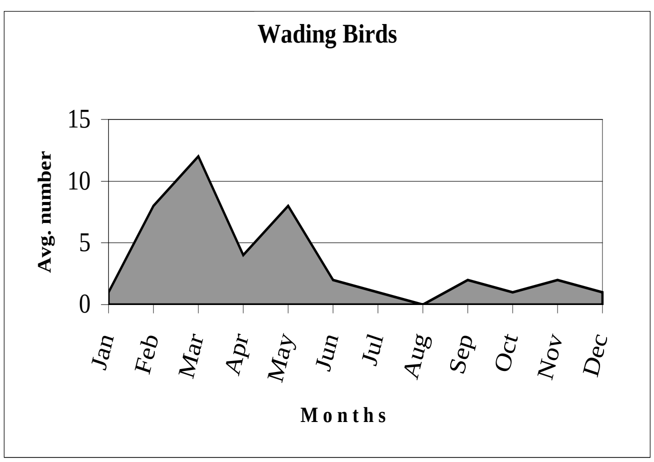
Also lumped into this discussion as wading birds were, among others but most notably, herons and egrets. Due to their large size, slow flight and their occasional use of the airfield make them a species of concern to aircraft. Great blue herons (*Ardea herodias)* are large grey-blue birds up to 46 inches in length and can have 6 foot wingspans. They have a thicker bill than shorebirds and are able to hunt and swallow ground squirrels whole. Great egrets (*Ardea alba*) are also tall, white birds (not generally as tall as great blue herons) with heavy yellow bills. Generally ranging, depending on species, from 24 inches to 34 inches in length and can have wingspans up to 54 inches.

General Abundance at NOLFIB. Killdeer, the most abundant shorebird at NOLFIB, were present on the airfield through the entire survey. Feeding was the primary activity in which they were engaged. The long-billed shorebirds were often seen foraging in the short grass areas of the airfield most predominately up against the borders of the refuge and by the Helicopter pads (Appendix 8) (Figure 28). Herons and egrets were also observed in the short grass area of the airfield foraging. Seasonal trends can be seen in figure 29. The shorebirds of concern seem to be most prevalent in the Fall, Winter and Spring months (Figure 30).

Attractants. The aforementioned species of shorebirds are generally attracted to wide open spaces characteristic of airports because this type of habitat provides a predator-free environment with ample food supply. Shallow puddles and mud flats may also attract shorebirds. When they are detected, curlews, godwits, and whimbrels should be immediately dispersed, especially upon their initial arrival in spring, before they have a chance to feed. If they are attracted by an out break of insects or some other attractive resource (e.g protein-rich caterpillar larvae), they might be less responsive to traditional hazing methods and lethal control may be necessary. The same holds true for herons and egrets.

Damage. Shorebirds are commonly hit by aircraft, primarily because of their propensity to flock and because they tend to fly up in a wide circling pattern when startled or dispersed. Shorebirds have the potential to cause substantial damage to an aircraft, especially if an entire flock is involved. Herons and egrets can also cause substantial damage due to their size alone. While not commonly referred to as a flocking bird they can be present in numbers utilizing the same areas. As mentioned before, their low and slow flying can create hazardous crossings.

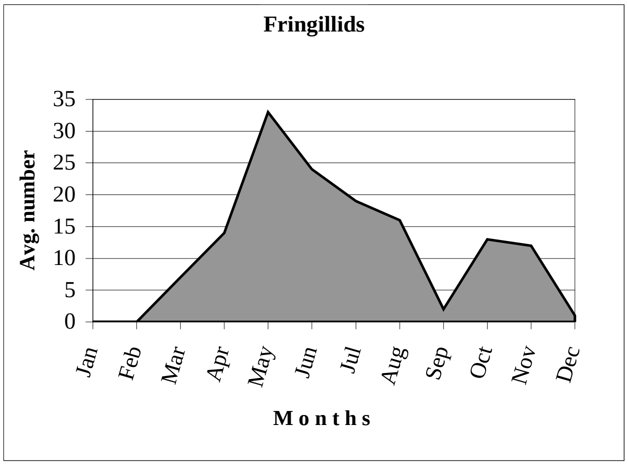
Operations that continue out over the refuge, especially when personnel are exposed to the hazards hanging from tow lines, should do test runs over the Tijuana Estuary to observe the response of the shorebirds when present in large numbers.



Legal Status. All shorebirds are classified as migratory nongame birds and are afforded protection under the Migratory Bird Treaty Act.

Control Measures. Because of their flight characteristics, most shorebirds often do not respond favorably to hazing tactics. Killdeer may be persuaded to abandon the airfield for a short time, but they often return. Caution should always be exercised when dispersing shorebirds because they often circle the airfield for a period before abandoning the site. Therefore, it is essential to consider the status of air traffic before initiating any action. Longer grass regimes will also preclude many shorebirds from the airfield, but in some situations it may simply displace them onto the runways and taxiways where they create a greater hazard. In this case, the species of shorebirds and wading birds are attracted to the airfield for foraging opportunities in the short grass areas, so elimination of those areas would greatly curtail use.

7.1.11 FRINGILLIDS (Sparrows, Warblers, and Finches)



Description. This guild is comprised of small granivorous (seed-eating) birds that form loose flocks, especially during the winter months. Sparrows and finches are small birds with thick, heavy bills for opening seed husks. As with many birds, the males are generally more colorful, and both genders often have streaking on the breast, back, or wings. Finches exhibit a characteristic undulating flight.

General Abundance at NOLFIB. House finches (*Caprodacus mexicanus)*, American goldfinch *(Carduelis tristis)*, Cassin's finch *(Caprodacus cassinii)*, house sparrows *(Caprodacus domesticus)*, white-crowned sparrows (*Zonotrichia leucophyrs)* are all residents of San Diego County, and were observed from moderate to high abundance at NOLFIB throughout this assessment (Figure 31 and 32). They were most abundant during the late summer and early fall where the spike is representative of the recruitment of fledglings.

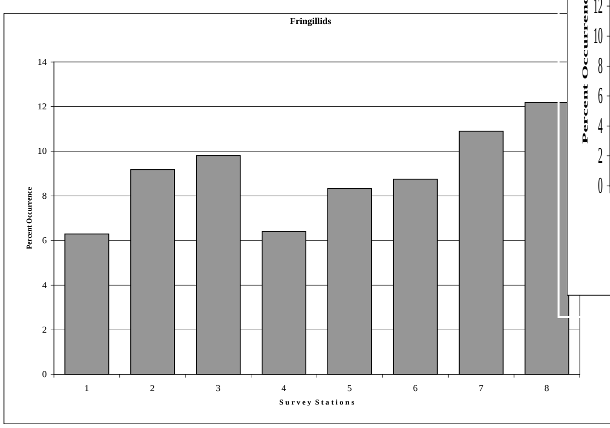
Attractants. Members of this guild are diverse in the type of habitat they occupy, but they are often attracted to buildings, brush piles, trees, shrubs, weedy fields, grasslands, and cultivated fields. Many species are common in urban areas, especially during the breeding season. Although these species are primarily seed eaters, they may also feed on fruits, grains, and insects.

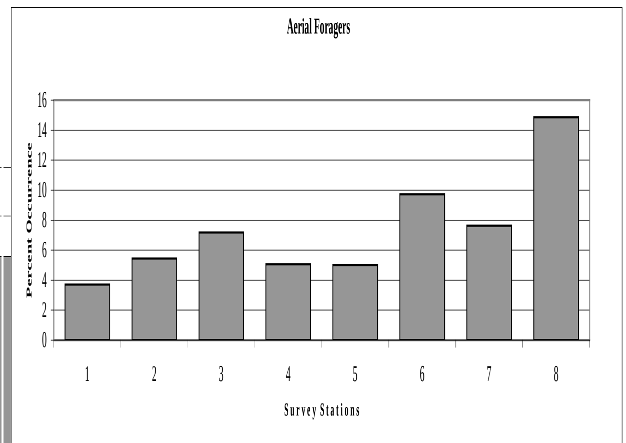
Damage. Most sparrows and finches tend to hang close to shrubs, trees, and structures where they are afforded protection from predators, therefore, they are infrequently struck by aircraft. Because members of this guild are small in size, they rarely result in damage to an aircraft when they are struck, hence, they were not considered a significant hazard at NOLFIB. This does not, however, mean their hazard potential can be discounted altogether, especially given their propensity to flock. In addition to bird strike hazards, finches and sparrows can cause structural damage with their droppings and can act as vectors for disease.

Legal Status. With the exception of house sparrows, which are not afforded any protection, members of this guild are protected as migratory nongame birds.

Control Measures. Management of tall, non-seeding grass, and the removal of brush piles, unwanted structures, and weeds will reduce these species populations. Birds nesting in structures, may be excluded by placing a :-inch or smaller mesh over the opening. Aircraft engines should be covered if they are stored for any extended period to prevent birds from nesting. Pyrotechnics combined with visual repellents and periodic shooting can be used to disperse flocks away from the runways, but they adapt to these methods quickly, especially around structures. Funnel traps and the Australian crow trap baited with milo or some other grain can be effective in reducing the population where necessary (Figure 7). Avitrol7 (4-aminopyridine) is toxicant registered for house sparrows (Appendix 12) that is supposed to act as a frightening agent because it elicits distress calls and other behavioral responses by the birds that consume it. Because house sparrows do not have loud distress calls they are not greatly affected by the frightening response. This toxicant is generally not recommended for use on birds close to the runways because they respond in unpredictable ways and may be more prone to bird strikes. If Avitrol is used, the directions on the label (Appendix 12) should be stringently adhered to.

7.1.12 AERIAL FORAGERS

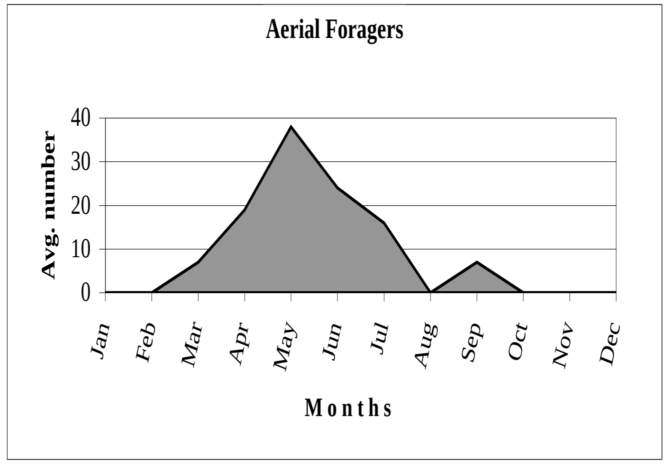




(Swallows)

Description. Swallows are slender aerialists with long, pointed wings. They feed on insects by flying in an erratic manner with their gaping mouths. Cliff swallows (*Petrochelidon pyrrhonota)* and barn swallows (*Hirundo rustica)* build mud nests under eaves and bridges, whereas, the other swallows nest in banks, trees, and cavities of rocks.

General Abundance at NOLFIB. Cliff and Barn swallows were the two species observed at NOLFIB. (Figure 33). These birds were distributed throughout the airfield and were not observed at any single station with great regularity (Figure 34). However large flocks entered onto the airfield on a few occasions, the most of which occurred when a flock of 450 individuals was observed at Station 8 and 70 were seen at Station 6, both in July. No unusual outbreaks of insects (e.g. mosquitoes or gnats) were noted during the period swallows were on the airfield.



Damage. Swallows are commonly involved in collisions with aircraft because of their erratic flight behavior while foraging for insects, similar to bats. Fortunately these collisions seldom result in damage because the birds are small. Those species that build mud nests can also cause damage from falling debris and droppings when they nest around aircraft hangars. The swallow population at NOLFIB was not considered a significant hazard during this assessment.

Legal Status. All swallows are listed as migratory non-game birds protected under the Migratory Bird Treaty Act and require a USFWS permit for lethal take.

Control Measures. Control of swallows can be fairly difficult because their presence on an airfield is closely tied to a feeding resource. Removal of their food-base is generally the most effective method of dispersing them from the airfield. This is most effectively accomplished by spraying and insecticide, but may also include the removal of habitat used by the aerial insects for a breeding ground. Because spraying can be an expensive endeavor, it is only be feasible if an outbreak of insects attracts an unusually high number of swallows to a location on the airfield where are likely to be struck. Persistent removal of mud nests with a high pressure sprayer may temporarily discourage swallows from using the area in some instances, but more often it simply enhances their rebuilding efforts. A Federal permit is required to remove the nests if they contain eggs or young chicks. Exclusion from crevices and surfaces with right-angles using 2-inch wire mesh installed with an angled profile will preclude most swallows from nesting on the outside of hangars and terminal buildings. While it is not as permanent as wire mesh or hardware cloth, plastic (e.g.Visquene) is an effective material for temporarily excluding swallows from buildings and structures during the nesting period because it provides a slippery surface to which mud nests will not readily adhere.

7.2. MAMMAL SURVEYS.

7.2.1 SMALL MAMMALS

Description. Cottontail rabbits (*Sylvilagus audubonI)* and Black-tailed jackrabbits *(Lepus californicus)* are both present on NOLFIB. Cottontail rabbits are a small, grey colored rabbit with white fluffy tails. The Black-tailed jackrabbit is much bigger than the cottontail rabbit with longer ears, darker coloring, and black tail. Both feed on a variety of vegetation including grass, flowers, young trees, shrub stems, and many garden crops. Striped skunks (*Mephitis mephitis)* are dark with a long white stripe running on top of their backs and range in size from 4-10 pounds, they live in sheltered places such as culverts and wood piles. Skunks are nocturnal, preferring to hunt at night for insects, small rodents, carrion, pet food, and garbage. California ground squirrels (*Spermophilus beecheyi*) are a small brown rodent with a large bushy tail. Ground squirrels live in tunnels they burrow in the ground. Ground squirrels feed on grasses and forbs.

General Abundance at NOLFIB. Rabbits and ground squirrels were by far the most abundant mammal at NOLFIB. Large densities of cottontail rabbits were observed during each of the night surveys. The cottontail rabbits were present in each of the observation points except observation point one which is entirely surrounded by pavement. Black-tailed jack rabbits were also a abundant mammal at NOLFIB. They were present in smaller densities than the cottontail and were generally visible utilizing the short grass areas during night surveys. Both cottontails and jack-rabbits could be observed well after sunrise and in the early evening feeding, thus attracting nocturnal as well as diurnal raptors and owls. Striped skunks were also seen at NOLFIB. They were usually seen in small densities all around the airfield. California ground squirrels were seen loafing at various locations all over the airfield. The squirrels were seen at all observation points except survey station 1 (Appendix 8). California ground squirrels were seen in high densities especially on warmer sunny days.

Attractants. Rabbits, both species, are attracted to open grass areas, and sparsely vegetated desert areas. They both primarily eat green vegetation. Striped skunks are omnivorous. They feed on mice, eggs, insects, grubs, berries, and carrion. Common to semi-open country; mixed woods; brushland and open prarie; normally located within 2 miles of water (Petersens Field Guide pg 65). California ground squirrels are attracted to open fields, grainfields, slopes with scattered trees, and rocky ridges. They eat green vegetation, bugs, birds, eggs, berries, and seeds.

Damage. Cottontails, Jack-rabbits, skunks, and squirrels do not generally present a direct threat to aircraft. However , they serves as an attractant to raptors and large mammalian predators which, in turn, pose a direct threat to aircraft. NOLFIB is surrounded with short grass areas that are easily visible to birds of prey in the area. Because of the large numbers of rabbits and squirrels, avian predators should be considered one of the major hazards at the airfield.

Legal Status. Black-tailed jackrabbits and cottontail rabbits are considered game mammals and are regulated by the state. A permit may be required before any lethal control action can be implemented at NOLFIB. California ground squirrels are nongame mammals and are afforded no protection in California. Skunks are a non-game mammal and may be taken at any time when causing damage.

Control Measures. Removing all available habitat is the long term solution, but is probably not feasible. Most of the rabbits seen on the airfield live in the Tijuana Slough National Wildlife Refuge during the day and enter the airfield to feed after dark. Hardware cloth or a chicken wire wrap around the bottom of the existing fence, buried at the base at least one foot under ground, would help to exclude rabbits from the airfield. Ground squirrels can be controlled by trapping, burrow fumigants, rodenticides, or shooting and usually requires a combination of the aforementioned methods. Skunks can be excluded from buildings by sealing up entry ways, and culverts can be covered with slotted vent covers which will allow water to flow.

8.0. RECOMMENDATIONS

The following recommendations are offered as a means to alleviate the hazards observed at NOLFIB during the Wildlife Hazard Assessment , and can be readily adapted into a Wildlife Hazard Management Plan or Bird/Animal Hazard Management Plan. If diligently followed, these recommendations should result in a significant reduction of current hazards at NOLFIB, but they do not diminish the need to monitor for new hazards that may arise as airport conditions change. If the Navy is interested in contracting with Wildlife Services, we can provide a cost estimate for assisting the Navy in conducting a BASH program . Cost estimates will vary due to length of contract, frequency of visits, supplies, and personnel needs.

Designate a BASH Working Group and Delineate Responsibilities of All Personnel Involved

A BASH Working Group, and/or its contracted representative, should be appointed by the Navy to respond to and monitor all wildlife related activities. It would be the responsibility of the group to see that recommendations from the wildlife hazard assessment are implemented and the appropriate wildlife control permits and supplies are obtained. The group, or contracted representative, should keep a database of wildlife strike information collected from pilot reports, mechanical inspections, and runway sweeps. It should also be the groups, specifically the Airfield Safety Officers and Airfield Managers, responsibility to help ensure that NOLFIB personnel, pilots and control tower personnel are familiar with the proper procedures for reporting all types of wildlife strikes and to make the strike reporting process readily available.

The BASH Working Group should actively participate in land-use projects or changes, on or off airfield property that could increase wildlife hazards at NOLFIB. For example, new buildings should be designed in a manner that discourages use by wildlife. Companies that produce refuse should be encouraged to use disposal methods that are not attractive to wildlife. Mitigation projects to restore wildlife habitat for potentially hazardous species should be sited as far as possible from the airfield's critical zone. The closer new projects are to the airfield, the more involved the role of the BASH Working Group.

The Working Group should establish individual responsibilities for disseminating wildlife hazard information and coordinate wildlife control activities. The group should meet at least quarterly to discuss progress with wildlife activities, but may need to meet more frequently if situations dictate otherwise. The Working Group should have representatives from all appropriate airport departments such as Management, Maintenance, Firefighting/Operations, Air Traffic Control, and Natural

Resources. A wildlife hazard management program will need to involve each of these departments to varying degrees if it is to be effective.

Obtain the Necessary Permits to Control Wildlife

NOLFIB does not currently possess any permits to control state or federally protected wildlife. The ability to respond to hazardous situations in a prompt and efficient manner is paramount to ensuring air safety, and may sometimes require the lethal removal of hazardous wildlife. To enable a rapid response, the management at NOLFIB should procure a depredation permit from the USFWS (see Appendix 7 for a copy of the application). WS will assist in the application process if the Navy should so desire. There is no fee for obtaining a depredation permit.

Develop a Bird Aircraft Strike Hazard (BASH) Plan Based on the Wildlife Hazard Assessment

One of the objectives of a Wildlife Hazard Assessment is to determine if a Bird Aircraft Strike Hazard Plan is necessary for the airport under review. It is our opinion that a plan is necessary at NOLFIB because it provides the framework from which an active bird dispersal program operates. This document has been formatted in a manner that if adhered to and implemented, should satisfy most of the requirements of a Bird Aircraft Strike Hazard Plan. Because airports are dynamic environments, however, the plan should be revisited annually to determine if changes are necessary and to consider how the wildlife deterrent program can be improved or modified. If the Navy is interested in contracting with Wildlife Services, we can provide a cost estimate for assisting the Navy in writing a BASH Plan.

Train Personnel in Wildlife Hazing Procedures and Species Identification

All personnel that have duties requiring them to access the airport operation area (AOA) should be trained to recognize <u>and</u> respond to potential wildlife hazards in an appropriate manner. Depending on the situation, responding may entail an active hazing or shooting action, or it may simply require the individual to notify the contracted representative or other responsible entity of the hazard. All personnel that might encounter wildlife hazards on the airfield should be made acutely aware that it is their responsibility to recognize and respond to the situation, and not just the role of the bird dispersal team. Personnel should also be familiar with the damage caused by wildlife and how to respond to potentially hazardous situations. To facilitate this decision process, we have assembled a flowchart (see Appendix 3) for selecting the appropriate action. While it may be somewhat simplistic, the flowchart is intended to sequentially guide an individual through the various steps that must be considered before initiating an action. Inherent in this decision process is that employees should be trained in species identification of the most hazardous wildlife, or at least the general category/guild (e.g. gulls, waterfowl, crows, hawks, pigeons) of wildlife. A field guide is very useful for achieving this goal and should be made readily available to those who would use it. There are many guides that are easy to use and can be purchased at a local bookstore for $15 - $20 such as *Stokes Field Guide to Birds - Western Region* (Stokes and Stokes1996), *All the Birds of North America* (American bird Conservancy and Griggs 1997), and *Field guide to the Birds of North America* (National Geographic Society 1987). Personnel should be trained in the safe handling and use of hazing devices to avoid creating a more hazardous situation (e.g. chasing birds into the path of an approaching aircraft). WS offers an four hour training course designed to familiarize airport personnel with basic bird identification and dispersal techniques involving hands-on training, with an emphasis on safety. There is no fee for providing this service.

Have Control Supplies (Pyrotechnics {cannons, screamers, and bangers}, Effigies, Etc.) On Hand

It is recommended that vehicles regularly operating on the airfield (e.g. airport operations) be equipped with a 15 mm single or double shot pyrotechnic launcher and an accompanying supply of bangers, screamers, or whistlers (see Appendix 13 for a list of distributors of wildlife control supplies). This will enable airport personnel to quickly and easily haze any birds they may encounter while conducting other collateral duties. Due to security issues, all weapons for lethal control will have to be registered with NASNI Security before they are allowed to be transported onto to Navy property. At a minimum, the airport should have on hand at least:

2 each	15 mm pyrotechnic pistol launchers and caps-$37.00 each
10 boxes	bird bombs/bangers-$35.00 per box
10 boxes	screamers-$37.50 per box
1 carton	Mylar tape-$7.50 per role (1.25 inch x 250 feet)
2 each	propane cannons/exploders-Single detonation cannon-$275.00 each -Multi detonation cannon-$365.00 each

Additional supplies such as distress calls, silhouettes, and coyote effigies may be necessary as specific situations arise, and it is up to the airport to ensure these static deterrents are procured in a timely manner. Refer to Appendix 13 for a list of suppliers who can provide costs for any additional supplies needed.

Continue Monitoring Wildlife Populations and Use Patterns on the Airfield

The intent of this Wildlife Hazard Assessment has been to document general occurrence, land-use patterns, and population characteristics of wildlife at NOLFIB. Attempts were also made to identify significant attractions within a 5-mile radius of the airfield that could adversely affect the safety of pilots and their passengers. It must be realized that wildlife abundance and use patterns on airfields are affected by a host of variables that are rarely the same from year-to-year. Hence, conclusions based on wildlife populations and patterns during this study are only meant to be a guide and may or may not be consistent with subsequent years. Survey routes and methods were cognitively established in a manner that facilitates continued monitoring by airport personnel. Data from this study will provide a baseline for comparison in subsequent years. NOLFIB should continue to monitor wildlife populations by conducting monthly surveys using the same stations established in this assessment (Appendix 8). While surveys conducted in subsequent years by airport personnel will not be conducted with the same frequency or intensity as this initial hazard assessment, they will still provide general insights into wildlife use patterns over time and enable NOLFIB to gauge the effectiveness of its control efforts. These monthly surveys will take about 1-12 hours and should be conducted by the technical representative, a trained individual whom the representative designates, or a contracted representative. If the Navy is interested in contracting with Wildlife Services, we can provide a cost estimate for assisting the Navy in conducting monthly wildlife surveys.

Develop a Record Keeping System for Wildlife Strikes and Control/Hazing Actions

Wildlife strike records should be kept and maintained by the BASH Working Group or its' designated representative. As was previously discussed, most strike records are incomplete and conclusions must be drawn cautiously. All bird remains (particularly feathers from the head, wings, and tail) that are discovered as part of the routine runway sweeps for FOD should be retained until the type of bird can be identified by airfield personnel or a WS biologist (refer to Section 3.2 for identification procedures or resources). If possible, place the remains in a sealed plastic bag and freeze until the animal can be identified. If a freezer is unavailable, place the remains in a trash container or other outdoor receptacle that can be secured to avoid attracting carrion-eating wildlife. Additional information that is useful includes the runway where the carcass was found (e.g on the helicopter pads), predominant runway in use at the time of the incident, and nature of strike (e.g. reported by pilot, found during a runway sweep, found during mechanical inspection, etc.).

Detailed records of wildlife dispersal and control efforts should also be maintained. Keeping a record of control activities on the airfield provides a useful index of wildlife abundance and use of the airfield over time. It only takes a moment to record the data and the information gained enables the manager or contracted representative to monitor the effectiveness of different methods. The minimum amount of information recorded should include the person conducting the action, the date, time, species, number of animals, location on airfield (the airfield should be partitioned into control zones), and control method used. It would also be useful to document the animal's response to the control action (e.g. abandoned airfield, flew to another zone, etc.). A standardized form makes it quick and easy to log an action or observation. Records of action are most easily maintained on a computer database because the data can be easily extracted or sorted into a presentable report. Many databases also allow the data to be displayed in a graphical format, facilitating interpretation.

Advise the Tower When Hazards are Observed or Expected

Sometimes, a sudden increase in wildlife abundance may occur due to an unforeseen or unpredictable factors such as an outbreak of insects on the airfield that attracts a large number of birds, rains leaving puddles that attract wildlife, or birds being flushed from adjacent properties. If a short-term wildlife hazard such as these are observed that may only last for a matter of hours or minutes, the tower should be notified immediately so the hazard can be included in the airport advisory to pilots. In some situations, it may be necessary for the tower to hold an aircraft until the threat can be eliminated (e.g. birds dispersed from the runway). Ground crews should meet with tower personnel to coordinate communication procedures involving wildlife hazards.

Reduce and Maintain Pigeon Populations at Low Levels

Pigeons were abundant in the structures and buildings along the airfield's eastern perimeter where they loaf, feed, and nest. A control program should be initiated to reduce or eliminate the population from the area. This can be most effectively accomplished by shooting at night with air rifles when the birds have settled into roost and/or by trapping with funnel traps baited with grain or decoys. Pigeon populations generally respond favorably to these types of control measures, and once reduced, require little effort keep them at a maintenance level. If the Navy is interested in contracting with Wildlife Services, we can provide a cost estimate for conducting a pigeon trapping program.

Nest Removal in Facilities

NOLFIB should monitor nesting activity on buildings within the airfield property, and remove any nests that are found. Birds that have young in the nest are more bold in their feeding habits and will increase the number of forays onto the airfield to feed than in those without young. Short of lethal removal, exclusion generally provides the most cost-effective long-term measure for reducing nesting activity in buildings, especially with starlings that often return to the same nesting areas again and again. Once they have selected a site and begun construction of the nest, starlings can be very difficult to exclude because of their persistent behavior. Persistent birds can be removed with a pellet gun or a nest-box trap (Figure 6). While not as persistent at starlings, pigeons and house sparrows will frequently nest in buildings on and around NOLFIB and may present nuisance, health, and safety hazards. If the Navy is interested in contracting with Wildlife Services, we can provide a cost estimate for assisting the Navy in nest removal.

Habitat Manipulation

The manipulation of the current habitat on NOLFIB to inhibit use by potentially hazardous wildlife would be the most important and beneficial method that would have an immediate impact. First, herbicide all faults in the current tarmac and concrete to retard weed and grass growth on the immediate airfield. Most all seed eating birds were repeatedly observed on the airfield utilizing the food sources that grew through the cracks. Second, remove the dirt piles in the middle of the airfield. Not only were they excellent raptor perches, but they also are now overgrown with weeds that produce large seeds very attractive to bird species present at NOLFIB. Third, address the short grass areas on the airfield that is the main attractant for **all** the species present at NOLFIB. This can be done by re-seeding the areas with a native monotypic grass that can be cut to longer lengths without producing a seed head. Also, a soil stabilization project could be used to asphalt areas where no vegetative growth can occur, or a combination of both. Last, the bunkers need to be stabilized. They are not only excellent perches but are riddled with ground squirrel burrows. They are also covered with seed producing weeds. Wildlife Services recommends that the Navy contact the Public Works Center to obtain a cost estimate for maintaining the airfield and soil stabilization projects.

Evaluate Potential Wildlife Hazards When Planning New Construction or Land Use Changes

Airports are constantly undergoing expansion and improvement projects. It is critical to consider wildlife attractants during these planning phases. Several aspects to consider will be the planting of new vegetation, which may provide food to wildlife in the form of seeds and fruits and the creation of water bodies or drainage basins which provide fresh water. Contact the Commander Navy Region Southwest Natural Resources Office for review of airport plans and recommendations.

Adopt a Zero-Tolerance Policy Toward Hazardous Wildlife

A policy of zero-tolerance on the airfield should be adopted toward all wildlife including, but not limited to: waterfowl, gulls, starlings, pigeons,(see Appendix 1 for a list of wildlife observed at NOLFIB). A zero tolerance policy means that hazardous wildlife should be immediately dispersed or removed from the airfield when they are detected. While some species clearly present a greater hazard than others, all have the potential to cause damage.

Haze Early and Consistently

All birds should be hazed from the airfield in the early morning. If birds are consistently harassed each morning before they have a chance to feed, they will find alternative food sources and will be less apt to return later in the day. If this policy is consistently maintained, they will soon learn to avoid the airfield altogether. Once birds become established in an area, they become increasingly difficult to disperse, especially if they begin nesting. Flocking birds such as ducks, geese, gulls, and starlings are readily attracted to individuals or flocks of birds already present, resulting in a dramatic increase in the number of birds on the airfield in a short period of time. To prevent this decoying effect, all birds should be hazed (scared off) from the airfield <u>immediately</u> upon their arrival and not allowed to nest, feed, or loaf. If the Navy is interested in contracting with Wildlife Services, we can provide a cost estimate for conducting a hazing program.

Increase Hazing Efforts During Migrational Periods

During migrational periods, the frequency of hazing patrols should be substantially increased because non-resident birds are unaware of the Aoff-limits@ nature of the airfield and will attempt to land. Propane exploders and other static deterrents may be applied during these short-term periods of migration to discourage transient birds from landing on the airfield in the first place. It should be noted that static devices such as propane exploders, coyote effigies, and raptor silhouettes/kites rapidly lose their effectiveness if not frequently moved. For this reason, these deterrents are typically directed at non-resident animals just passing through the area. If the Navy is interested in contracting with Wildlife Services, we can provide a cost estimate for assisting the Navy in hazing wildlife from the airfield.

Adopt a Policy of Lethal Control (Shooting) for Unusually Persistent Wildlife

Lethal control should be used to control birds that are non-respondent to other methods, especially gulls, waterfowl, pigeons. Lethal control of shorebirds (e.g. curlews and killdeer) is typically less effective and should be used only in situations where they pose an immediate hazard to aircraft safety. It should be noted that when shooting gulls, it is not uncommon for the remaining birds to concentrate around the downed birds in a circling formation as they investigate. Therefore, shooting should not be conducted if an aircraft is on final approach or is departing immediately unless it is a flock of three birds or less. If the Navy is interested in contracting with Wildlife Services, we can provide a cost estimate for assisting in removing persistent wildlife from the airfield.

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APPENDIX 8: RELEVANT LAWS AND U.S. DEPARTMENT OF THE NAVY INSTRUCTIONS THAT MAY PERTAIN TO BASH IMPLEMENTATION.

DEPREDATION PERMITS

Persons wishing to take migratory birds, nests, or eggs as part of an airport wildlife management program must first secure a depredation permit from the United States Fish and Wildlife Services. Some state wildlife management agencies may require that a state permit be obtained in addition. The local U.S. Department of Agriculture, Wildlife Services (USDA/WS) issues permits to persons wishing to take state-protected species (For California State protected birds see appendix A).

Contents

FEDERAL REGULATIONS AND DEPARTMENTAL POLICIES IMPACTING AIRPORT WILDLIFE MANAGEMENT

Standing Depredation Orders (4.2.c.ii)

Federal law does allow people to protect themselves and their property from damage caused by migratory birds, provided no effort is made to kill or capture the birds:

- ☐No permit is required to merely scare or herd depredating migratory birds other than endangered or threatened species or bald or golden eagles. (50 CFR 21.41)
- Some species of migratory birds may be killed or captured without a federal permit under specific circumstances.(50 CFR21)
- ☐No federal permit isrequired to control yellow-headed, red-winged, rusty and Brewer's blackbird, cowbirds, all grackles, crows, and magpies, when found committing or about to commit depredation upon ornamental or shade trees, agricultural crops, livestock, or wildlife, or when concentrated in such numbers and manner as to constitute a health hazard or other nuisance…" (50 CFR 21.43).
- Persons wishing to take any other migratory birds, or to take migratory birds in situations other than those specified as exempt, must first obtain a federal Migratory Bird Depredation Permit from the USFWS
- Depredation Permits are issued by the Migratory Bird Regional Permit Office:
- The U.S. Fish and Wildlife Service issues permits to qualified applicants for the following types of activities: falconry, raptor propagation, scientific collecting, special purposes (rehabilitation, educational, migratory game bird propagation, and salvage), take of depredating birds, taxidermy, and waterfowl sale and disposal
- A federal permit is required to harass threatened or endangered species, as well as bald and golden eagles, from airports.

NAVAL SAFETY CENTER DEPREDATION GUIDELINES

The following describe changes in U.S. Fish and Wildlife Service policy on the taking of migratory birds:

- Navy installations must have a depredation permit issued by the USFWS prior taking migratory birds necessary for health or safety reasons, including BASH program implementation.
- Non-lethal control methods must be used first to solve the problem before taking lethal action.
- Federal agencies are still bound by the Endangered Species Act and all take operations must be handled in accordance with the ESA.
- Installations must comply with migratory bird treaties entered into between the U.S. and other nations.
- Federal contractors and volunteers are not exempt from the mandates of the Migratory Bird Treaty Act.
- Installations must protect state-listed endangered, threatened, or rare species when practical.
- Any proposal to take, or otherwise impact, migratory bird species is subject to the National Environmental Policy Act (NEPA) (42 USC 4321-4347) and AFI 32-7061, and The Environmental Impact Analysis Process (EIAP) (32 CFR 989).
- Installations shall prepare an administrative record to document the "take". At a minimum, this will consist of a memo for record with reasons for control measures, previous actions taken, consultations, Bird Hazard Working Group concurrence and total number, by species, of birds killed.

Each Navy installation located in the US or its territories will:

- Apply for a depredation permit from the USFWS
- Apply for any required State permits
- Consult with the USFWS informally on issues of bird conservation
- Retain records of take (or any other activity) of species regulated under the Migratory Bird Treaty Act and Bald & Golden Eagle Protection Act and Bird/Animal Aircraft Strike Hazard (BASH) Depredation Permits.

Code of Federal Regulations
TITLE 50--WILDLIFE AND FISHERIES
CHAPTER I--UNITED STATES FISH AND WILDLIFE SERVICE
PART 21--MIGRATORY BIRD PERMITS

Subpart D--Control of Depredating Birds

Overview:

Depredation Permits are required before any person may take, possess, or transport migratory birds for pest control purposes. No permit is necessary to scare depredating birds other than those considered threatened or endangered or birds protected under the Bald and Golden Eagle Protection Act and the Endangered Species Act. A Federal permit is not necessary in the case of required to control yellow-headed red-winged, rusty, and Brewer's blackbirds, cowbirds, all grackles, crows, and magpies, when found in such numbers and manner as to constitute a health hazard or other nuisance as long as it does not contradict state laws

Depredation Permits (sec. 21.41)

- Permit Holders are not allowed to kill migratory birds unless specifically authorized
- Permit holders may not use baits such as decoys, calls, blind pits to attract birds to within range

Authority to Issue Permit (sec 21.42):

- Evidence clearly showing migratory game birds have accumulated to an extent great enough to cause serious damage.

The Director of the Federal Register may authorize a depredation order to permit the killing of such birds under the following conditions (sec 21.42)

- Birds may only be killed by shooting with a shotgun not larger than No. 10 gauge only on or over the threatened area or areas;
- Shooting will be limited to such time as may be fixed by the Director on the basis of all circumstances involved.
- Shall not authorize the killing of the designated species of depredating birds contrary to any State laws or regulations.
- The order must show that emergency measures designed to relieve depredations are necessary.

Depredation order for blackbirds, cowbirds, grackles, crows and magpies (sec 21.43)

- That none of the birds killed pursuant to this section, nor their plumage, shall be sold or offered for sale, but may be possessed, transported, and otherwise disposed of or utilized.

Depredation order for designated species of depredating birds in California (sec21.44)

In any county in California in which horned larks, golden-crowned, white-crowned and other crowned sparrows, and house finches are, under extraordinary conditions, seriously injurious to agricultural or other interests, the Commissioner of Agriculture may, without a permit, kill or cause to be killed under his/her general supervision such of the above migratory birds as may be necessary to safeguard any agricultural or horticultural crop in the county: Provided:

(a) That such migratory birds shall be killed only when necessary to protect agricultural or horticultural crops from depredation; that none of the above migratory birds killed, or the parts thereof, or the plumage of such birds, shall be sold or removed from the area where killed; but that all such dead migratory birds shall be buried or otherwise destroyed within this area,

Appendix A; California State protected birds

- American peregrine falcon (Falco peregrinus anatum)
- Brown pelican
- California black rail (Laterallus jamaicensis coturniculus)
- California clapper rail (Rallus longirostris obsoletus)
- California condor (Gymnogyps californianus)
- California least tern (Sterna albifrons browni)
- Golden eagle
- Greater sandhill crane (Grus canadensis tabida)
- Light-footed clapper rail (Rallus longirostris levipes)
- Southern bald eagle (Haliaeetus leucocephalus leucocephalus)
- Trumpeter swan (Cygnus buccinator)

- White-tailed kite (Elanus leucurus)
- Yuma clapper rail (Rallus longirostris yumanensis)

THE ENDANGERED SPECIES ACT

Overview:

The Endangered Species Act of 1973 protects various species of wildlife that have become threatened due to economic growth and development. The purpose of the act is to provide a program for conservation of the ecosystem to which threatened and endangered species. Under the act all federal agencies are required to institute into their policies and programs a means for conservation of endangered species. Federal agencies must also cooperate with state and local agencies to resolve water issues as they affect the conservation of endangered species. Agencies are responsible to ensure that any action authorized, funded, or carried out by the agency is not likely to jeopardize the existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of the endangered or threatened species.

The Act prohibits the following activities involving endangered species:

- Importing into or exporting from the United States.
- Taking (includes harassing, harming, pursuing, hunting, shooting, wounding, trapping, killing, capturing, or collecting) within the United States and its territorial seas.
- Taking on the high seas.
- Possessing, selling, delivering, carrying, transporting, or shipping any such species unlawfully taken within the United States or on the high seas.
- Delivering, receiving, carrying, transporting, or shipping in interstate or foreign commerce in the course of a commercial activity.
- Selling or offering for sale in interstate or foreign commerce.

The Act provides for:

- Protection of critical habitat
- Creation of a recovery plan for each listed species.
- Permits may be granted for scientific or propagation purposes or for economic hardship situations involving endangered or threatened species.

Federal Agencies

- All federal agencies are to protect species and preserve their habitats.
- Federal agencies must utilize their authorities to conserve listed species
- Insure that their actions do not jeopardize the continued existence of listed species.
- Modify federal projects so that they will have minimal impact on listed species and their habitat.
- Installations having a listed endangered or threatened species must develop specific plans for preserving those species and their habitats.

The Endanger Species Act

- Sec. 1531. Congressional findings and declaration of purposes and policy
- Sec. 1532. Definitions
- Sec. 1533. Determination of endangered species and threatened species

- Sec. 1534. Land acquisition
- Sec. 1535. Cooperation with States
- Sec. 1536. Interagency cooperation
- Sec. 1537. International cooperation
- Sec. 1537a. Convention implementation
- Sec. 1538. Prohibited acts
- Sec. 1539. Exceptions
- Sec. 1540. Penalties and enforcement
- Sec. 1541. Endangered plants
- Sec. 1542. Authorization of appropriations
- Sec. 1543. Construction with Marine Mammal Protection Act of 1972

Sec. 1544. Annual cost analysis by Fish and Wildlife

MIGRATORY BIRD TREATY ACT

SUMMARY OF THE MIGRATORY BIRD TREATY ACT

The Migratory Bird Treaty Act is an agreement between the U.S. and Canada, Japan, Mexico and the former Soviet Union for the protection of migratory birds. The Act prohibits the, taking, killing or possessing of migratory birds. It further prohibits attempts to take, capture, kill, pursue, hunt, possess, offer or to sell, barter, purchase, deliver or cause to be shipped, exported, imported, transported, carried or received any migratory bird, part, nest, egg or product, unless permitted by regulation(s) adopted by the Secretary of the Interior. These regulations determine the extent to which, if at all, hunting, taking, capturing, killing, possessing, selling, purchasing, shipping, transporting or exporting of any migratory bird, part, nest or egg will be allowed.

- Sec. 703. Taking, killing, or possessing migratory birds unlawful
- Sec. 704. Determination as to when and how migratory birds may be taken, killed, or possessed
- Sec. 705. Transportation or importation of migratory birds; when unlawful
- Sec. 706. Arrests; search warrants
- Sec. 707. Violations and penalties; forfeitures
- Sec. 708. State or Territorial laws or regulations
- Sec. 709. Omitted
- Sec. 709a. Authorization of appropriations
- Sec. 710. Partial invalidity; short title
- Sec. 711. Breeding and sale for food supply
- Sec. 712. Treaty and convention implementing regulations; seasonal taking of migratory birds for essential needs of indigenous Alaskans to preserve and maintain stocks of the birds; protection and conservation of the birds

Amendments to The Migratory Bird Treaty Act

P.L. 105-312 Migratory Bird Treaty Reform Act of 1998, amended the law to make it unlawful to take migratory game birds by the aid of bait if the person knows or reasonably should know that the area is baited. These amendments also make it unlawful to place or direct the placement of bait on or adjacent to an area for the purpose of taking or attempting to take migratory game birds. Violations of the amendment are punishable under title 18 United States Code. The new amendments require the Secretary of Interior to submit to the Senate Committee on Environment and Public Works and the House Committee on Resources a report analyzing the effect of these amendments and the practice of baiting on migratory bird conservation and law enforcement.

FEDERAL INSECTICIDE, FUNGICIDE, AND RODENTICIDE ACT

Overview:

The focus of FIFRA was to provide federal control of pesticide distribution, sale, and use. EPA has authority under FIFRA not only to study the consequences of pesticide usage but also to require users (farmers, utility companies, and others) to register when purchasing pesticides. Through later amendments to the law, users also must take exams for certification as applicators of pesticides. All pesticides used in the U.S. must be registered (licensed) by EPA. The Act also outlines penalties, and administrative procedures. The Administrator may also exempt, exempt any Federal or state agency from any provision of this Act, if he determines emergency conditions, requiring such exemption, exist.

To obtain a pesticide product registration, an applicant must submit a substantial body of health, safety and environmental data as specified by EPA. FIFRA §

- Pesticides must meet criteria set forth by the EPA regarding the quantity, quality and impact upon the environment by the active ingredient(s).
- Approved pesticides must also be labeled as such.
- The EPA is required to publish a list of all registered pesticides by the classification and certification by specific use.
- FIFRA requires registration of chemicals used to control pests.
- EPA must establish regulations for the storage and disposal of pesticide containers, excess pesticides and pesticides for which registration has been canceled.
- Under FIFRA, no manufacturer or importer may make or sell a product for use to control pests unless the compound is registered with EPA.
- If a pesticide is classified as restricted use, then the applicator must be certified in accordance with Title 40 CFR Part 171, "Certification of Pesticide Applicators."

Relevant regulations within the Act pertaining to Federal Agencies:

- Federal agencies will use Integrated Pest Management techniques in carrying out pest management activities and shall promote Integrated Pest Management through procurement and regulatory policies, and other activities.
- The Department of Defense requires that all of its pesticide applicators be certified.
- Pesticides will be disposed of in an environmentally safe manner

SUBCHAPTER II - ENVIRONMENTAL PESTICIDE CONTROL

- Sec. 135 to 135k. Omitted
- Sec. 136. Definitions
- Sec. 136a. Registration of pesticides
- Sec. 136a-1. Reregistration of registered pesticides
- Sec. 136b. Transferred
- Sec. 136c. Experimental use permits
- Sec. 136d. Administrative review; suspension
- Sec. 136e. Registration of establishments
- Sec. 136f. Books and records
- Sec. 136g. Inspection of establishments, etc.
- Sec. 136h. Protection of trade secrets and other information
- Sec. 136i. Use of restricted use pesticides; applicators
- Sec. 136i-1. Pesticide recordkeeping
- Sec. 136i-2. Collection of pesticide use information
- Sec. 136j. Unlawful acts
- Sec. 136k. Stop sale, use, removal, and seizure
- Sec. 136l. Penalties
- Sec. 136m. Indemnities
- Sec. 136n. Administrative procedure; judicial review
- Sec. 136o. Imports and exports
- Sec. 136p. Exemption of Federal and State agencies
- Sec. 136q. Storage, disposal, transportation, and recall
- Sec. 136r. Research and monitoring
- Sec. 136r-1. Integrated Pest Management
- Sec. 136s. Solicitation of comments; notice of public hearings
- Sec. 136t. Delegation and cooperation
- Sec. 136u. State cooperation, aid, and training
- Sec. 136v. Authority of States
- Sec. 136w. Authority of Administrator
- Sec. 136w-1. State primary enforcement responsibility
- Sec. 136w-2. Failure by the State to assure enforcement of State pesticide use regulations
- Sec. 136w-3. Identification of pests; cooperation with Department of Agriculture's program
- Sec. 136w-4. Omitted
- Sec. 136w-5. Minimum requirements for training of maintenance applicators and service technicians
- Sec. 136w-6. Environmental Protection Agency minor use program
- Sec. 136w-7. Department of Agriculture minor use program
- Sec. 136x. Severability
- Sec. 136y. Authorization of appropriations

THE SIKES ACT

Overview:

Under the Sikes Act military installations are required to develop environmental conservation and rehabilitation programs. The Secretary of Defense ensures the program provides for the conservation and rehabilitation of natural resources on military installations. Departments of the Interior and Defense work with the appropriate state agencies in the planning, development and maintenance of fish and wildlife resources on military reservations. Each cooperative plan must provide for: fish and wildlife habitat improvements or modifications; range rehabilitation where necessary to support wildlife; control of off-road vehicle traffic; specific habitat improvement projects for the protection of species of fish, wildlife and plants considered threatened or endangered. The Secretary of Defense in cooperation with the Secretary of the Interior and the appropriate state agency may carry out a program for the conservation, restoration and management of migratory game birds on military reservations, including issuing special hunting permits and collecting fees.

The Sikes Act requires

- Implement an ecosystem based conservation program that provides for conservation and rehabilitation of natural resources in a manner consistent with the military mission.
- Federal military installations with adequate wildlife habitat to implement cooperative agreements with other agencies and develop long range integrated natural resources management plans.
- Provide for sustainable multipurpose uses of natural resources.
- Provide for public access for use of natural resources subject to safety and military security considerations.

Objectives:

• Fish and wildlife management, land management, forest management, and fish and wildlife oriented recreation.
• Fish and wildlife habitat enhancement/modifications.
• Wetland protection, enhancement, and restoration where necessary for support of fish, wildlife, or plants.
• Establish specific natural resource management goals and objectives
• Public access to the military installation that is necessary or appropriate for sustainable use of natural resources by the public to the extent that such use is consistent with the military mission and the needs of fish and wildlife resources.
• Enforcement of applicable natural resource laws and regulations.
• There must be no net loss in the capability of military installation lands to support the military mission of the installation due to conservation activities.
• Provisions for spending hunting and fishing permit fees exclusively for the protection, conservation, and management of fish and wildlife, including habitat improvement, and related activities in accordance with the INRMP.

CONSERVATION PROGRAMS ON MILITARY INSTALLATIONS (SIKES ACT)

- Sec. 670. Definitions
- Sec. 670a. Program for conservation and rehabilitation of natural resources on military installations
- Sec. 670a-1. Repealed. Pub. L. 105-85, div. B, title XXIX, Sec. 2912, Nov. 18, 1997, 111 Stat. 2022
- Sec. 670b. Migratory game birds; permits; fees; Stamp Act and State law requirements

- Sec. 670c. Program for public outdoor recreation
- Sec. 670c-1. Cooperative agreements for land management on Department of Defense installations
- Sec. 670d. Liability for funds; accounting to Comptroller General
- Sec. 670e. Applicability to other laws; national forest lands
- Sec. 670e-1. Federal enforcement of other laws
- Sec. 670e-2. Natural resources management services
- Sec. 670f. Appropriations and expenditures

THE BALD EAGLE AND GOLDEN EAGLE PROTECTION ACT

Overview:

The Act imposes criminal and civil penalties on anyone (including associations, partnerships and corporations) in the U.S. or within its jurisdiction who, unless excepted, takes, possesses, sells, purchases, barters, offers to sell or purchase or barter, transports, exports or imports at any time or in any manner a bald or golden eagle, alive or dead; or any part, nest or egg of these eagles; or violates any permit or regulations issued under the Act. A criminal conviction requires that the violator acted knowingly or with wanton disregard of the consequences.

Exceptions:

If compatible with the preservation of bald and golden eagles, the Secretary of the Interior may issue regulations authorizing the taking, possession and transportation of these eagles for scientific or exhibition purposes, for religious purposes of Indian tribes or for the protection of wildlife, agricultural or other interests. If requested by a state governor, the Secretary must authorize the taking of golden eagles to protect domesticated flocks and herds in the state. The Secretary also may permit the taking, possession and transportation of golden eagles for falconry, if these eagles would have been taken because of depredations on livestock or wildlife. The Secretary may permit the taking of golden eagle nests which interfere with resource development or recovery operations. Bald eagles may not be taken for any purpose unless the Secretary issues a permit prior to the taking. § 668a.

Major Sections Federal Agencies are Responsible to:

No sections deal specifically with military organizations or federal agencies, however all Federal Agencies are expected to comply with environmental regulations pursuant to endangered species act Executive Order 11514 which states that it is the responsibility of federal agencies in their policies, plans, and programs to meet national environmental goals.

The Bald Eagle and Golden Eagle Protection Act

- Sec. 668. Bald and golden eagles
  Prohibited acts; criminal penalties
  Civil penalties
  Cancellation of grazing agreements
- Sec. 668a. Taking and using of the bald and golden eagle for scientific, exhibition, and religious purposes
- Sec. 668b. - Enforcement provisions

  Arrest; search; issuance and execution of warrants and process

Forfeiture
Customs laws applied
- Sec. 668c. Definitions
- 16 U.S.C. § 668d. Availability of appropriations for Migratory Bird Treaty Act

Amendments to the Act

- 1972 amendments increased penalties for violating provisions of the Act or regulations issued pursuant thereto and strengthened other enforcement measures. Rewards are provided for information leading to arrest and conviction for violation of the Act.

- 1978 amendment authorizes the Secretary of the Interior to permit the taking of golden eagle nests that interfere with resource development or recovery operations. (See also the Migratory Bird Treaty Act and the Endangered Species Act.)

- 1994 Memorandum (59 F.R. 22953, April 29, 1994) from President William J. Clinton to the heads of Executive Agencies and Departments sets out the policy concerning collection and distribution of eagle feathers for Native American religious purposes.

THE CALIFORNIA ENDANGERED SPECIES ACT

Overview:

The California Endangered Species Act is administered by the California Department of Fish and Game. It is the purpose of the act to protect and conserve species that have become threatened and endangered through “destruction, adverse modification, or severe curtailment, or because of overexploitation, disease, [and] predation”. An endangered or threatened species under the act is defined as a species of plant, fish, or wildlife which is "in serious danger of becoming extinct throughout all, or a significant portion of its range" limited to species native to California.
The act states that no person shall import to or export from the State of California , or take, possess, purchase, or sell within the state, any species, or any part or product thereof, that the Fish and Game commission determines to be an endangered or a threatened species,

Primary objective

The primary objective of the California Endangered Species Act is to evaluate and amend state agency activity to protect and conserved listed threatened and endangered species in

Specific Allowances and Regulations

- California Department of Fish and Game may authorize exceptions to the state’s prohibition against take of a listed species. Sections 2091 and 2081
- State lead agencies may take a listed endangered species provided that the agency has consulted with the California Department of Fish and Game. Section 2091
- The Department may authorize take of a threatened or endangered species for educational, scientific, or management purposes. Section 2081

- Private developers whose projects do not involve a state lead agency under CEQA may not take a listed species without formally consulting with the California Department of Fish and Game. .
- Incidental take permit authorizes the taking of an endangered species or a threatened species, no further authorization or approval is necessary under this chapter
- Through permits or memorandums of understanding, the department may authorize individuals, public agencies, universities, zoological gardens, and scientific or educational institutions, to import, export, take, or possess any endangered species, threatened species, or candidate species for scientific, educational, or management purposes.

- The department may authorize, by permit, the take of endangered species, threatened species, and candidate species if the following conditions are met:
  The take is incidental to an otherwise lawful activity,
  The impacts of the authorized take shall be minimized and fully mitigated.
- No permit may be issued if issuance of the permit would jeopardize the continued existence of the species.

California Fish and Game Code
Division 3. Fish and Game Generally
Chapter 1.5 Endangered Species (California Endangered Species Act)

- Article 1. General Provisions §§ 2050-2068
- Article 2. Listing of Endangered Species §§ 2070-2079
- Article 3. Taking, Importation, Exportation, or Sale §§ 2080-2085
- Article 3.5. Incidental Take Associated with Routine and Ongoing Activities §§ 2086-2089
- Article 5. Funding §§ 2098-2100
- Article 7. Recovery Strategy Pilot Program §§ 2105-2116

THE CLEAN WATER ACT

Overview

Subchapter I Research and Related programs
Subchapter II Grants for Construction of Treatment Works
Subchapter III Standards and Enforcement
Subchapter IV Permits and Licenses
Subchapter V General Provisions
Subchapter VI Water Pollution Control Revolving Funds
House of Representatives Clean Water Restoration Act of 2003

- **Overview:** The Clean Water Act (CWA) is the primary Federal statute regulating the protection, restoration, and maintenance of the “chemical, physical, and biological integrity of the Nation’s waters.” The CWA authorizes EPA and States to regulate, implement, and enforce compliance with guidelines and standards to control the direct and indirect discharge of pollutants into U.S. waters. Under CWA national programs for the prevention, reduction, and elimination of pollution in navigable water and groundwater have been established and. A water quality standards program and required permits for discharge and treatment of wastewater and storm water also fall under the act.

The Primary objectives of the CWA are:

- Prohibit discharges of pollutants into U.S. navigable waters, except in compliance with a permit; and
- Achieve an interim goal of protecting water quality that, wherever attainable, provides for the protection and propagation of shellfish, fish, and wildlife, and provides for recreation in and on the water.

The Major Sections under the CWA to which Federal agencies are responsible:

- obtain a National Pollutant Discharge Elimination System permit and manage direct discharges in compliance with permit conditions,
- Manage discharge to a Publicly-Owned Treatment Works in accordance with established Federal, State, and local pretreatment standards
- Manage domestic treatment works in accordance with sludge requirements
- Applying for §404 dredge and fill permits for construction and development projects
- Monitor, record, and report pollutant effluent concentrations
- Develop, implement, and maintain storm water pollution prevention plans and obtain necessary permits.
- Develop Spill Prevention, Control, and Countermeasure Plans

Major integrated regulatory programs, standards, and plans:

- *National Pollutant Discharge Elimination System (NPDES) Program*: Establishes an effluent permit system for point source (e.g., pipe, ditch) discharges into navigable waters. The storm water program is a part of the NPDES program and is designed to prevent the discharge of contaminated storm water into navigable waters. Storm water program requirements address permit applications, regulatory guidances, and management and treatment requirements (§402).
- *National and Local Pretreatment Standards*: Requires new and existing industrial users to pre-treat wastewater discharged to Publicly-Owned Treatment Works (POTWs) to prevent pollutants in excess of certain limits from passing through POTWs or causing interference in the operation of the treatment works (§307).
- *Dredge or Fill Discharge Permit Program*: Establishes a permit system, administered by the Army Corps of Engineers, for regulating the placement of dredge or fill material into waters of the United States, including wetlands (§404).
- *Sewage Sludge Use and Disposal Program*: Protects human health and the environment when sewage sludge is beneficially applied to the land, incinerated, or placed in a surface disposal site by requiring generators, processors, users, and disposers of sewage sludge from privately- or Publicly-Owned Treatment Works to meet certain standards (§405).

CWA provisions potentially affecting Federal facilities :

- *§303: Water Quality Standards and Implementation Plans* - regulations require States to identify waters that do not meet or are not expected to meet water quality standards even after technology-based or other required controls are in place. States are required to establish a priority ranking for such waters, taking into account the severity of the pollution and the uses to be made of such waters.
- *§307: National and Local Pretreatment Standards* -Facilities that discharge to POTWs are excluded from NPDES permitting requirements but are subject to national general pretreatment standards (40 CFR Part 403), applicable categorical pretreatment standards (specified in 40 CFR Parts 405-471), and any State or local pretreatment standards. Facilities must sample the effluent and submit reports on the results of such sampling at a

frequency specified in the permit. Monitoring reports must be submitted to EPA, States, or POTWs with approved pretreatment programs. The 1992 Federal Facility Compliance Act added §3023 titled Federally-Owned Treatment Works to the Resource Conservation and Recovery Act. Under §3023, FOTWs are defined as Federally-Owned and operated wastewater treatment works that 1) have an NPDES permit and 2) treat influent that is composed of a majority of domestic sewage. Section 3023 extends to FOTWs the so-called Domestic Sewage Exclusion (DSE) from the definition of "solid waste," provided the FOTW meets all the conditions set forth in §3023. See Section B.8 of this chapter for more information on §3023 requirements.

- *§308: Inspections, Monitoring, and Entry* -EPA, State agencies, or their authorized representatives (e.g., contractors) have broad authority to conduct compliance inspections at any premises on which an effluent source is located (including Federal facilities), or in which any records required to be maintained under §308 are located.
- *§311: Oil and Hazardous Substance Liability* -The discharge of oil or hazardous substances into or upon the navigable waters of the United States, or adjoining shorelines, or into or upon the waters of the contiguous zone, or which may affect natural resources belonging to, appertaining to, or under the exclusive management authority of the United States is prohibited. Any person in charge of a vessel, an on-site facility, or an offshore facility is required, as soon as she/he has knowledge of any discharge of oil or a hazardous substance, to immediately notify the appropriate Federal agency of the discharge.
- *§311(a)(10): Definition of "Onshore Facility"* -"Onshore facility" means any facility (including, but not limited to, motor vehicles and rolling stock) of any kind located in, on, or under, any land within the United States other than submerged land.
- *§311(a)(10): Definition of "Offshore Facility"* -"Offshore facility" means any facility of any kind located in, on, or under, any of the navigable waters of the United States, and any facility of any kind which is subject to the jurisdiction of the United States and is located in, on, or under any other waters, other than a vessel or a public vessel.
- *§312: Marine Sanitation Devices* -Section 312 regulates the discharge of vessel sewage to prevent the discharge of untreated or inadequately treated sewage from vessels into U.S. waters. Section 325 of the National Defense Authorization Act of 1996 amended CWA §312 by authorizing EPA and the Department of Defense to jointly establish Uniform National Discharge Standards for incidental liquid discharges from vessels of the Armed Forces. Federal agencies responsible for vessels of the Armed Forces are liable for a penalty of not more than $5,000 for each violation of §312(n)(8).
- *§313: Federal Facilities Pollution Control* -Each Federal agency having jurisdiction over any facility or engaged in activity resulting, or which may result, in the discharge or runoff of pollutants is subject to, and must comply with, all Federal, State, interstate, and local requirements and administrative authorities for the control and abatement of water pollution. If the President determines it to be in the paramount interest of the United States, he may exempt any effluent source of any department, agency, or instrumentality in the Executive Branch from compliance with any requirements of CWA.
- *§*313 of CWA waives the traditional immunity of the Federal government and requires Federal facilities to comply with Federal, State, interstate, and local water pollution controls. Requirements include compliance with EPA or State inspections and all applicable Federal, State, interstate, and local substantive and procedural requirements
- *§402: National Pollutant Discharge Elimination System* -Point source discharges of wastewater must comply with requirements established by a NPDES permit issued by EPA or a State agency that has an approved NPDES program. Dischargers must submit Discharge Monitoring Reports that record flow measurement, sample collection data, and

laboratory test results on a quarterly or monthly basis. Point source storm water discharges that are associated with certain industrial activities or are designated by EPA for contributing to a violation of water quality standards also require a permit.

- *§404: Permits for Dredged or Fill Material* -Facilities that discharge dredged or fill materials into navigable waters must apply for a permit issued by the Army Corps of Engineers. EPA also may restrict or deny the dredging or filling of any site where the activity could have an adverse effect on the environment. States may apply for the authority to implement the §404 program. However, the Army Corps of Engineers retains authority over navigable waters within the State.
- *§405: Permits of Sludge Management* -All treatment works that treat domestic sewage are required to meet Federal requirements for the use and disposal of sewage sludge through land application, surface disposal, or incineration. These requirements are incorporated into permits issued under §402 of CWA
- *§508: Federal Procurement* -No Federal agency may enter into any contracts with any person who has been convicted of any offense under §309(c) of CWA.

<u>Subchapter I Research and Related programs</u>

- Sec. 1251 Congressional declaration of goals and policy
- Sec. 1252 Comprehensive programs for water pollution control
- Sec 1252a Reservoir projects, water storage; modification; storage for other than for water quality, opinion of Federal agency, committee resolutions of approval
- Sec. 1253 Interstate cooperation and uniform laws
- Sec. 1254. Research, investigations, training, and information
- Sec. 1254a. Research on effects of pollutants
- Sec. 1255. Grants for research and development
- Sec. 1256. Grants for pollution control programs
- Sec. 1257. Mine water pollution control demonstrations
- Sec. 1257a. State demonstration programs for cleanup of abandoned mines for use as waste disposal sites; authorization of appropriations
- Sec. 1258. Pollution control in the Great Lakes -Omitted
- Sec. 1259. Training grants and contracts
- Sec. 1260. Applications; allocation
- Sec. 1261. Scholarships
- Sec. 1262. Definitions and authorizations
- Sec. 1263. Alaska village demonstration projects-Omitted
- Sec. 1263a. Grants to Alaska to improve sanitation in rural and Native villages-Omitted
- Sec. 1264. Omitted
- Sec. 1265. In-place toxic pollutants
- Sec. 1266. Hudson River reclamation demonstration project-Omitted
- Sec. 1267. Chesapeake Bay-Omitted
- Sec. 1268. Great Lakes Omitted
- Sec. 1269. Long Island Sound-Omitted
- Sec. 1270. Lake Champlain Management Conference-Omitted
- Sec. 1271. Sediment survey and monitoring
- Sec. 1272. Environmental dredging

- Sec. 1327. Omitted
- Sec. 1328. Aquaculture
- Sec. 1329. Nonpoint source management programs
- Sec. 1330. National estuary program

Subchapter IV Permits and Licenses

- Sec. 1341. Certification
- Sec. 1342. National pollutant discharge elimination system
- Sec. 1343. Ocean discharge criteria
- Sec. 1344. Permits for dredged or fill material
- Sec. 1345. Disposal or use of sewage sludge
- Sec. 1346. Coastal recreation water quality monitoring and notification

Subchapter V General Provisions

- Sec. 1361. Administration
- Sec. 1362. Definitions
- Sec. 1363. Water Pollution Control Advisory Board
- Sec. 1364. Emergency powers
- Sec. 1365. Citizen suits
- Sec. 1366. Appearance
- Sec. 1367. Employee protection
- Sec. 1368. Federal procurement
- Sec. 1369. Administrative procedure and judicial review
- Sec. 1370. State authority
- Sec. 1371. Authority under other laws and regulations
- Sec. 1372. Labor standards
- Sec. 1373. Public health agency coordination
- Sec. 1374. Effluent Standards and Water Quality Information Advisory Committee
- Sec. 1375. Reports to Congress; detailed estimates and comprehensive study on costs; State estimates
- Sec. 1375a. Report on coastal recreation waters
- Sec. 1376. Authorization of appropriations
- Sec. 1377. Indian tribes

Subchapter VI Water Pollution Control Revolving Funds

- Sec. 1381. Grants to States for establishment of revolving funds
- Sec. 1382. Capitalization grant agreements
- Sec. 1383. Water pollution control revolving loan funds
- Sec. 1384. Allotment of funds
- Sec. 1385. Corrective action
- Sec. 1386. Audits, reports, and fiscal controls; intended use plan
- Sec. 1387. Authorization of appropriations

THE COSTAL ZONE MANAGEMENT ACT

Overview:

The Costal Zone Management Act applies to coastal waters extending to the outer limit of state submerged land title and ownership, adjacent shorelines and land extending inward to the extent necessary to control shorelines. The coastal zone includes islands, beaches, transitional and intertidal areas, and salt marshes. Congress recognizes the Increased population, development and overall use have placed stress on coastline habitats and declares it national policy to “preserve, protect, develop, and where possible, to restore or enhance, the resources of the Nation's coastal zone for this and succeeding generations”. The act represents a federal-state partnership. The Federal Government supports states through financial assistance, mediation, technical services and information, and participation in priority state, regional, and local forums.

Objective:

The Goal of The Costal Zone Management act is to achieve effective protection and use of the land and water resources of the coastal zone while encouraging the states to exercise their full authority over the lands and waters in the coastal zone. Federal cooperation with the states, local governments and other affected interests in developing land and water use programs for the coastal zones, as well as ensure that federal activities are consistent with state programs for the protection and, enhancement of the nation's coastal zones are stipulated under the act.

Requirements of The Costal Zone Management Act

- States develop a State Coastal Zone Management Plan or program
- Federal agencies conducting or supporting activities affecting the coastal zone conduct must support those activities in a manner that is consistent with the approved state
- Federal agency must identify activities that would affect the coastal zone, including development projects. If an activity would affect the coastal zone, the agency must review the states costal zone management policy to determine if the activity is consistent with the state’s policy
- Implementation of management programs to achieve wise use of the land and water resources of the coastal zone.
- Federal assistance to support comprehensive planning, conservation, and management for living marine resources, including planning for the siting of pollution control and aquaculture facilities within the coastal zone
- Coordination between State and Federal coastal zone management agencies and State and wildlife agencies, and
- Develop and implement management measures for nonpoint source pollution to restore and protect coastal waters, working in close conjunction with other State and local authorities.

Federal Agencies

- Without adequate consideration of views of Federal agencies the Secretary will not approve the management program submitted by a state unless the views of Federal agencies affected by the program have been adequately considered.

- Federal agency activity within or outside the coastal zone that affects any land or water use or natural resource of the coastal zone must be consistent with the enforceable policies of approved State management programs.

Excluded from the coastal zone are lands the use of which is by law subject solely to the discretion of or which is held in trust by the Federal Government, its officers or agents.

Federal Government will

- Assisting states to effectively protect natural resources in the costal zone
- Management of coastal development to minimize improper development
- Improve, safeguard, and restore the quality of coastal waters
- program shall be to develop and implement management measures for nonpoint source pollution to restore and protect coastal waters,
- The Secretary shall not approve the management program submitted by a state unless the views of Federal agencies principally affected by such program have been adequately considered

Relevant Sections

- Sec. 1451. Congressional findings
- Sec. 1452. Congressional declaration of policy
- Sec. 1453. Definitions
- Sec. 1454. Submittal of State program for approval
- Sec. 1455. Administrative grants
- Sec. 1455a. Coastal resource improvement program
- Sec. 1455b. Protecting coastal waters
- Sec. 1456. Coordination and cooperation
- Sec. 1456a. Coastal Zone Management Fund
- Sec. 1456b. Coastal zone enhancement grants
- Sec. 1456c. Technical assistance
- Sec. 1456d. Coastal and Estuarine Land Conservation Program
- Sec. 1457. Public hearings
- Sec. 1458. Review of performance
- Sec. 1459. Records and audit
- Sec. 1460. Walter B. Jones excellence in coastal zone management awards
- Sec. 1461. National Estuarine Research Reserve System
- Sec. 1462. Coastal zone management reports
- Sec. 1463. Rules and regulations
- Sec. 1463a. Omitted
- Sec. 1463b. National Coastal Resources Research and Development Institute
- Sec. 1464. Authorization of appropriations Omitted
- Sec. 1465. Appeals to Secretary

APPENDIX 9: BASH PROGRAM SELF-INSPECTION CHECKLIST.

BASE SELF-INSPECTION CHECKLIST
ALL PURPOSE CHECKLIST
BASE SELF-INSPECTION CHECKLIST

1. Is the plan current and readily accessible for your reference?

2. Is the station instruction current and readily accessible for your reference?

3. If the base has a flying-mission, has a BASH reduction program and written plan been established?

4. Is the BASH plan reviewed annually?

5. Are changes and annual reviews posted to the plan?

6. Does the program establish a Bird Hazard Working Group (BHWG) or similar organization?

7. Are base agencies such as Safety, Civil Engineering, and Air Operations assigned responsibilities for the BASH program?

8. Is the base Commanding Officer or Wing Commanding Officer the BHWG chairman?

9. Does the BHWG meet at least semiannually as a separate meeting or along with another meeting containing the same members?

10. Are BASH topics included in flight safety briefings?

11. Are posters, pictures, maps, etc., related to BASH posted in the aircrew briefing areas, safety bulletin boards, and base operations flight planning areas?

12. Are local bird problems documented?

13. Are both damaging and non-damaging bird strikes recorded?

14. Are all non-damaging bird strikes reported to COMNAVSAFECEN, ATTN Code 114, 375 A St., Norfolk, VA 23511-4399? Or mail-in reports? Or on-line reports via Naval Safety Center: web site at http://www.safetycenter.navy.mil/aviation/operation/BASH.

15. Are all damaging bird strikes reported with COMNAVSAFECEN as an addressee?

16. Are bird remains (feathers, beaks, feet) collected as a result of a bird strike?

17. Are bird remains sent to a local authority (US Fish and Wildlife Service, university, or ornithologist) for identification?

18. Is the bird strike information tracked to facilitate the identification of trends (for example, type of bird, route, time of day, type of aircraft)?

19. As part of the bird awareness program, do you have a bird identification book?

20. Are daily surveys taken of the airfield and surrounding area to observe potential and actual bird hazards?

21. Are records of daily observations kept in order to establish trends?

22. During the surveys, are areas like standing water, food sources, or areas for protection noted?

23. Is the vegetation on the airfield particularly attractive to birds?

24. Does the mowing or guideline contract specify that the grass be maintained at a height of seven to 14 inches?

25. Does the base practice controlled burning?

26. Are trees or shrubs located within Primary Surface and Clear Zone of the runways removed in accordance with NAVFAC P-80.3?

27. Are these trees or shrubs attractive to birds?

28. Are birds attracted to the taxiways or active runways?

29. Has it been determined what type birds are attracted to the taxiways and runways?

30. Are the areas with water (ponds, lakes, swamps, etc.) attractive to birds?

31. Are the birds, feeding in these wet areas?

32. Has it been determined what type of birds are attracted to these wet areas?

33. Do wet areas contain vegetation along their perimeters?

34. Do the wet areas contain fish or amphibians (frogs or salamanders)?

35. Are there other areas near the runways that attract birds (horse stables, recreation areas, golf courses, etc.)?

36. Has it been determined what is attracting the birds?

37. Has it been determined what type of bird is being attracted to these other areas?

38. Does farming in the surrounding area of the base attract birds?

39. Is the base notified by the farmer of the plowing times in order to alter operations?

40. Does the base outlease cropland on adjacent areas?

41. Does the lease provide for restrictions concerning BASH?

42. Are there garbage dumps, landfills, or sewage lagoons in the area near the base.?

43. Is the garbage dump, landfill, or sewage lagoon covered daily with dirt, wire, or netting?

44. Does the garbage dump, landfill, or sewage lagoon attract birds?

45. Are there other areas attractive to birds near the base (for example, lakes, ponds, swamps, cemeteries, wildlife areas)?

46. Have aircraft hangars and buildings been inspected for pest birds?

47. Do bird droppings cause problems for equipment or aircraft?

48. Is equipment covered and aircraft cockpits closed each night to provide protection against bird dropping?

49. Are hangar doors left open all the time?

50. Is the cost of cleaning up the bird droppings and any damage incurred less than any type of solution to the problem?

51. Is there an active hunting club on base?

52. Are the game birds and deer controlled so they do not interfere with flying operations?

53. Does the control tower warn operations and pilots of birds in the airdrome?

54. Is there a designated bird control team that actually manages and controls birds and maintain bird dispersal equipment and permits?

55. Is the control team actively patrolling the airdrome?

56. Does the BHWG suggest ways of altering the situation or changing the habitat to discourage birds from the areas before using elimination or reduction techniques?

APPENDIX 10: BASH BIRD/ANIMAL REMAINS FORM (example for NAS North Island).

Airfield Facilities/Crash Crew
Wildlife/Aircraft Strike Remains Reporting Form

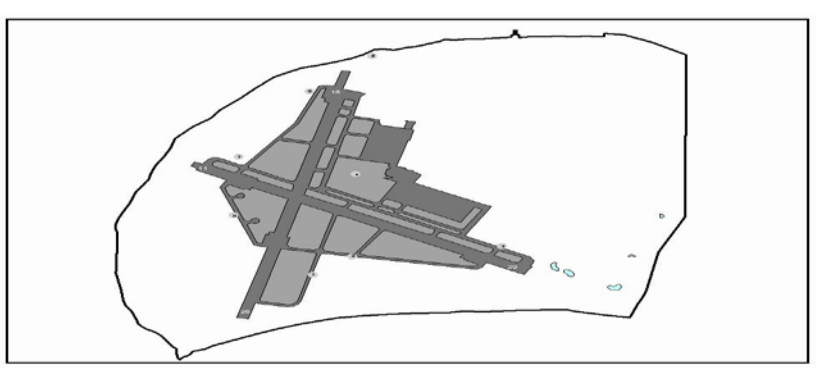
Instructions for collecting wildlife/aircraft strike remains:
· Put remains (including single feathers) into a plastic bag.
· **Complete this form** and put it into the bag containing the remains.
· Deposit the bag with remains and completed form into a BASH freezer (call Environmental Department: **phone .**
· **Fax a copy** of the report to the **Environmental Department** at .

Date: ___________________________________
Time:_____________________________________
POC Name:______________________________
Phone____________________________

Did the Tower request that you respond to a probable birdstrike? Yes / No

If yes, answer the following questions:
Type of Aircraft:
Aircraft Squadron:
Phase of Flight:
Active Runway:

Mark (with an 'X') the location where the remains were found on the airfield on the map below. Find the nearest distance marker when picking up the remains, and note the number on the map below.



APPENDIX 11: BASH STRIKE REPORTING PROCEDURES.

Go to www.safetycenter.navy.mil/aviation/operations/bash.

Go to "submit an online BASH report" and follow instructions.

Matthew W. Klope
Wildlife Biologist
NAS Whidbey Island
1115 W. Lexington St. (Bldg 103)
Oak Harbor, WA 98278
(360) 257-1468
(DSN) 820-1468
E-mail: klopemw@efanw.navfac.navy.mil

Contact the Naval Base Coronado ASO to report details of the strike.

NBC Aviation Safety Office
Building 516
(619) 545-1056
DSN 735-1056

APPENDIX 12: NAS NORTH ISLAND and NALF SAN CLEMENTE ISLAND BIRD PROFILES.

American Crow

(*Corvus brachyrhynchos*)

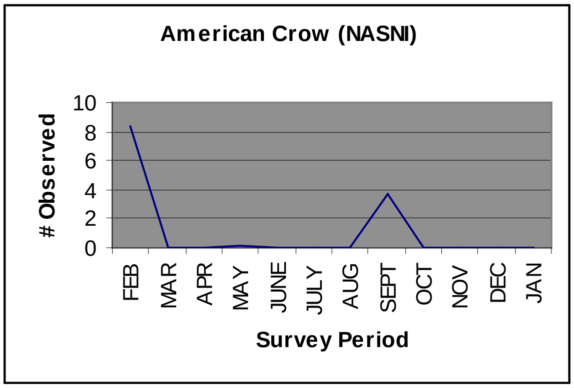
Identification: Largest crow; 43-53 cm long; 438-458 g; stocky black bird with stout bill and fan shaped tail (Udvardy 1994, 1961, NGS 1987).

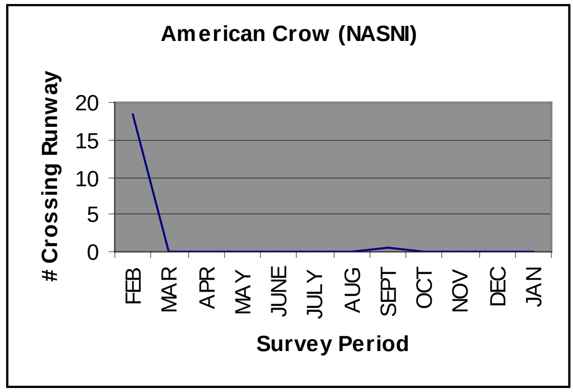
Habitat: Deciduous growth along rivers and streams; orchards and city parks. Also mixed and coniferous woods, but avoids closed coniferous forests and desert expanses (Udvardy 1994).

Food habits: Mainly seeds, some insects, carrion, fruit, nuts and eggs (Gough et al. 1998).

Status: American crows are protected under the Migratory Bird Treaty Act.

NAS North Island:





Best management practice: A 260 cm Balloons with 60 cm eyespots dispersed crows within three to four days (Shirota 1989). Lasers are effective in short term dispersion, however all crows returned to roosts within the same night of treatment, and lasers are not recommended as an overall dispersal tool (Gorenzel et al. 2002). Unanimated predator effigies are ineffective in dispersing crows but can be effective if either the model is in motion or is grasping a bird model that has some sort of motion (mechanical or movement due to wind both work to frighten birds). Electronic alarm and distress such as Av-Alarm, or crow calls intermingled with hawk screams are effective in scarring crows/ravens. Pyrotechnics such as 12 gauge exploding shells, noise-bombs, bird-bombs and rocket bombs are recommended over bird whistlers or whistle bombs which do not scare crows effectively. Effigies could have some effects for roosting birds (M. Avery, 2005. Pers. Commun.

American Kestrel

(*Falco sparverius*)

Adult male

Adult female

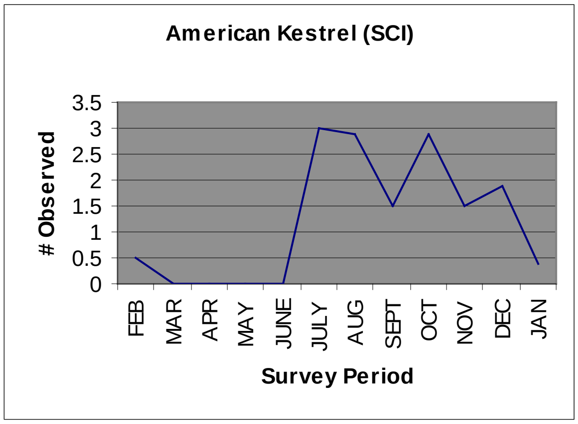
Identification: Males 22-27 cm, females 23-31 cm (Bird and Palmer 1988); males 111±9.3 g, females 120±9.2g (Bloom 1973). Large, dark-brown eyes, curved bill compact and toothed. Legs and toes rather short, talons black. One vertical black stripe across malar region, another across auricular region; a third, shorter lack mark at edge of nape suggests "eye-spots" from dorsal view. Crown blue-gray, with variable amount and concentration of rufous. Back and rump orange to rufous, with variable amount of black barring. Marked sexual dimorphism: male has blue-gray wings, black subterminal band and white to rufous tip on tail, highly variable streaking; female has rufous wings barred with black, tail also rufous with black bands along entire length, heavily streaked with brown (Smallwood and Bird 2002).

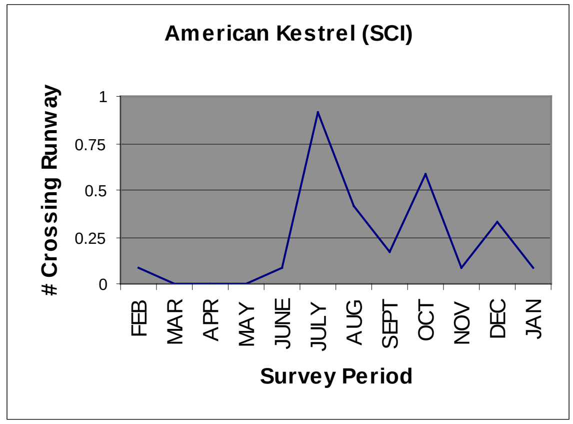
Habitat: Wide variety of open to semiopen habitats, including meadows, grasslands, deserts, early oldfield successional communities, open parkland, agricultural fields, and both urban and suburban areas (Smallwood and Bird 2002).

Food habits: Primarily insects (grasshoppers, cicadas, beetles, and dragonflies), small mammals (voles, mice, shrews, and bats) and birds (small passerines) (Sherrod 1978).

Status: American kestrels (*Falco sparverius*) are protected under the Migratory Bird Treaty Act.

NALF San Clemente Island: From June through February, American kestrels are commonly seen on and around the airfield loafing, foraging and perching on structures.





Best management practice: Habitat modification, such as removal of prey species, and removal can be used to reduce the number of birds from the primary surface of the runway and potential for bird aircraft strike hazards. Perches should be eliminated as they may raise frequency of raptor use in areas due increased visibility when hunting. Prey species population will decrease in areas with shorter vegetation therefore mowing is effective in reducing prey species (Sheffield et al. 2000). Translocation is successful in many areas: airports in Toronto and Windsor Canada hawks were trapped, banded and released 50 kilometres away. 4% of birds returned to the airports. Eliminate habitat that attracts insects and small mammals, drain water from airfields, remove perches or discourage perching with spikes or other repellents (Nichols, McDonald, O'Brien 1994).

Barn Swallow
(*Hirundo rustica*)


Photo by David Blevins

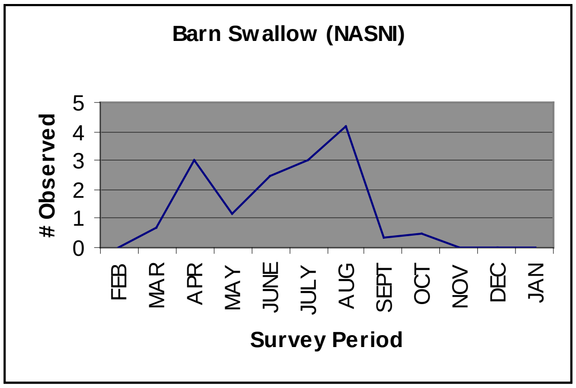
Identification: Medium-sized swallow, 17-20 g, long forked tail, with white spots on inner webs. Adults have steely-blue upperparts, rufous underparts, and chestnut on forehead (Brown and Brown 1999). Sexes similar, but males have longer outer tail-streamers than females – usually 79-106 mm in males and 68-84 mm in females (Pyle 1997) – and males tend to be darker chestnut on under-parts (Brown and Brown 1999).

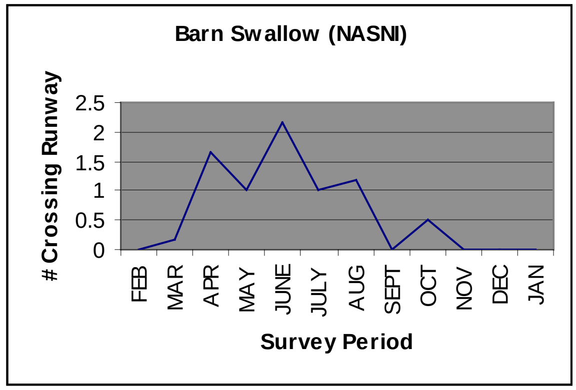
Habitat: Found in various habitats up to 3,000 m, mostly in agricultural areas, cities, and suburbs, and along highways. Breeding habitat usually contains open areas (fields, meadows) for foraging, nest site – a vertical or horizontal substrate underneath some type of roof or ceiling – and a body of water that provides mud for nest-building (Brown and Brown 1999).

Food habits: Forage on flying insects at all times of the year (Brown and Brown 1999) – 99.8% of 467 stomachs contained animal matter (Beal 1918). Often picks up grit or small pebbles, apparently to aid in digestion and possibly for some calcium – 80% of nestlings in Washington had grit in their stomach (Barrentine 1980). Island-nesting birds off California coast feed over inshore waters (Small 1994). Diurnal forager that pursues insects in flight, often feeding on insects flushed by farm implements, grazing mammals, humans, and flocks of other small birds (Brown and Brown 1999).

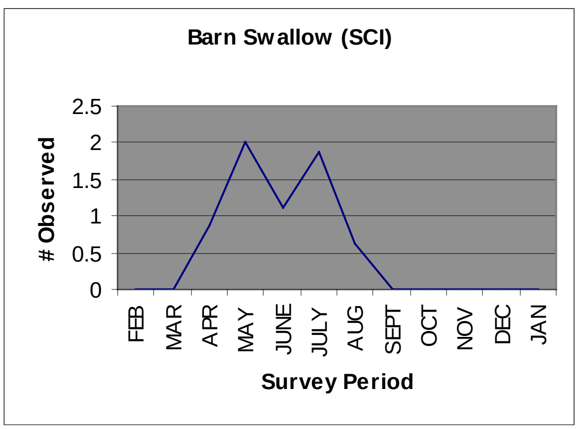
Status: Barn swallows are protected under the Migratory Bird Treaty Act.

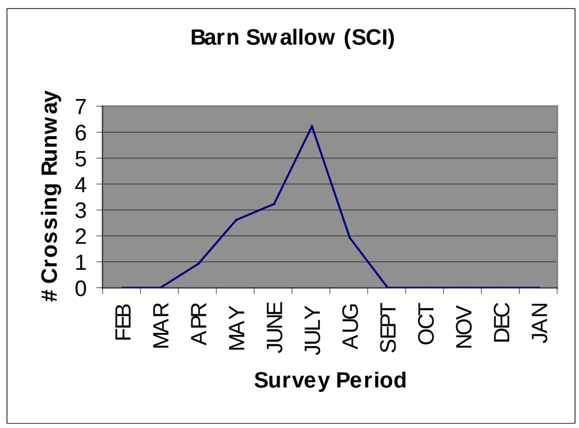
NAS North Island:





NALF San Clemente Island: From April through August, barn swallows are commonly seen flying just above the primary surface of runway 5-23 along the entire length.





Best management practice: Exclude birds from nesting and roosting sites by using netting, wire mesh or plastic strips suspended over the specific area. Modification of the substrate by making it a slick surface will discourage nesting and roosting. Changing the architectural designs by eliminating eaves will discourage nesting and loafing. Removing nests by hand or with a water hose are effective management techniques (Gorenzel and Salmon 1994). Monofilament lines, the chemical deterrent Phenethyl Alcohol, eyespot balloons, changes in the magnetic field, and avian predator effigies are ineffective in deterring nesting habits. Birds quickly became habituated to both effigies and eyespot balloons, and magnetic field changes had no apparent effect on nesting. Sticky- type repellents improve nest adherence. Scare devices such as bird models, lights or noisemakers are usually ineffective (Gorenzel and Salmon 1994). Falconry and pyrotechnics are not effective scaring techniques (Nichols et al.1995).

California Least Tern

(*Sterna antillarum browni)*

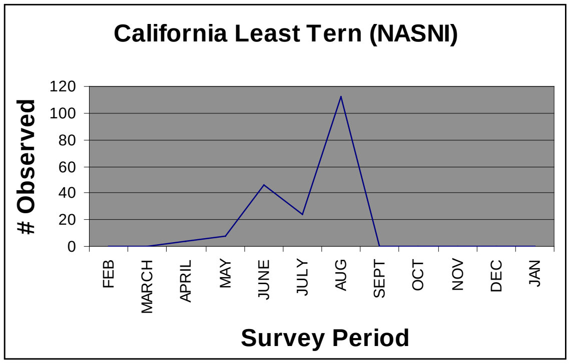
Identification: The smallest North American tern; breeding adult is mainly gray above, with a black cap and nape, white forehead, orange-yellow bill with or without a dark tip, grayish underparts, short deeply forked tail, and yellow-orange legs and feet; a black wedge on the outer primaries is conspicuous in flight (NGS 1983). Adult in winter plumage has a dingy cap, dark nape, a black line through the eye, a dark bill, and yellowish feet and legs (NGS 1983, Peterson 1990). Juvenile is pinkish-buff above, with brownish U-shaped marks on the back; crown is dusky; dark bar is present on the front part of the folded wing. First-summer birds resemble adults but retain the dark bar on the wing and have a dark bill, dark feet and legs, dusky primaries, a dark nape, and a black line through the eye (NGS 1983).

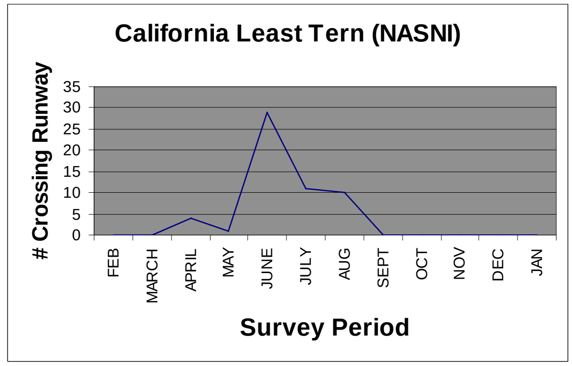
Habitat: Sea coasts, beaches, bays, estuaries, lagoons, lakes, and rivers (AOU 1983). Rests and loafs on sandy beaches, mudflats, and salt-pond dikes (Stiles and Skutch 1989). Before nesting, adults will roost at night on sandy beaches away from nesting areas.

Food habits: Eats mainly small fishes (generally less than nine cm long, such as anchovy, topsmelt, surf-perch, killifish, and mosquitofish), obtained by diving from air into shallow water. When breeding, forages within a few hundred meters of colony.

Status: California least terns are protected under the Migratory Bird Treaty Act and this subspecies is protected as Endangered under the Endangered Species Act.

NAS North Island: California least terns are observed on NAS North Island from April through September. They are found on the edge of the airfield along the coastline of the Pacific Ocean and the San Diego Bay, and have been observed crossing runway 11-29 and 18-36. Specific areas on NAS North Island are set-a-side for nesting and young rearing which include an area near the center of the base and an area on the south side of the approach to runway 29.





Best Management Practices: Since this species is protected by the Endangered Species Act, authorization must be given before management tactics are used. If authorized, wire grids, sight barrier systems and the use of disturbance techniques at the nesting area could be effective in dispersing birds. In addition, these techniques combined with habitat modification, and other frightening techniques could also be effective in dispersing birds.

Caspian Tern
(*Sterna caspia*)

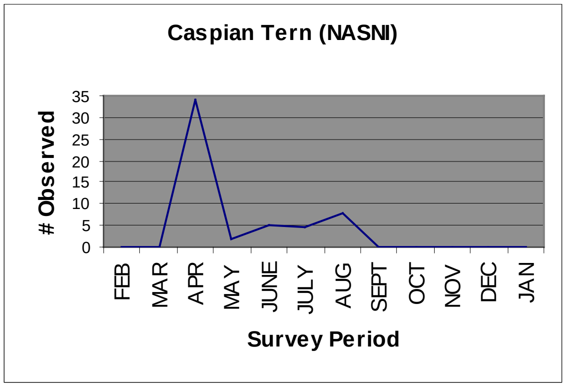
Identification: Large, gull-like tern, 47-54 cm long (Cramp 1985); body mass 530-782 g (Quinn 1990). Sexes similar throughout year and cannot be distinguished externally (Quinn 1990). Easily distinguished from other terns by large size and massive, dagger-shaped bill that is blood red or scarlet in adults, with dark gray mark near tip and often yellow, orange, or white at extreme tip. Tail is relatively short and only slightly notched (Gantlett 1987). In flight, Caspian tern distinguished from other terns by undersurface of outer five to six primaries, which are entirely blackish, whereas uppersurface is whitish. Call in flight is a hoarse low croak (*kaaa*), and a shorter *kow* or *kowk* when bird is threatened (Bent 1921).

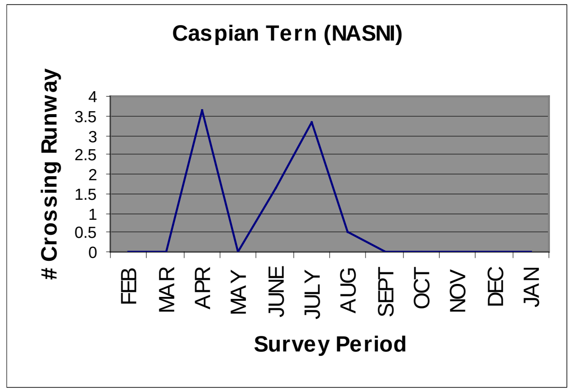
Habitat: Breeds in wide variety of habitats, ranging from coastal estuarine, salt marsh, and barrier islands along Pacific, Atlantic and Gulf Coasts, to James Bay beaches and freshwater islands in Great Lakes and other inland sites (Cuthbert and Wires 1999). Breeding habitat is specific: open, fairly flat islands or similar environments, because eggs and young are vulnerable to ground predators (Ludwig 1991).

Food habits: Diet consists primarily or exclusively of fish; occasionally takes crayfish and insects (FJC). Typically fishes along coasts, shorelines, inland lakes, rivers, lagoons, estuaries, and sloughs; less commonly op open sea (Baltz et al. 1979).

Status: Caspian terns are protected under the Migratory Bird Treaty Act.

NAS North Island: Caspian terns are observed on NAS North Island from April through September. They are found on the edge of the airfield along the coastline of the Pacific Ocean and the San Diego Bay, and have been observed crossing runway 11-29 and 18-36.





Best management practice: Wire grids, sight barrier systems and nest disturbance techniques are most effective when combined with habitat modification, and frightening. Relocation of Caspian terns near Portland, Oregon to other areas with abundant prey populations reduced the number of breeding pairs (unpubl. data, Portland Oregon Fisheries).

Chukar

(*Alectoris chukar*)

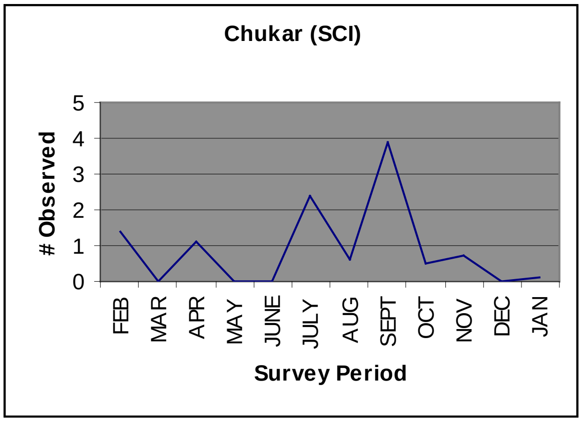
Identification: Medium-sized partridge: 34-38 cm long; mass 550-675 g (Christensen 1996). Females slightly smaller than males in length and mass; sexes otherwise alike. Unique plumage pattern is distinctive among North American game birds. Generally grayish brown to olive above, with buff underparts. Distinctive black line through forehead, eyes, and down neck forms a gorget between the white throat and gray upper breast. Red legs and bill, prominent black and chestnut barring on flanks, and chestnut outer tail-feathers (Christensen 1996).

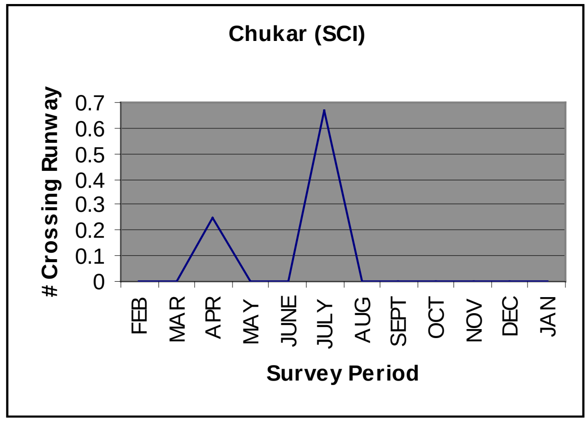
Habitat: Typical habitat includes steep hillsides, talus slopes, deep canyons, and rocky outcrops; arid to semiarid climate; four broad vegetation types: northern desert shrub, salt desert shrub, pinon-juniper and mountain brush (Christensen 1996).

Food habits: Vegetation, primarily grass and forb seeds, green grass and forb leaves; occasional insects. Primarily a ground forager; individuals move continuously and range widely (Christensen 1996).

Status: No special federal or state species status exists for chukars (*Alectoris chukar*).

NALF San Clemente Island: Chukars are present on and around the airfield throughout the year. They are often observed in the vegetation and along the edge of runway 5-23 and taxiways Alpha and Beta. They have also been observed on the marker boards along runway 5-23.





Best management practice: Habitat modification and wildlife hazing can be used to reduce the number of birds from the primary surface area of the runway and potential for bird/aircraft strike hazards.

Common Raven
(*Corvus corax*)

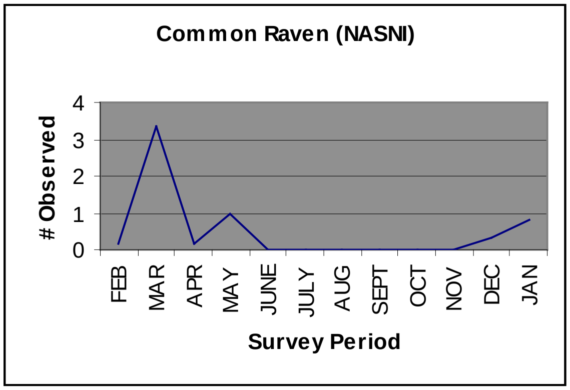
Identification: Very large corvid: up to 69 cm, mass 689-1625 g (Boarman and Heinrich 1999). Plumage entirely glossy black with relatively long pointed wings (wing chord 35-46 cm), wedge-shaped tail, throat with elongated feathers (commonly referred to as "hackles"), and large, chisel-like bill (upper bill has a slight hook at end; lower bill is pointed and sharp). Sexes similar in appearance although females smaller than male in some characteristics. No seasonal variation in adult plumage (Boarman and Heinrich 1999).

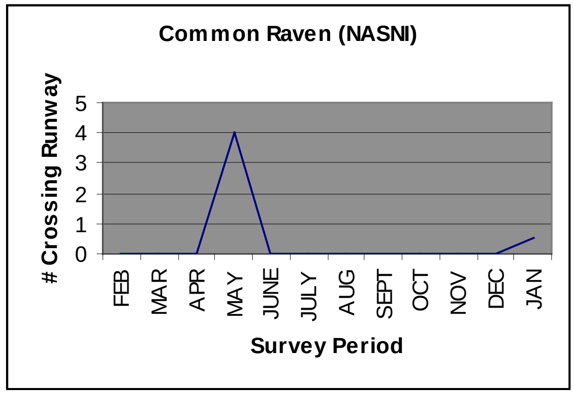
Habitat: Broad range of habitats; prefers heavily contoured landscapes, such as cliffs, which provide thermals for long-distance foraging; and also areas with cliffs, trees or human structures necessary for nesting (Boarman and Heinrich 1999). In the southwest U.S., are found in significantly greater numbers at landfills, agricultural fields, and along highways than in the open desert (Knight and Kawashima 1993, Knight et al. 1993, WIB).

Food habits: An omnivore eating live meat, eggs, arthropods, grains, buds, fruit, garbage, carrion, amphibians, reptiles, birds (adults, chicks, and eggs) and small mammals (Boarman and Heinrich 1999). Generally feed anywhere food is present, probably most often on the ground but also catch birds and insects in flight (Boarman and Heinrich 1999). Seasonal change in food availability probably results in seasonal patterns in raven distribution and foods eaten (Dorn 1972, Stiehl 1978, Boarman 1993).

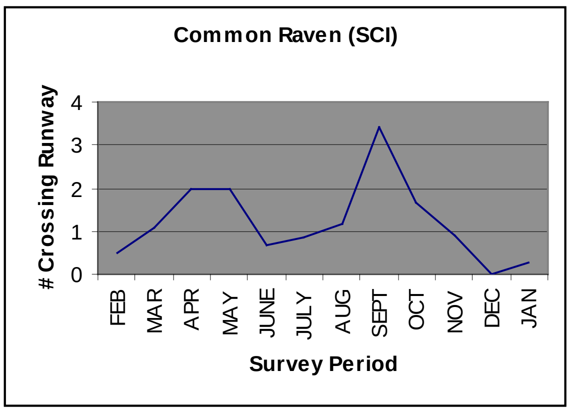
Status: Common ravens are protected under the Migratory Bird Treaty Act.

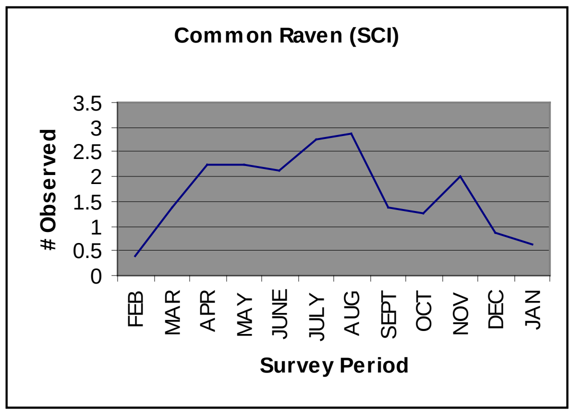
NAS North Island:





NALF San Clemente Island: Common ravens are present throughout the year and are known to have had nests in relatively close proximity to the airfield in the last few years; they have been observed crossing the runways carrying oranges in their mouths.





Best management practice: Hazing as well as habitat management including closing trash lids and implementing a no bird/mammal feeding program can be used to reduce the number of birds from the runway and potential for bird/aircraft strike hazards. A 260 cm balloon with 60 cm eyespots dispersed corvids within three to four days (Shirota 1989). Lasers are effective in short term dispersion, however all crows returned to roosts within the same night of treatment, and lasers are not recommended as an overall dispersal tool (Gorenzel et al. 2002). Unanimated predator effigies are ineffective in dispersing corvids but can be effective if either the model is in motion or is grasping a bird model that has some sort of motion (mechanical or movement due to wind both work to frighten birds) Animated versions reduced damage 81% (Conover 1985). Electronic alarm and distress such as Av-Alarm, or raven calls intermingled with hawk screams are effective in scaring ravens. Pyrotechnics such as noise-bombs, bird-bombs and rocket bombs are effective in hazing corvids. Effigies might be an effective deterrent (M. Avery, 2005. Pers. Coummun.)

European Starling

(*Sturnus vulgaris*)

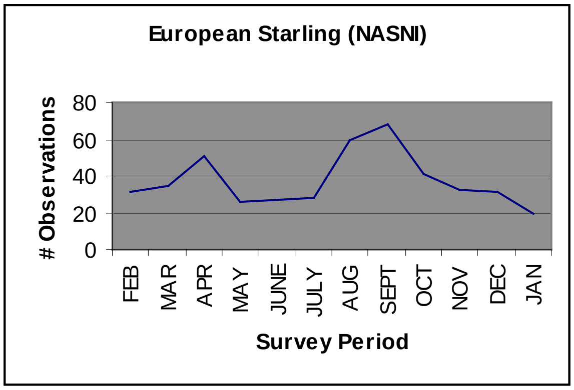
Identification: Compact, stocky passerine. Predominantly glossy black plumage, purple and greenish iridescence on the head, back, and breast; most head and body feathers have whitish or buff terminal spots following molt. Short, squared tail, pointed wings, and long bill (Cabe 1993). Length: males 206-231 mm, females 203-224 mm; weight: males 84.7 g, females 79.9 g (Hicks 1934).

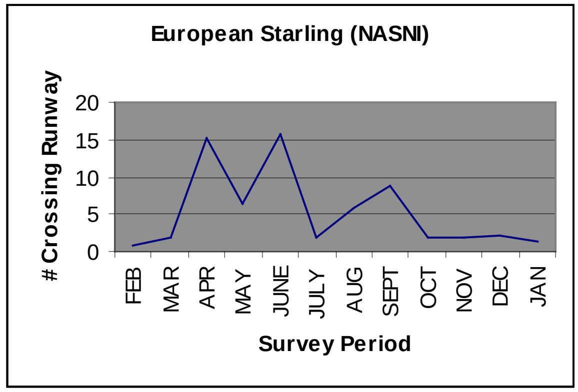
Habitat: Introduced into Central Park, New York City from Europe in 1890 and 1891 and since then have flourished nation-wide are intense competitiors for nesting cavities causing a detrimental effect on many native cavity-nesting species (Cabe 1993). Found in a wide variety of areas, including open country on short, mown, or grazed fields (Cabe 1993). Highest starling densities have been observed in agricultural and disturbed areas including cities and towns where food is abundant and buildings are available for shelter (Feare 1984, Cabe 1993).

Food habits: Diet varies depending on geography, age, and with season. Diet consists mainly of invertebrates, fruits, berries, grains, and certain seeds; also unusual items including garbage and livestock feed (Cabe 1993).

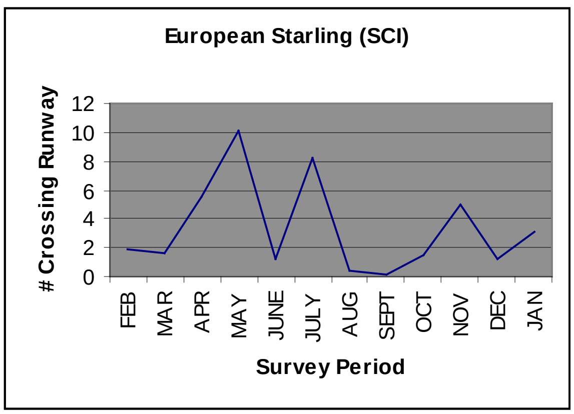
Status: No special federal or state species status exists for European starlings.

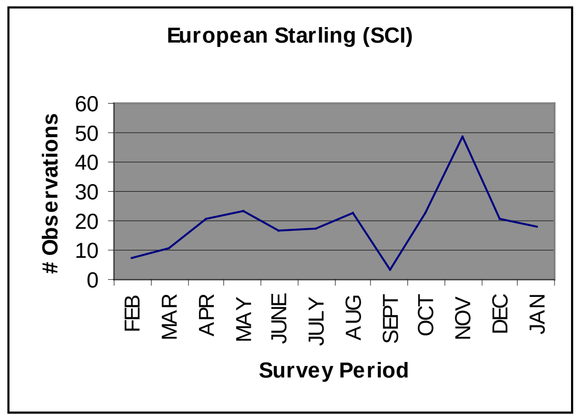
NAS North Island:





NALF San Clemente Island: European starlings are abundant throughout the year foraging and roosting in the buildings and utility lines in and around the airfield, especially near the airfield operations buildings and the ramp where aircraft is parked.





Best management practice: Pyrotechnics are effective in dispersing starlings, but birds will return if there is not constant hazing. Lethal removal using shooting, field cage trapping or nest box trapping, and habitat modification can disperse or reduce the number of birds using the primary surface area on the airfield. The chemical DRC-1339 is a registered avicide for starling control and can be used around structures or on staging areas. It is especially effective post-breeding when birds are flocking and staging before going to roost. The chemical naphthalane (moth balls) is ineffective in deterring starling from nest sites (Dolbeer,et al. 1988).

Great Blue Heron

(*Ardea herodias*)

Photo by David Blevins

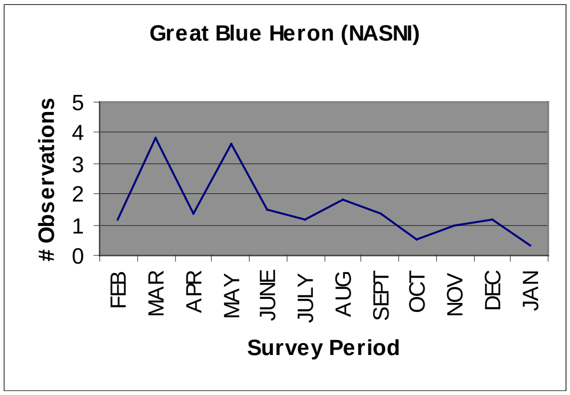
Identification: Largest heron in North America, about 60 cm tall, 97-137 cm long, 2.1-2.5 kg mass (Butler 1992). Legs and neck long; long body and occipital plumes on adults. Upperparts gray, fore-neck streaked with white, black, and rust-brown; bill yellowish; legs brownish or greenish. Middle toe with small comb (pectinate). Wings long and rounded, bill long and tapered, tail short. In flight, folds neck in S-shape and extends legs along the body axis; deep, slow wingbeats (Butler 1992).

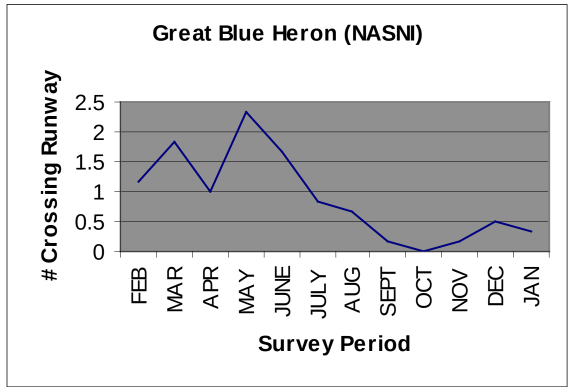
Habitat: Widespread and remarkably adaptable. Herons feed mostly in slow moving or calm freshwater, along seacoasts and occasionally in surf, fields and grassy areas. Nests in trees, bushes, on ground and artificial structures, usually near water; prefers vegetation on islands or in swamps, probably to avoid ground predators (Butler 1992).

Food habits: Mostly fish but also amphibians, invertebrates, reptiles, mammals, and birds (Palmer 1962, Kushlan 1978, Verbeek and Butler 1989). They also forage both night and day on beaches (Black and Collopy 1983).

Status: Great blue herons are protected by the Migratory Bird Treaty Act.

NAS North Island: Great blue herons are found on NAS North Island throughout the year. They roost in several areas around the airfield and have been observed crossing the airfield from their roosts to foraging sites in the morning and vice versa in the late afternoon.





Best management practice: Pyrotechnics in combination with distress calls and nylon lines placed overhead of ponds are effective in dispersing egrets and herons, while flashing lights and helicopters (Hughes 300C) proved ineffective (Moerbeek et al. 1987). Lasers are not effective in dispersing herons at foraging areas used at night or during daytime (Cummings 2003, unpubl. data). Habitat modification of roosting habitat is effective in dispersing herons. Also, relocation of the natural habitat combined with calls and decoys can be effective in relocating a large colony of herons. Habitat modification of foraging areas by draining, using exclusions such as grid wires or reducing the food source can disperse or reduce the number of herons using a site. Shell crackers are an effective scare tactic if used in conjunction with other control methods. A radar-activated integrated hazing system which combines the use of acoustic, pyrotechnic and chemical repellents (bird tear-gas) timed on a random interval system was effective in dispersing waterfowl during day and night and may work for herons. Birds were 12.5 times less likely to fly over areas where the system was in operation (Stevens et al. 2000). Alarm-distress calls, movable noisemaking scarecrows and effigies are usually ineffective as the herons habituate to the devices (James et al. 1999).

Horned Lark

(*Eremophila alpestris*)

Photo by Don DesJardin

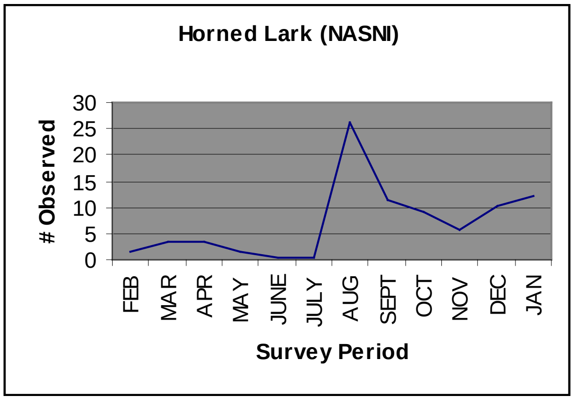
Identification: Small, ground-dwelling oscine: 16-20 cm long, weight 28-40 g (Beason 1995). Have occipital feather tufts – "horns" – which can be raised or lowered, are usually erect in males. Males are slightly larger and darker than females. The nape, back, rump and dorsal surfaces of the rectrices and remiges are shades of brown streaked with dusky brown to black, and the brown varies geographically. Under surfaces of rectrices and remiges medium gray, with black undersides of medial rectrices visible in flight. The two lateral rectrices on each side of the tail are black edged with light gray on distal web; appear almost white in flight. Breast and abdomen cinnamon to white. Head strikingly marked with black lores, cheek patches, occipital feather tufts, and breast patch; alternating with white to yellow eyebrow strike, ear coverts, and chin. Bill slender, varies from dark neutral gray to black; feet and legs black (Beason 1995).

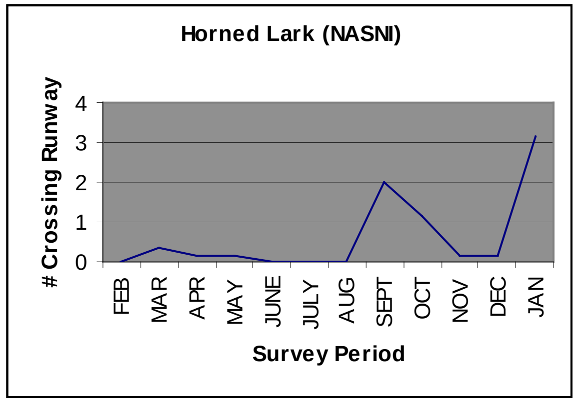
Habitat: Found in open, generally barren country; avoids forests. Prefers bare ground to grasses taller than a few centimeters (Wiens et al. 1987). Found from sea level to elevations of 4,000 m (Behle 1942); from areas with less than ten cm annual precipitation to those receiving > 100 cm. In nonagricultural lands, typically inhabits areas of short vegetation or bare ground, including shortgrass prairie, deserts, brushy flats, and alpine habitat (Verbeek 1967, Cannings and Threlfall 1981). Horned larks inhabit same areas during the spring and fall migration as during other times of the year, but use of beaches and sand dunes as well as mowed areas (including airfield) is increased (Beason 1995).

Food habits: Primarily seeds and insects, but also some fruit (Beason 1995).

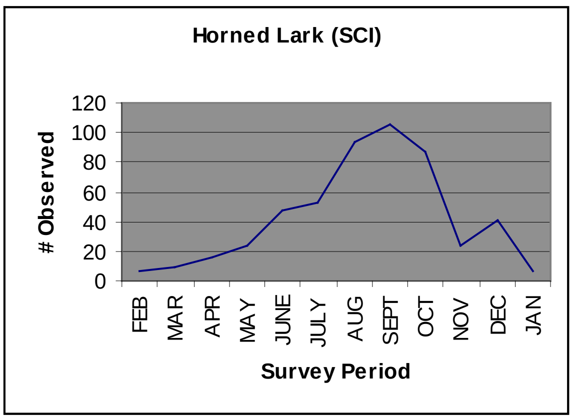
Status: California horned larks (*Eremophila alpestris actia*) are a species of special concern in California and protected by the Migratory Bird Treaty Act.

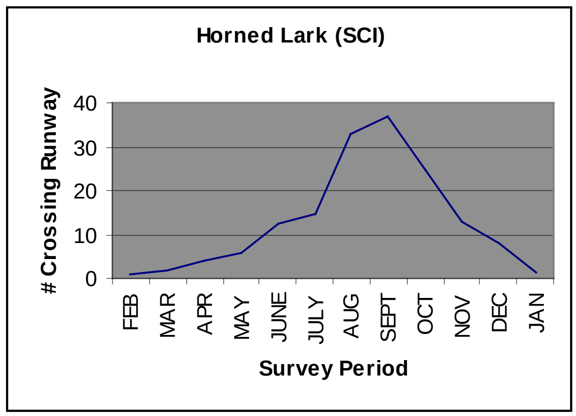
NAS North Island:





NALF San Clemente Island: Horned larks are abundant throughout the year in the vegetation along the edge of runway 5-23, and in the overrun areas in both approaches to runway 5-23.





Best management practice: Habitat management and exclusion not effective; frightening devices such as propane exploders in conjunction with shotgun fire, shell crackers, bird bombs or whistles, and raptor-mimicking kites, or use Avitrol® to produce flock-alarming reactions or Repel with Capsicum-containing granular as a repellent (Clark and Hygnstrom 1994) are mostly ineffective. Hazing techniques combined with frightening devices for horned larks are mostly ineffective.

House Finch

(*Carpodacus mexicanus*)

Male

Female

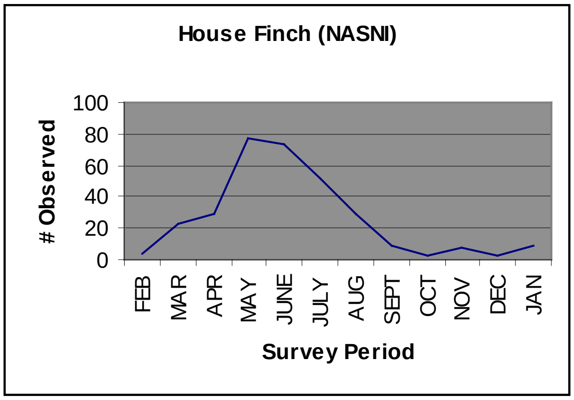
Identification: Small, sexually dichromatic; generally drab gray-brown with heavy streaking below (Hill 1993); mass: 19-25.5 g (McClure unpublished). Males have carotenoid pigmentation ranging in color from pale yellow to bright red variously on crown, back, eyebrow stripe, cheek, shoulder patch, rump, and ventral plumage (Michener and Michener 1931, Hill 1990, 1992). Some females show faint carotenoid pigmentation on the rump, crown and breast, but never as bright as males (McEntee 1970, Hill 1993b).

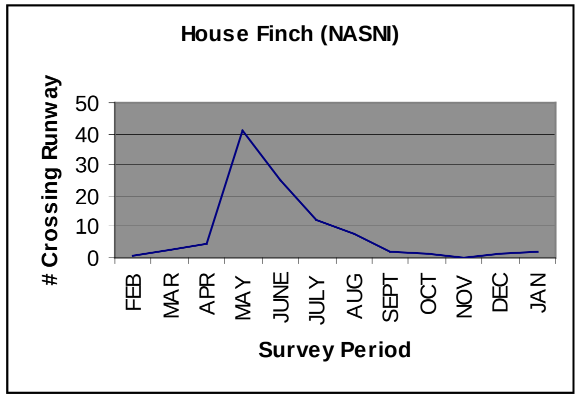
Habitat: Found almost exclusively in settled areas. Prefers areas with buildings, lawns, and small conifers, but also found in urban centers (Hill 1993). Also found in a variety of undisturbed habitats including dry desert with access to water (Bartholomew and Cade 1956), desert grassland, chaparral, oak savannah, riparian areas, and open coniferous forest at elevations to about 2,000 m (Grinnell and Miller 1944). Prefers edge habitat (Salt 1952). Absent from dense coniferous forest (Hill 1993).

Food habits: Ninety-seven percent buds, seeds, and fruits (Beal 1907). Feeds young exclusively vegetable matter (Hill 1993).

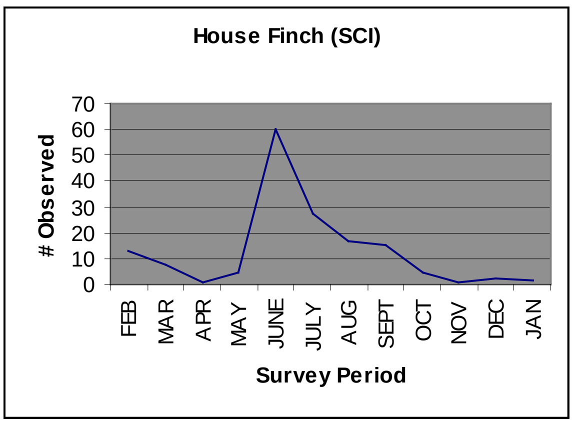
Status: House finches are protected under the Migratory Bird Treaty Act.

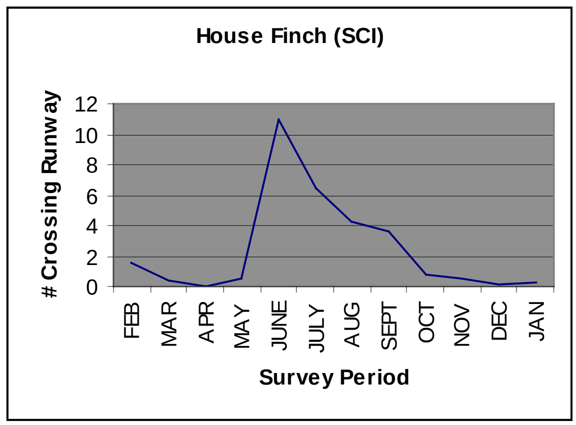
NAS North Island: House finches and other groups of small sparrow like birds are abundant throughout the year in the vegetation along the edges of runways.





NALF San Clemente Island: House finches are abundant throughout the year in the vegetation along the edge of runway 5-23, in the overrun areas in the approach to both runways 5 and 23, and the airfield operations buildings near the ramp.





Best management practice: Remove cover used for nesting and resting; frighten using Av-Alarm® and gas cannons, or Avitrol® to produce flock-alarming reactions; repel with Capsicum-containing granular repellents; and trap using modified Australian crow traps and converted cotton trailer traps (Clark and Hygnstrom 1994). Devices using ultrasonic or the combination of ultrasonic and sonic frequencies did not noticeably frighten birds at baited sites (Griffith 1987).

Mourning Dove

(*Zenaida macroura*)

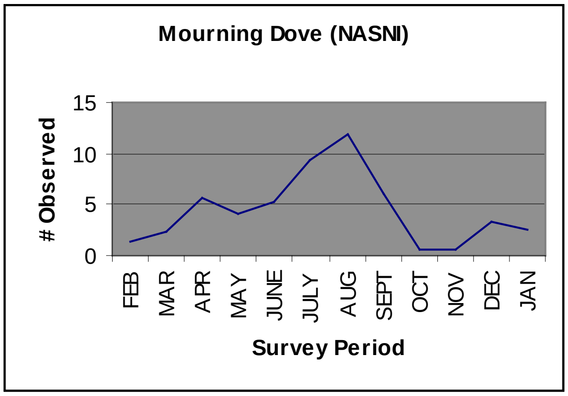
Identification: Streamlined, midsized columbid with small head and long, pointed (graduated) tail. Total length: males 26.5-34 cm, females 22.5-31 cm (Mirarchi and Baskett 1994); mass: males 123±1.85 g, females 115±1.76 g (Hanson and Kossack 1957). Color grayish blue or grayish brown above, buffy below. Black spots on wing coverts and behind eye. Wing and tail feathers gray except for black-bordered white tips on tail. Delicate, black bill; dull red legs and feet. Eyes dark brown bordered by bluish skin. Adult male slightly more colorful than female, with pale rosy breast versus tannish in female. Male head with bluish crown and nape, female with brownish (Mirarchi and Baskett 1994).

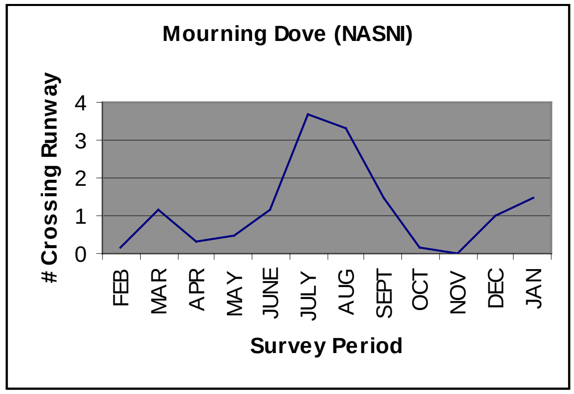
Habitat: Nests in wide array of ecological types throughout southern Canadian provinces, lower 48 states in U.S., north-central Mexico and the Greater Antilles (Sayre and Silvy 1993). Generally shuns deep woods or extensive forests and selects more open woodlands and edges between forest and prairie biomes for nesting (Tomlinson et al. 1994). Highest breeding densities occur in agricultural areas of mid-western, southeastern, and southwestern U.S. (Sayre and Silvy 1993). Additional habitat created with planting of trees and shrubs in cities, towns, and suburbs. No aversion to nesting close to humans (Mirarchi and Baskett 1994).

Food habits: Almost exclusively seeds (99% of diet). Agricultural cereal grains when available, otherwise seeds of mostly herbaceous plants found in early successional stages. Insignificant amounts of animal matter and green forage may be acquired incidentally. Principal food items vary by region and immediate locale. Feeds almost entirely on ground; avoids rank, tall vegetation. Seldom feeds where ground litter makes food difficult to find (Mirarchi and Baskett 1994).

Status: Mourning doves are protected under the Migratory Bird Treaty Act.

NAS North Island: Mourning doves are observed on NAS North Island throughout the year in short vegetation on the edge of the taxiways and runways. In addition, they are often observed crossing the runways to and from roosting locations.





Best management practice: Exclosures, monofilament lines, effigies or flags and mylar tape are effective in hazing doves. Noise makers and shell crackers are also effective dispersal techniques. Manage weeds and other plants on or around the airfield that produce small seeds that are attractive to mourning doves and other seed eating birds.

Red-tailed Hawk

(*Buteo jamaicensis*)

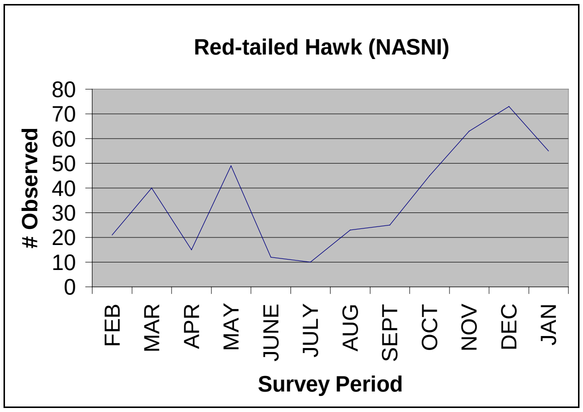
Identification: One of the most widespread and commonly observed birds of prey in North America. It is characterized as stout bodied, broad-winged hawk; total length of males 45-56 cm, mass 690-1,300 g; females 50-65 cm, 900-1,460 g (Preston and Beane 1993). Sexes are similar in appearance. Resembles other buteos in general size and shape, but adults may be distinguished from other North American buteos by the uniformly reddish (dorsally) tail with a narrow dark subterminal band and in light phase birds the presence of dark rectangular markings along the leading edge of the patagium. Plumage color and pattern are highly variable in some populations, and individuals may be broadly classified as light or dark morphs (Preston and Beane 1993).

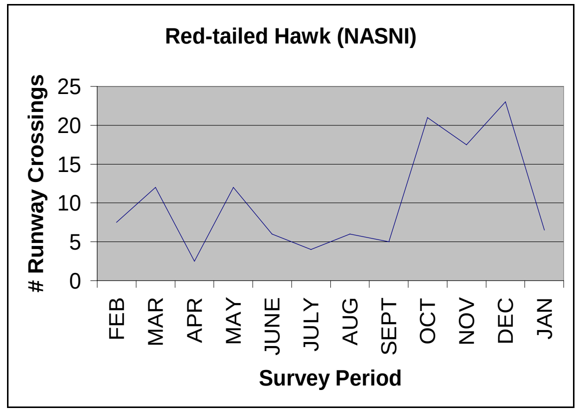
Habitat: Open areas with scattered, elevated perch sites in wide range of altitudes and habitats, including scrub desert, plains and montane grassland, agricultural fields, pastures, urban parkland, broken coniferous and deciduous woodland, and tropical rain forest. Few seasonal or sexual differences in habitat use noted (Peterson 1979).

Food habits: Small to medium sized mammals, birds, reptiles (Preston and Beane 1993). Most hunting (60%-80%) is done from an elevated perch, visually searching surrounding area for prey (Fitch et al. 1946, Thiollay 1981, Ballam 1984).

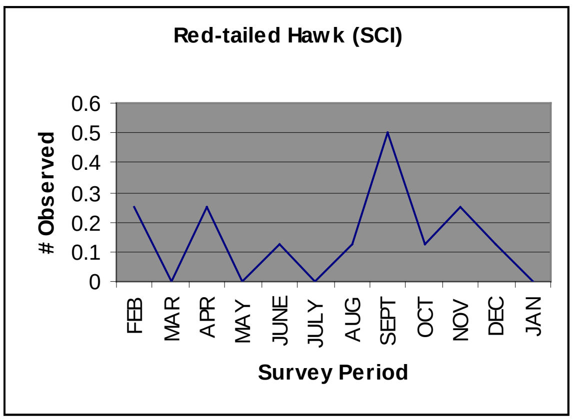
Status: Red-tailed hawks are protected under the Migratory Bird Treaty Act.

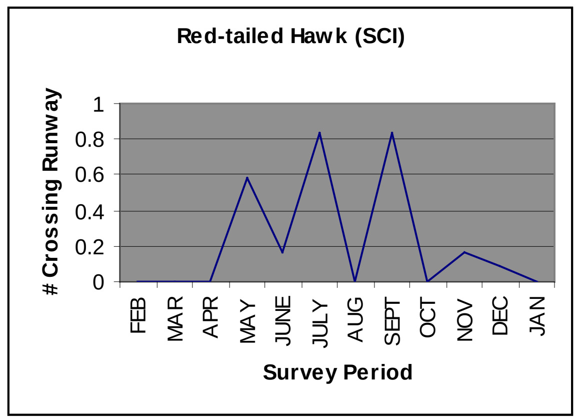
NAS North Island: WHA data indicates that red-tailed hawks are the most common raptor observed on NAS North Island. The greatest numbers of runway crossings occur from September to December. They are usually observed perching, hunting, or soaring adjacent to runway 29 or 36 and along the perimeter road from the approach to 36 to the approach to runway 18. The highest densities of red-tailed hawks have been observed near the approach to runway 36.





NALF San Clemente Island: Red-tailed hawks are present throughout the year hunting and loafing on and around the airfield. They have been observed perching on utility poles and lines along the perimeter road near runway 5-23.





Bird management practice: Eliminate perch sites by removing large, isolated trees, snags, and other elevated sites, install utility lines underground at every opportunity and remove telephone poles; cap poles with sheet metal cones, Nixalite®, Cat Claws®, or inverted spikes; use scarecrows and pyrotechnics; erect electric pole shockers when hawks are observed; trap and translocate hawks – state and federal permits required (Hygnstrom and Craven 1994). Perches should be eliminated or modified as they may increase the frequency of raptor use in areas due increased visibility when hunting. Mowing is an effective in reducing prey populations for raptors and ground predators (Sheffield et al. 2001). Avian predators will decrease in areas with shorter vegetation but increase in areas with vegetation (grass species). Lethal removal of juvenile red-tailed hawks has been effective at reducing strikes at Whidbey Island, Washington (M. Klope pers. comm. 2003). It is suspected that juvenile birds have less experience in and around the airfield and are more susceptible to getting stuck by aircraft.

Western Gull
(*Larus occidentalis*)

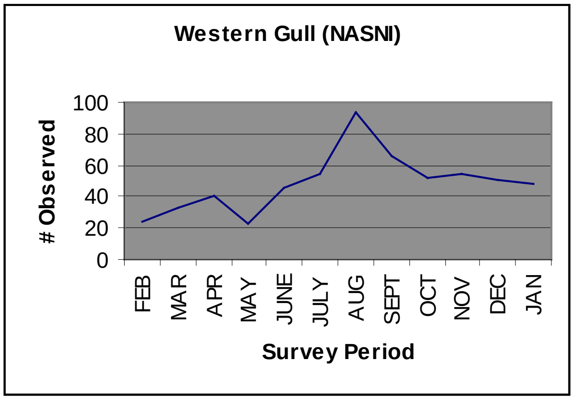
Identification: Medium-sized white headed gull (male: total length 60-66 cm, 1050-1250 g; female 56-62 cm, 800-980 g; sexual dimorphism in body size appears prior to fledging) (Pierotti and Annett 1995). Adult has white head, neck, and body; yellow bill with subterminal red spot; yellow white to golden brown iris, with yellow or orange orbital ring. Only gull breeding in North America that has dark grey mantle, black wingtips, and pink legs in adult stage (Pierotti and Annett 1995).

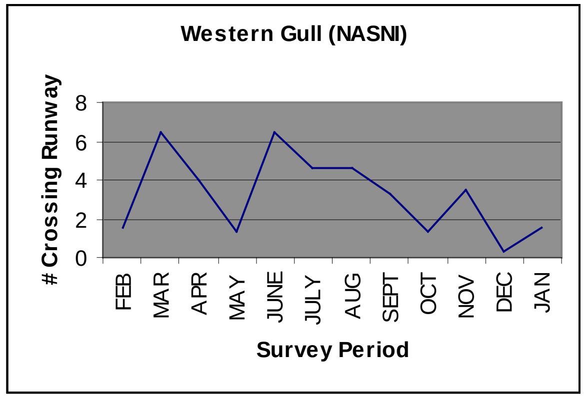
Habitat: Breeding habitat includes major off shore islands, rocky islets, abandoned piers, channel markers, dikes in commercial salt flats. Adults prefer dry, well-drained substrate, e.g. rock, sand. Highest breeding success is achieved in either rocky or vegetated areas with adequate cover for semiprecocial young (Pierotti 1976, 1981). Outside breeding season, nearly all individuals stay near foraging habitats and roost in areas on or adjacent to foraging sites (Spear 1988).

Food habits: A generalist predator on both pelagic and intertidal marine invertebrates and fishes; will also eat eggs, chicks, and adults of other seabirds and eggs and young of conspecifics and congeners (Pierotti and Annett 1995).

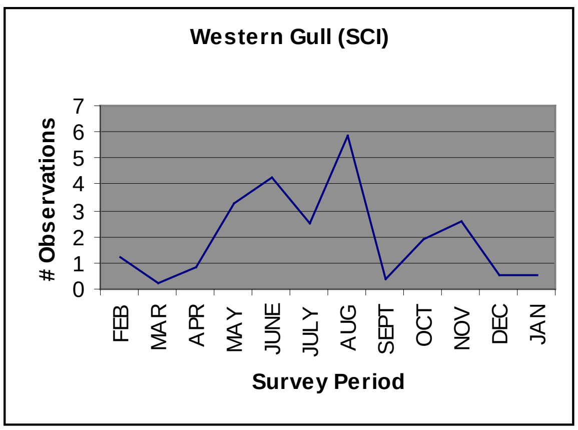
Status: Western gulls are protected under the Federal Migratory Bird Treaty Act.

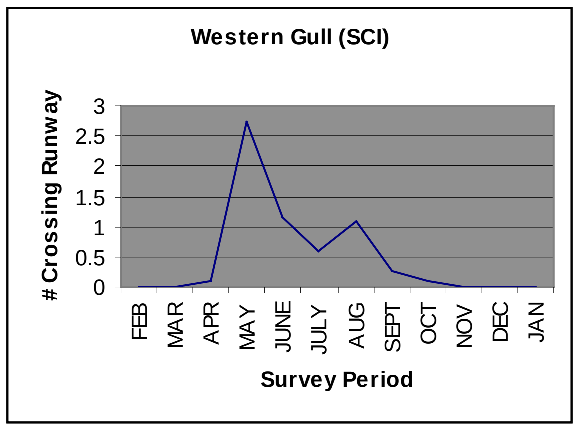
NAS North Island:





NALF San Clemente Island: Western gulls are present throughout the year on the outskirts of the airfield on either side of the island as well as crossing the runway to and from foraging and roosting areas.





Best management practice: Exclusion through suspension of parallel wire or monofilament strands over area needing protection or through use of stainless steel wire spikes on roosting sites; reduce or eliminate sources of food, water, and nesting or resting sites; auditory and visual frightening devices; trapping by rocket or cannon netting over bait, box trapping over nests and eggs, spotlighting and netting by hand at night; shooting with rifle or shotgun under special permit; and removal of nests, eggs, and young or sterilization of eggs (Solman 1994). Dogs have been shown to be effective on geese, ducks and gulls at Dover Air Force Base with a 99.9 % reduction in numbers over a month period. Pyrotechnics and other hazing techniques may be effective in reducing gull numbers.

Western Meadowlark
(*Sturnella neglecta*)

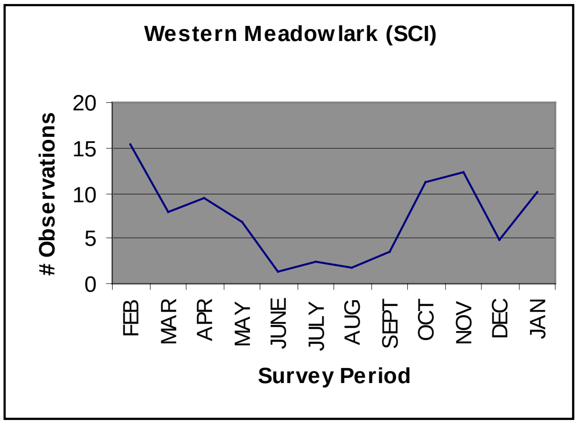
Identification: Medium-sized terrestrial songbird with long, slender bill, short tail with rather rigid rectrices, and long legs and toes (Lanyon 1994); males 106 g, females 89.4 g (Wiens and Rotenberry 1980). Nostrils ovate, overhung by prominent horny operculum. Crown dark with light median stripe. A light line over eye becomes bright yellow from eye to bill. Upperparts with intricate concealing pattern of browns, and black streaks and bars. Underparts are bright yellow, the sides, flanks, and undertail-coverts dull white, broadly streaked, and spotted with dusky black (Lanyon 1994).

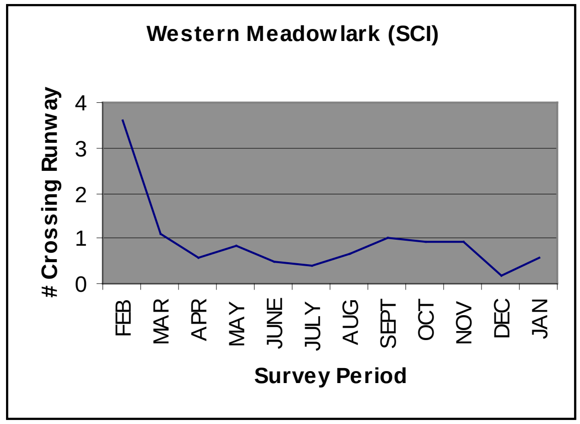
Habitat: Most common in native grasslands and pastures, but also in hay and alfalfa fields, weedy borders of croplands, roadsides, orchards, and other open areas; occasionally desert grassland (Lanyon 1994). Preference has been shown for habitats with good grass and little cover (Wiens and Rotenberry 1981).

Food habits: Feeds almost entirely on the ground. Diet consists largely of vegetable (grain and weed seeds) and animal matter (insects). Favorite insects foods include beetles, weevils, wireworms, cutworms, grasshoppers, and crickets. Marked seasonal differences in main staple: grain during winter and early spring, insects late spring and summer, weed seeds in fall (Lanyon 1994).

Status: Western meadowlarks (*Sturnella neglecta*) are protected under the Migratory Bird Treaty Act.

NALF San Clemente Island: Western meadowlarks are abundant throughout the year in the vegetation along the edge of runway 5-23, and taxiways Alpha, Beta, Charlie and Delta. They perch on the marker boards and other structures along the edge of runway 5-23.





Best management practice: Wildlife hazing, habitat modification, and removal are management strategies that can be used to reduce the number of birds from the primary surface area of the runway and potential for bird aircraft strike hazards. Devices using ultrasonic or the combination of ultrasonic and sonic frequencies did not noticeably frighten birds at baited sites (Griffiths 1987). The chemical deterrent Phenethyl Alcohol, eyespots, magnetic field changes of 88-118 Gauss, and avian predator effigies are ineffective in deterring nesting habits. Birds quickly became habituated to both effigies and eyespots, and Magnetic field changes had no apparent effect on nesting (et al). Dimethyl Anthranilate an effective repellent when used as a feed additive in feedlots, may work in other areas that birds feed (Mason et al 1985 (Mahli 1997). The chemical Nalpthene does not appear to act as an irritant and is ineffective in deterring birds from nesting or renesting (Dolbeer, Link, Woronecki 1988)

Western Snowy Plover

(*Charadrius alexandrinus nivosus*)

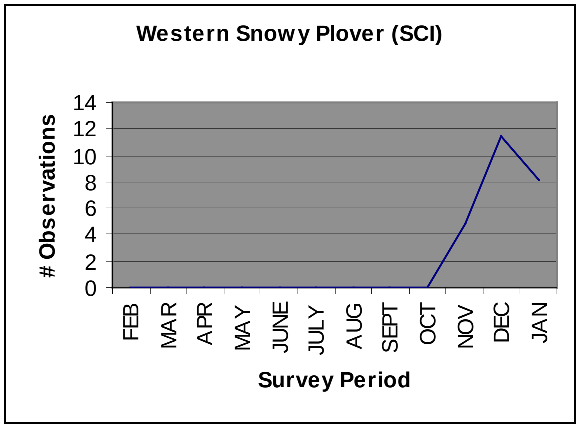
Identification: Small plover: 15-17 cm long; 34-58 g. Breast band always restricted to lateral patches, pale brown upperparts, dark gray to blackish legs and black bill (Page et al. 1995).

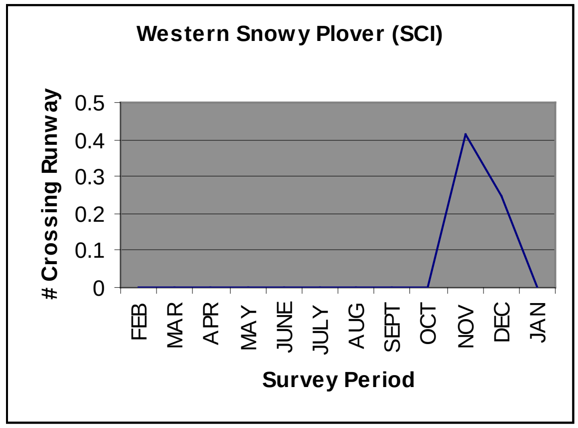
Habitat: Primarily coastal: beaches, tidal flats, lagoon margins, and salt-evaporation ponds (Page et al. 1995). In California, most breeding occurs on dune-backed beaches, barrier beaches, and salt-evaporation ponds; infrequently on bluff-backed beaches (Page and Stenzel 1981).

Food habits: Primarily terrestrial and aquatic vertebrates. Usually pauses, looks, runs, and then seizes prey from surface of beach or tide flat, and probing in sand near the base of low growing plants above the high-tide line (Page et al. 1995).

Status: Western snowy plovers (*Charadrius alexandrinus nivosus*) are a federally-listed threatened species and are protected under the Migratory Bird Treaty Act.

NALF San Clemente Island: A small number of western snowy plovers are present on the NALF SCI airfield from November through January, at which time they roost and loaf on Taxiway Delta near the Red Label Area.





Best management practice: Wildlife hazing is a management strategy that can be used to reduce the number of birds from the primary surface area of the runway and potential for bird/aircraft strike hazards. Falconry has been shown effective in reducing bird strikes by 50% (Cooke 1998). Dogs have been shown to be effective on geese ducks and gulls at Dover Airforce Base with a 99.9 % reduction in numbers over a month period (Carter Nicholas B). Detonators in combination with play back distress calls and overhead lines are effective, while flashing lights, helicopters proved ineffective (Morbbek, Van Dobben 1986) Nest disturbance techniques such as nest and/or egg removal or destruction were found to reduce gull nesting. These techniques are most effective when combined with habitat modification, and frightening (Ickes, , Dolbeer 1998) Egg-oiling if done in the late incubation phase will reduce gull numbers, subsequent oil applications may be necessary for late nests and re-nest attempts (Blackwell, BF et al) Egg oiling only under severe conditions will have a significant impacting hatching success (Ickes, , Dolbeer 1998) Eliminate wet areas such as ponds and ditches, maintain long grass, scare tactics such as shell crackers, gas cannons, and pyrotechnics such as screamers and whistlers are effective. Falconry is effective, yet costly. (Nichols, McDonald, O'Brien 1994).

Willet

(*Catoptrophorus semipalmatus*)

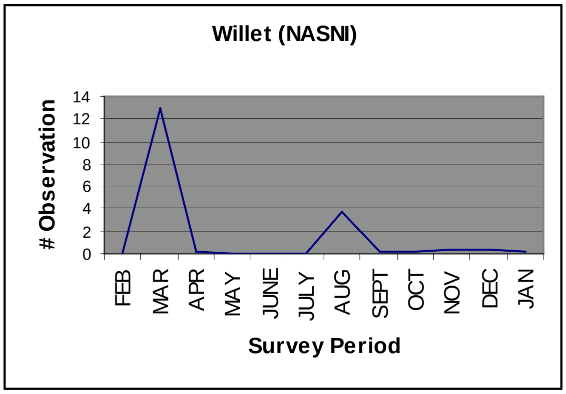
Identification: Large, gray to brownish-gray sandpiper with white lower rump to base of tail and distinctive black-and-white wing pattern; length 33-41 cm; mass 200-330 g. Sexes have similar plumage but the female is slightly larger. Webbing at base of toes; webbing between outer and middle toes larger than between middle and inner. When in flight, willet displays unique and distinctive wing-stripe (Lowther et al. 2001).

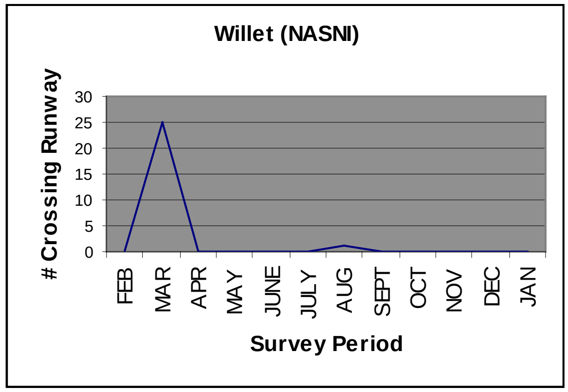
Habitat: On the prairies, used short, sparse cover in wetlands and grasslands (Lowther et al. 2001). Breeds in uplands near brackish or saline wetlands (Bent 1929, Higgins et al. 1979). During nonbreeding season, found in diverse California coastal types: mudflat, marsh, sandy beach, and rocky coast (Mendenhall 1970).

Food habits: Primarily insects, small crustaceans, mollusks, polychaetes, occasionally small fish (Lowther et al. 2001). Feeds both day and night on ebb, flood, and slack tides (McNeil and Rompre 1995, Rompre and McNeil 1996).

Status: Willets are protected under the Migratory Bird Treaty Act.

NAS North Island: From August through April willets were observed on and around the airfield, primarily on the beach foraging or crossing the runway to and from foraging locations.





Best management practice: Eliminate wet areas on the runways as well as ponds and ditches; maintain long grass to a height of over 12 inches; scare tactics such as shell crackers, gas cannons, and pyrotechnics (such as screamers and whistlers) are effective.

APPENDIX 13: WILDLIFE SERVICES SCOPE OF WORK TO CONDUCT BASH MANAGEMENT AT NAS NORTH ISLAND.

Naval Base Coronado BASH Work Plan-2003: USDA/Wildlife Services

This Work Plan is being developed under the terms outlined in the Interagency Agreement (N68711-02-LT-00048) between Naval Base Coronado (NBC), and USDA APHIS Wildlife Services (Wildlife Services). This purpose of this Agreement is to maintain the operational component of the Bird Aircraft Strike Hazard (BASH) reduction program at Naval Air Station North Island (NASNI) and Naval Outlying Landing Field Imperial Beach (NOLFIB). This Work Plan will cover the period of October 1, 2002 through May 31, 2004.

Wildlife Services will conduct control operations for the purpose of identifying and managing wildlife (birds and mammals) that are hazardous to aircraft operating at NAS North Island and NOLF Imperial Beach. Wildlife Services will apply an Integrated Wildlife Damage Management approach to managing wildlife that pose a BASH risk to aircraft at these airfields. This approach incorporates a variety of practical methods and techniques to reduce threats to aircraft, other property, and human-health and safety, while minimizing harmful effects on non-target species, human interests and the environment. In general, direct control efforts will be based on three primary strategies:

1. Physical exclusion of wildlife:
Some examples include: Grid wires over ponds; anti-perching materials installed on structures; effigies and other scare devices installed on rooftops; netting or other materials installed in hangars or other buildings as well as other techniques.

2. Modification of human behavior to eliminate wildlife attractions:
Some examples include: Eliminate feeding of birds and other wildlife; adequate and timely refuse maintenance; operational changes based on current wildlife conditions; modifications to maintenance practices/procedures, etc.

3. Wildlife management:
Some examples include: Harassment of birds (e.g. pyrotechnics, propane cannons, bioacoustics, spotlights, lasers, and other frightening devices), capture techniques (e.g. decoy traps, tranquilizing drugs, cannon nets, etc.), lethal control (e.g. shooting, trapping, and pesticides), and habitat modifications.

These techniques may be implemented simultaneously or sequentially, dependant on the characteristics of specific threats and concerns. Wildlife populations are dynamic and their behavior, frequency, and abundance will vary daily and seasonally, therefore it is critical that any operational BASH program maintain the flexibility to adjust such changes. The primary focus of this program will be to reduce, discourage, or otherwise eliminate wildlife that nest, roost, or loaf in several critical areas at NAS North Island and NOLF Imperial Beach. This Work Plan will provide an outline of where, when and how activities will be performed in fulfilling the requirements of this Agreement.

NAVAL AIR STATION NORTH ISLAND

Over the past several years, Wildlife Services has identified several critical areas around the NAS North Island airfield that are of particular concern due to increased wildlife use, increased aircraft activities, or a combination of both. As a result, strategies have been developed to address concerns in each of these areas. A description of each critical area (below) will identify how work is going to be completed to reduce the wildlife strike hazards. Generally, the following activities will be completed as part of the daily schedule of the Wildlife Specialist assigned to NAS North Island:

- Make general observations of wildlife using each critical area. Observations as to the type, number, location, and activity of wildlife using each critical area will be recorded on data sheets. Observations and data collected will help determine the most practical and expedient means to address the problem.

- Take necessary actions to alleviate the problem at hand. Depending on species, number, location, significance of threat, aircraft activity, human activity, and other factors, the timing of action and methodology will vary. In the case of native bird species, harassment techniques will generally be deployed as the first option. Lethal control will generally be applied to non-native species, and certain, persistent native birds and mammals. Results of any actions taken, including methods, species, numbers, etc., will also be recorded as described above. In some cases, the problem will be addressed immediately, while other situations may involve more elaborate strategies. All results of these activities will be documented in the Monthly Reports.

- Provide recommendations on management practices, building modifications, habitat modifications, and maintenance procedures, as required, to reduce wildlife attractions. Recommendations may consist of simple, verbal communications with on-the-ground personnel, or they may be quite large in scope. In either case, these recommendations will be documented on field data sheets as a means to communicate to appropriate Navy personnel. Additionally, all recommendations and technical assistance will be documented in the Monthly Report for that month.

NAS North Island Golf Course:
Several ponds in this area tend to attract a variety of waterfowl species which represent a significant threat to aircraft using the primary runway (Approach 29) at NAS North Island. American coots (*Fulica americana*), American wigeons (*Anas americana*), mallards (*Anas platyrhynchos*), and other waterfowl utilize the ponds and greens in this area. The following area-specific actions will be taken to minimize threats:

- Identify any features on the Golf Course that have the potential to create hazardous wildlife attractions. When necessary, the Wildlife Specialist will communicate directly with Golf Course personnel to address specific maintenance

concerns as they are identified. All recommendations will be documented as earlier described.
- Assist Golf Course staff in the design and construction of a grid wire system prior to the arrival of waterfowl (late summer). Regularly inspect grid wire system for proper function.
- Haze waterfowl from Golf Course ponds, and lethally remove persistent waterfowl when necessary (with emphasis on fall/winter months).
- Monitor and manage raptors as specific problems are identified (Wildlife Services will work closely with Natural Resources Office (NRO) personnel in the development of guidelines for managing raptor species in all critical areas).
- Conduct European starling (*Sturnus vulgaris*) control as required.

Approach to 29:
The Approach to 29 is likely the most frequently used runway by aircraft at NAS North Island. This, combined with a variety of wildlife attractions in the vicinity, make this area a particular concern for BASH management. The nearby eucalyptus groves attract raptors, corvids (i.e. crows and ravens), herons, and other birds. The nearby Golf Course, as described, attracts waterfowl from other areas, potentially causing them to transit through the approach path of aircraft in this area. California ground squirrels (*Spermophilus beecheyi*), and black-tailed jackrabbits (*Lepus californicus*) are quite numerous in this area. These species, in turn, attract hawks, corvids, owls, and great blue herons (*Ardea herodias*). The following area-specific actions will be taken to minimize threats:

- Haze wildlife (gulls (*Laurus sp.*), raptors, starlings, etc.) from the Approach to 29 area with the use of a variety of methods. Remove any persistent wildlife.
- Monitor for nesting gull activity during the breeding season (March-August) and take appropriate actions to remove them.
- Identify specific maintenance issues, including vegetation management, to reduce attractions to rodents and other wildlife.
- Monitor and manage raptors and herons as specific problems are identified.

Radar Field:
The Radar Field is one of the larger areas of disturbed habitat at NAS North Island, offering hunting/perching opportunities for raptors. California ground squirrels and black-tailed jackrabbits are also quite numerous in this area. Navy helicopters often approach the airfield and wash-down areas over this area at relatively low altitudes. The following area-specific actions will be taken to minimize threats:

- Provide technical assistance to Public Works Department for the installation of anti-perching devices to minimize birds' use of towers, runway lights, etc.
- Provide management recommendation on rodent/rabbit control to minimize the attractiveness to raptors.
- Monitor and manage raptors as specific problems are identified.

Approach to 36:

This is a very critical area due to the variety and quantity of birds that are frequently observed loafing and foraging, as well as the high level of aircraft that utilize this runway. Terns (*Sterna sp.)*, gulls, pelicans and other shore birds often forage, loaf or roost along Zuniga Beach, which lies directly at the end of Approach to 36. The following area-specific actions will be taken to minimize threats:

- Haze wildlife (gulls, starlings. etc) from the approach with the use of a variety of methods. Due to their high use of this area, care will be taken to avoid any harassment of brown pelicans (*Pelecanus occidentalis*), and other threatened or endangered species. Remove persistent wildlife as required.
- Monitor for nesting gull activity during the breeding season (March-August) and take appropriate actions to remove them.

Weapons Area

Although much of the Weapons Area is away from the airfield proper, several characteristics of this area make it important concern for BASH management at NAS North Island. Light standards surrounding the Weapons area are frequently used by raptors for perching and hunting small mammals along the north side of the Approach to 36. The Weapons Pier is frequently used by a large number of shore birds for roosting and loafing. Western gulls often nest atop several ammunition bunkers and other structures in this area. The following area-specific actions will be taken to minimize threats:

- Haze gulls from buildings, bunkers and other structures.
- Haze gulls from the Weapons Pier to deter loafing, roosting, or nesting.
- Provide technical assistance to the Weapons Department to exclude, harass or otherwise deter wildlife from utilizing the Weapons Pier.
- Monitor and manage raptors as specific problems are identified. Provide recommendations for deterring raptor use of these areas.
- Monitor for nesting gull activity during the breeding season (March-August) and take appropriate actions to remove them.
- Remove persistent wildlife.

Moffett Road:

- Provide technical assistance to building tenants on bird exclusion techniques
- Haze wildlife (gulls, etc.) from utilizing buildings along Moffett road for nesting, loafing, and roosting. Remove persistent wildlife.
- Monitor for nesting gull activity during the breeding season (March-August) and take appropriate actions to remove them.

Approach to 11:

- Provide technical assistance on habitat modifications to reduce the attractiveness of the area so as to minimize foraging, roosting, or nesting.
- Haze wildlife (gulls, starlings, etc.) from the Approach with the use of a variety of methods. Remove persistent wildlife.
- Monitor and manage raptors as specific problems are identified.

- Monitor for nesting gull activity during the breeding season (March-August) and take appropriate actions to remove them.

Approach to 18:

- Provide technical assistance on habitat modifications to reduce the attractiveness of the area so as to minimize foraging, roosting, or nesting.
- Haze wildlife (gulls, starlings, etc.) from the Approach with the use of a variety of methods. Remove persistent wildlife.
- Monitor and manage raptors as specific problems are identified.
- Monitor for nesting gull activity during the breeding season (March-August) and take appropriate actions to remove them.

Hanger Areas:

- Provide technical assistance on exclusion techniques to reduce the attractiveness of the hangers so as to minimize foraging, roosting, or nesting.
- Eliminate any feeding of wildlife in hangars and other buildings.
- Remove wildlife (gulls, pigeons, doves, etc.) from the hangers with the use of a variety of methods.
- Monitor for nesting gull activity during the breeding season (March-August) and take appropriate actions to remove them.

Other areas:

- Make general observations on the type and location of wildlife that are utilizing NAS North Island.
- Provide technical assistance on management techniques to reduce the attractiveness of the station to minimize foraging, roosting, or nesting of wildlife.
- Monitor for nesting gull activity during the breeding season (March-August) and take appropriate actions to remove them.
- Identify and eliminate feeding of wildlife station-wide.

Additional activities:

- Wildlife Services will assist NRO with burrowing owl surveys and trapping.
  - During March-August, conduct one survey/week.
  - During March-August, assist in the capture of burrowing owls for the purpose of marking.
  - During September-February, conduct one survey/month.

NAVAL OUTLYING LANDING FIELD IMPERIAL BEACH

Approximately two visits per week will be made to NOLF Imperial Beach in order to evaluate and respond to wildlife hazards on the airfield. Visits to NOLF Imperial Beach may vary, depending on the type and level of control activities required. Below is a list of areas at NOLF Imperial Beach that have been identified as significant wildlife attractions, followed by a description of activities to be conducted to reduce the wildlife strike hazards in these areas.

DRMO 1
DRMO 2
Approach to 26
Perimeter Road South
Helicopter Pads
Perimeter Road East
Approach to 27
DRMO Storage Yard

- Make general observations on the type and location of wildlife that are utilizing the areas.
- Provide technical assistance on exclusion techniques to reduce the attractiveness of the hangers so as to minimize foraging, roosting, or nesting of birds.
- Haze wildlife (except threatened or endangered species) using a variety of methods including pyrotechnics, propane cannons, bioacoustics, and others.
- Remove wildlife (gulls, pigeons, starlings, etc.) from the hangers through the use of a variety of methods, both lethal and non-lethal.
- During the breeding season (March-August) monitor for nesting gulls and take appropriate action to remove them.
- Provide management recommendations on rodent control/habitat modifications to minimize the attractiveness to raptors.
- Identify raptors that may be utilizing critical areas and provide recommendations on their exclusion. Wildlife Services will work closely with Natural Resources Office (NRO) personnel in the development of operational guidelines for managing raptor species in critical areas.
- Provide technical assistance to Public Works Department for the installation of anti-perching devices to minimize birds' use of towers, runway lights, etc.
- Identify and eliminate feeding of wildlife station-wide.

Adjacent Lands:
- Make general observations on the type and location of wildlife that are utilizing the areas.
- Coordinate with NRO and personnel from U.S. Fish and Wildlife Service, Tijuana Slough National Wildlife Refuge (Refuge) when utilizing pyrotechnics or other bird harassment devices, so as to eliminate potential impacts to threatened or endangered species.
- Coordinate with NRO and Refuge personnel on the development of raptor management guidelines if applicable.

RESPONSE TO AIRCRAFT STRIKES
Wildlife Services is to be notified of all wildlife strikes occurring at NAS North Island and NOLF Imperial Beach, according to previously established guidelines set forth by the

NBC Aviation Safety Office. When appropriate, Wildlife Services will be available to respond to the location to interview personnel, document the incident, collect/identify bird remains, and make pertinent recommendations. In the event that hazardous wildlife conditions remain on the airfield, Wildlife Services will take appropriate actions to minimize the threat.

PERSONNEL INVOLVED

Operational activities at NAS North Island and NOLF Imperial Beach will conducted primarily by Wildlife Services Specialist (WSS).

APPENDIX 14: LIST OF DISPERAL OR DETERRENT TECHNIQUES AND SUPPLIERS.

BIRD DAMAGE CONTROL

Exclusion

Electrified Wire System

Avian Flyaway, Inc.
500 Turtle Co Suite 120
Rockwall, TX 75087
(800) 888-0165
Fax: (214)722-0165

Bird B Gone Inc
23918 Skyline Mission Viejo, CA 92629
(800)-392-6915
www.birdbgone.com

Bird Barrier America, Inc.
20925 Chico Street,
Carson, CA 90746, USA
800-503-5444
310-527-8000,
Fax: 310-527-8005
www.birdbarrier.com

DeerBusters
9735A Bethel Road
Frederick, MD 21702
(301)694-6072
1-888-422-DEER (3337)
Fax:(301)694-9254
www.deer-busters.com

Fly-Bye
(800)820-1980
www.flyebye.com

Integrated Pest Supply Inc
109-360 Edworthy Way
New Westminster, BC V3L 5T8 Canada
(604)-520-9900

Shelly Enterprises
18176 Arnold Dr.
Sonoma, CA 95476

Wildlife Management Supplies
9435 E. Cherry Bend Rd.
Traverse City Michigan 49684
(800) 451-6544
Fax: (231) 947-9919
www.crittercontrol.com

Metal wire or projectors (including spikes)

Animal Control Products
P.O. Box 398
215 South McKay
Spring Valley, WI 54767 US
Email: barons@svtel.net
800-729-8056
Fax: 715-778-5633

Bird B Gone Inc
23918 Skyline
Mission Viejo, CA 92629
(800)-392-6915
www.birdbgone.com

BirdMaster
175-D New Boston St.
Woburn, MA 01801-6203
800-562-2473
Fax 781-932-0013
Email: info@birdmaster.com

Bird Barrier America, Inc.
20925 Chico Street,
Carson, CA 90746, USA
800-503-5444
310-527-8000,
Fax: 310-527-8005
www.birdbarrier.com

Bird-X
300 N. Elizabeth St.
Chicago, IL 60607
800-662-5021
Fax: 312-226-2473
www.bird-x.com

Cat Claw, Inc.
Box 5250
Johnstown, PA 15904
(800) 832-2474
Fax:(814)269-3800

DeerBusters
9735A Bethel Road
Frederick, MD 21702
(301)694-6072
1-888-422-DEER (3337)
Fax:(301)694-9254
www.deer-busters.com

Integrated Pest Supply Inc
109-360 Edworthy Way
New Westminster, BC V3L 5T8 Canada
(604)-520-9900

Nixalite of America
1025 16th Ave.
box727
East Moline, IL 61244-0727
(309) 755-8771
(800)624-1189
Fax: (309)755-0077

Wildlife Management Supplies
9435 E. Cherry Bend Rd.
Traverse City Michigan 49684
(800) 451-6544
Fax: (231) 947-9919
Email: wendysak@hotmail.com
www.crittercontrol.com

Netting

ADPI Enterprises, Inc.
3621 B St.
Philadelphia, PA 19134
(215) 425-8866
(800)621-0275
Fax: (215)739-8480

APGAR
Mill River Supply
375 Adams
Bedford Hills, NY 10507
(914)666-5774
Fax:
(914)666-9183

Animal Control Products
P.O. Box 398
215 South McKay
Spring Valley, WI 54767
800-729-8056
Fax: 715-778-5633
www.animalcontrolproducts.com

Animal Repellents, Inc.
P.O. Box 999
Griffin, GA 30224
404/227-8222
800/241-5064

Bird B Gone Inc
23918 Skyline
Mission Viejo, CA 92629
(800)-392-6915
www.birdbgone.com

Bird Barrier America, Inc.
20925 Chico Street,
Carson, CA 90746, USA
800-503-5444
310-527-8000,
Fax: 310-527-8005
www.birdbarrier.com

Bird Busters
1083 Jefferson St. NW
Washington, DC 20007
(202) 338-6263
(800)662-4737
Fax: (202) 338-6268

Bird Guard
100 State St Suite 312
Erie, PA 16507
(800) 331-2973
www.birdgaurd.com

BirdMaster
175-D New Boston St.
Woburn, MA 01801-6203
800-562-2473
Fax 781-932-0013
Email: info@birdmaster.com

Bird-X
300 N. Elizabeth St.
Chicago, IL 60607
800-662-5021
Fax: 312-226-2473
www.bird-x.com

Conwed plastics
760 29th Ave. SE'
Minneapolis, MN 55414
(800) 426-6933

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Frederick, MD 21702
(301)694-6072
1-888-422-DEER (3337)
Fax:(301)694-9254
www.deer-buster.com

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Polymers product Dept.
Wilmington, DE 19898
(800) 448-9835
Fax: (302) 774-7321

Fly-Bye
(800)820-1980
www.flyebye.com

Green Valley Farm
9345 Ross Station Rd.
Sebastpol, CA 95472
(707) 887-7496
(800) 827 9590
Fax: (707) 887-7499

Integrated Pest Supply Inc
109-360 Edworthy Way
New Westminster, BC V3L 5T8 Canada
(604)-520-9900

InterNet, Inc.
7300 49th Ave.
Minneapolis, MN 55428
(612) 541-9690
(800)328-8456
Fax: (763)971-0872

J.A. Cissel Do., Inc.
Box 2025
Lakewood, NJ 08701
(800) 631-2234
Fax: (732)901-1166

Laird Plastics, Inc.
6311 Erdman Ave.
Baltimore, MD 21205-3585
(561) 684-7000
(800) 610-1016

Margo Supplies LTD.
P.O. Box 5400
High River, Alberta, Canada T1V 1M5
Tel. (403) 652-1932
Fax (403) 652-3511
info@margosupplies.com

Snow Pond Farm Supply
699 Adams Street
P.O. Box 115
North Abington, MA 02351
781-878-5581
Fax781-878-5398
www.snow-pond.com

Miller Net and Twine
Box 18787
Memphis, TN 38181-0780
(800) 423-6603
Fax: (901) 743-6580

National Netting, Inc.
2009 Treetrail Parkway
Norcross, GA 30093
(800)233-7896
Fax: (770) 717-1186

Nichols Netting & Twine Co., Inc.
2200 Hwy 111
Granite City, IL 62040
(618) 797-0211
(800) 878- Nets
Fax: (618) 797- 0212

Nylon Net Co.
845 N. Main St
Memphis, TN 38101
(800) 238-7529
(901) 526-6538
Fax: (901)775-5374

ProSoCo, Inc.
3741 Greenway Cir.
Lawrence, KS 66046
(800)255-4255
Fax: (800) 877-2700
Sutton Ag Equipment
746 Vertin Ave.
Salinas, CA 93901
(831) 422-9693
Fax: (800) 482-4240

Tenax Corp.
4800 E. Monument St
Baltimore, MD 21205
(410) 522-7000
(800) 356-8495
Fax: (410) 522-7015

Wildlife Control Technology
2501 Sunnyside Ave. #103
Fresno, CA 93727
(559) 490-2262
(800)235-0262
Fax: (559) 490-2264

Frightening Devices

Air Horns

Falcon Safety Products, Inc.
25 Chubb Way

Branchburg, NJ 08876
(908) 707-4900
Fax: (908)707-8855

Alarm or Distress Calls

Animal Control Products
P.O. Box 398
215 South McKay
Spring Valley, WI 54767 US
800-729-8056
Fax: 715-778-5633
Email: barons@svtel.net

Bird Barrier America, Inc.
20925 Chico Street,
Carson, CA 90746, USA
800-503-5444
310-527-8000,
Fax: 310-527-8005
www.birdbarrier.com

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Washington, DC 20007
(202) 338-6263
(800)662-4737
Fax: (202) 338-6268

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Erie, PA 16507
(800) 331-2973
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www.bird-x.com

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Fax:(301)694-9254
www.derr-buster.com

Johnny Stewart
600 Huntington Ct. NE
Cedar Rapids IA 52402
(800) 537-0652
Fax: (319) 395-00352

Pest Bird & Animal Control

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www.pest-bird-animal-control.com

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(800) 647-5554
Fax: (662) 335-8850

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Fax781-878-5398
E-Mailsales@snow-pond.com

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870-265-3584
fax: 870-265-4146
www.southernaquaculturesupply.com

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Sioux Falls, SD 57117
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www.ravenind.com

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Salinas, CA 93901
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Fax: (800) 482-4240

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Chemical Frightening Agents (4-aminopyridine)

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7644 E. 46th St.
Tulsa, OK 74103
(918) 582-3359
(800) 633-5069

Fax: (918) 622-2527

B&G Chemicals & Equipment Co., Inc.
10539 Maybank
Dallas,TX 75354-0428
(214) 357-5741
(800) 345—9387
Fax: (214) 357—4541

Bird-X
300 N. Elizabeth St.
Chicago, IL 60607
800-662-5021
Fax: 312-226-2473

Brewer Environmental
311 Pacific Street
Honolulu, Hawaii 96817
Phone: (808) 532-7400
Fax: (808) 832-7901
Email: bes@brewerenv.com

Ecolab Center
370 N. Wabash St.
St Paul MN 55102-2233
651-293-2233
Fax 651-293-2092
www.ecolab.com

Estes Inc.
1925 John Carpenter Freeway suite 525
Irving TX 75063
(469)916-4020
Fax (469)916-4050
www.estesinc.com

DVM Resources
Wichita, KS (800) 362-2870
Buda, TX (877) 842-6936
Hastings, NE (800) 321-2887

Forshaw Distribution
www.forshawonline.com
Main Office
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Charlotte, NC 28208
Phone: 704-372-6790
Fax: 704-372-6796
Branch
11264-B Grooms Road
Cincinnati, OH 45242
Phone: 513-489-6616
Fax: 513-489-6993
Branch
1369 Jacqueline Drive
Columbus, GA 31907

Phone: 706-561-7490
Fax: 706-561-0286

Nu-Gro Corporation
10 Craig Street
Brantford, Ontario,
Canada N3R 7J1
1 800 268-2806
(519) 757-0077
Fax: (519) 757-0010
E-mail: finance@nu-gro.ca products@nu-gro.ca

United Agri Products
251 W 4th Street, Greeley Colorado 80634
970-356-4400:
www.uap.com

Effigies, Gator

Better Pest Control Inc.
(718)714-4444
(888)229-0102
www.pestpest.com

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300 N. Elizabeth St.
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800-662-5021
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Fax: (231) 947-9919
www.crittercontrol.com

Effigies, Human

Raven Industries, Inc.
P.O. Box 1007
Sioux Falls, SD 57117
605/335-2750

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1 - 877 266 3532
www.pest-bird-animal-control.com

W. Atlee Burpee Seed Co.
Warminster, PA 18974
215/674-4900

Effigies, Owl

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(888)229-0102
www.pestpest.com

Bird Barrier America, Inc.
20925 Chico Street,
Carson, CA 90746, USA
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300 N. Elizabeth St.
Chicago, IL 60607
800-662-5021
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9735A Bethel Road
Frederick, MD 21702
(301)694-6072
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Snow Pond Farm Supply
699 Adams Street
P.O. Box 115
North Abington, MA 02351
781-878-5581
Fax781-878-5398
www.snow-pond.com

Effigies, Raptor

Bird-X
300 N. Elizabeth St.
Chicago, IL 60607
800-662-5021
Fax: 312-226-2473

Flambeau Products Corp.
801 Lynn Ave.
Barabo,WI 53913
(608) 355-6585
(800) 457-5252
Fax: (608) 356-8044

Fly-Bye
(800)820-1980
www.flyebye.com

Sutton Ag Equipment
746 Vertin Ave.
Salinas, CA 93901
(831) 422-9693
Fax: (800) 482-4240

Effigies, Snake

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699 Adams Street
P.O. Box 115
North Abington, MA 02351
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Fax781-878-5398
www.snow-pond.com

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Salinas, CA 93901
(831) 422-9693
Fax: (800) 482-4240

Electronic Alarms/ultrasonic and sonic devices

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215 South McKay
Spring Valley, WI 54767 US
800-729-8056
Fax: 715-778-5633
Email: barons@svtel.net

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Fax (403) 652-3511
info@margosupplies.com

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Exploders, Automatic Gas

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310-527-8000,
Fax: 310-527-8005
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1-888-422-DEER (3337)
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PO Box 31510
Stockton, CA 95213
Fax: 978-983-8449

Harmon International Co.
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Minot, ND 58702
(701) 839-6717
Fax: (701) 859-8679

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(800) 647-5554
Fax: (662) 335-8850

Southern Aquaculture Supply
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870-265-3584
fax: 870-265-4146
www.southernaquaculturesupply.com

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Salinas, CA 93901
(831) 422-9693
Fax: (800) 482-4240

WildLife Control Technology
2501 N. Sunnyside Avenue
Fresno, CA 93727
(800) 235-0262
(559) 490-2262
(559) 490-2260 (Sales fax)
(559) 490-2274 (Service fax)
http://www.wildlife-control.com
wct@wildlife-control.com

Kites

Bird Barrier America, Inc.
20925 Chico Street,
Carson, CA 90746, USA
800-503-5444
310-527-8000,
Fax: 310-527-8005
www.birdbarrier.com

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9735A Bethel Road
Frederick, MD 21702
(301)694-6072
1-888-422-DEER (3337)
Fax:(301)694-9254
www.deer-buster.com

Raven Industries, Inc.
P.O. Box 1007
Sioux Falls, SD 57117
605/335-2750
www.ravenind.com

Sutton Ag Equipment
746 Vertin Ave.
Salinas, CA 93901
(831) 422-9693
Fax: (800) 482-4240

W. Atlee Burpee Seed Co.
Warminster, PA 18974
215/674-4900

Lights, (flashing, Revolving)

Animal Control Products
P.O. Box 398
215 South McKay
Spring Valley, WI 54767
800-729-8056
Fax: 715-778-5633
Email: barons@svtel.net

Bird-X
300 N. Elizabeth St.

Chicago, IL 60607
800-662-5021
Fax: 312-226-2473
www.bird-x.com

Pest Bird & Animal Control
1 - 877 266 3532
www.pest-bird-animal-control.com

Tripp-Lite Mfg. Co.
1642 Besly Ct.
Chicago, IL 60622
(773) 384-7765

Wildlife Management Supplies
9435 E. Cherry Bend Rd.
Traverse City Michigan 49684
(800) 451-6544
Fax: (231) 947-9919
www.crittercontrol.com

Lines and Tapes

Animal Control Products
P.O. Box 398
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Fax: 715-778-5633

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Washington, DC 20007
(202) 338-6263
(800)662-4737
Fax: (202) 338-6268

Bird-X
300 N. Elizabeth St.
Chicago, IL 60607
800-662-5021
Fax: 312-226-2473
www.bird-x.com

Better Pest Control Inc.
(718)714-4444

(888)229-0102
www.pestpest.com

DeerBusters
9735A Bethel Road
Frederick, MD 21702
(301)694-6072
1-888-422-DEER (3337)
Fax:(301)694-9254
www.deer-buster.com

Fly-Bye
(800)820-1980
www.flyebye.com

Nishizawa USA, Ltd
(raw materials)
19301 Pacififc Gateway Dr.
Torrance, CA 90502
(301) 532-7407
Fax: (301) 532-7408

Pest Bird & Animal Control
1 - 877 266 3532
www.pest-bird-animal-control.com

Reed-Joseph International Co.
Box 894
Greensville, MS 38702
(662) 355-5822
(800) 647-5554
Fax: (662) 335-8850

Snow Pond Farm Supply
699 Adams Street
P.O. Box 115
North Abington, MA 02351
781-878-5581
Fax781-878-5398
www.snow-pond.com

Sutton Ag Equipment
746 Vertin Ave.
Salinas, CA 93901
(831) 422-9693
Fax: (800) 482-4240

Ted Dodge Service
7604 Michel Rd.
Mountain Ranch, CA 95246
(209) 754-1216

WildLife Control Technology
2501 N. Sunnyside Avenue
Fresno, CA 93727

(800) 235-0262
(559) 490-2262
(559) 490-2260 (Sales fax)
(559) 490-2274 (Service fax)
http://www.wildlife-control.com
wct@wildlife-control.com

Wildlife Management Supplies
9435 E. Cherry Bend Rd.
Traverse City Michigan 49684
(800) 451-6544
Fax: (231) 947-9919
www.crittercontrol.com

Pyrotechnic Devices

Bird Barrier America, Inc.
20925 Chico Street,
Carson, CA 90746, USA
800-503-5444
310-527-8000,
Fax: 310-527-8005
www.birdbarrier.com

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9735A Bethel Road
Frederick, MD 21702
(301)694-6072
1-888-422-DEER (3337)
Fax:(301)694-9254

Margo Supplies LTD.
P.O. Box 5400
High River, Alberta, Canada T1V 1M5
Tel. (403) 652-1932
Fax (403) 652-3511
info@margosupplies.com

Reed-Joseph International Co.
Box 894
Greensville, MS 38702
(662) 355-5822
(800) 647-5554
Fax: (662) 335-8850

Stoneco, Inc.
Box 765
Trinidad, Co 81082
(719) 846-2853
Fax: (719) 846-7700

Sutton Ag Equipment
746 Vertin Ave.
Salinas, CA 93901
(831) 422-9693
Fax: (800) 482-4240

Western Display Fireworks
P.O. Box 932
Canby, Oregon 97013
(800) 628-6529
(503) 656-1999
Fax: (503) 656-6628
E-Mail: sales@westerndisplay.com

Wildlife Control Technology
2501 N. Sunnyside Avenue
Fresno, CA 93727
(800) 235-0262
(559) 490-2262
(559) 490-2260 (Sales fax)
(559) 490-2274 (Service fax)
http://www.wildlife-control.com
wct@wildlife-control.com

Scare Eyes

Bird Scare Predator Eye™ Inc.
132 East Demont Ave, Suite 122
St. Paul, MN 55117 USA
Phone: 651-482-1123
Fax: 651-482-1241

Bird Barrier America, Inc.
20925 Chico Street,
Carson, CA 90746, USA
800-503-5444
310-527-8000,
Fax: 310-527-8005
www.birdbarrier.com

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Chicago, IL 60607
800-662-5021
Fax: 312-226-2473
www.bird-x.com

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1-888-422-DEER (3337)
Fax:(301)694-9254
www.deer-buster.com

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(800)820-1980
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Fax (403) 652-3511
info@margosupplies.com

Nixalite of America
1025 16th Ave.
box727
East Moline, IL 61244-0727
(309) 755-8771
(800)624-1189
Fax: (309)755-0077

Raven Industries, Inc.
P.O. Box 1007
Sioux Falls, SD 57117
605/335-2750
www.ravenind.com

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Box 894
Greensville, MS 38702
(662) 355-5822
(800) 647-5554
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North Abington, MA 02351
781-878-5581
Fax781-878-5398
www.snow-pond.com

Sutton Ag Equipment
746 Vertin Ave.
Salinas, CA 93901
(831) 422-9693
Fax: (800) 482-4240

W. Atlee Burpee Seed Co.
Warminster, PA 18974
215/674-4900

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2501 N. Sunnyside Avenue
Fresno, CA 93727
(800) 235-0262
(559) 490-2262
(559) 490-2260 (Sales fax)
(559) 490-2274 (Service fax)
http://www.wildlife-control.com

wct@wildlife-control.com

Wildlife Management Supplies
9435 E. Cherry Bend Rd.
Traverse City Michigan 49684
(800) 451-6544
Fax: (231) 947-9919
www.crittercontrol.com

Repellents
Methyl Anthranilate

Bird Shield Repellent Corporation
PO Box 141556
Spokane, WA 99214-1556
(509)924-9511
866-272-bird
Fax (509) 926-2046
www.birdshield.com

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300 N. Elizabeth St.
Chicago, IL 60607
800-662-5021
Fax: 312-226-2473
www.bird-x.com

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www.pest-bird-animal-control.com

Wildlife Management Supplies
`9435 E. Cherry Bend Rd.
Traverse City Michigan 49684
(800) 451-6544
Fax: (231) 947-9919Email: barons@svtel.net
www.crittercontrol.com

Polybutenes (sticky or tacky repellents)

AGRX
751 So. Rose Ave PO Box 2008
Oxnard, CA 93034
(805) 487-0696
Fax: (805) 385-4728

Animal Control Products
P.O. Box 398
215 South McKay
Spring Valley, WI 54767
800-729-8056
Fax: 715-778-5633
Email: barons@svtel.net

B&G Chemicals & Equipment Co.

Bird B Gone Inc (Bird Gel)
23918 Skyline
Mission Viejo, CA 92629
(800)-392-6915
www.birdbgone.com

Bird Busters
1083 Jefferson St. NW
Washington, DC 20007
(202) 338-6263
(800)662-4737
Fax: (202) 338-6268

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300 N. Elizabeth St.
Chicago, IL 60607
800-662-5021
Fax: 312-226-2473

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(301)694-6072
1-888-422-DEER (3337)
Fax:(301)694-9254
www.deer-busters.com

Hot Foot America, L.P.
PO Box 1339
Sasalido, CA 94966
(800) 533-8421
Fax: (415)789-0564

Integrated Pest Supply Inc
109-360 Edworthy Way
New Westminster, BC V3L 5T8 Canada
(604)-520-9900

J.C. Elrich Chemical Co.
500 Ridge Dr.
Reading, PA 19612
(215) 372-9700
(800)488-9495
Fax: (215) 378-9744

Nisus Corp.
215 Durvant Dr
Rockford, TN 37853
(800)264-0870
www.nisuscorp.com

Snow Pond Farm Supply
699 Adams Street
P.O. Box 115
North Abington, MA 02351
781-878-5581

Fax781-878-5398
www.snow-pond.com

Sutton Ag Equipment
746 Vertin Ave.
Salinas, CA 93901
(831) 422-9693
Fax: (800) 482-4240

Tanglefoot Co.
314 Straight Ave, SW
Grand Rapids, MI 49504-6485
(616) 459-4139
Fax: (616) 459-4100

Wildlife Management Supplies
9435 E. Cherry Bend Rd.
Traverse City Michigan 49684
(800) 451-6544
Fax: (231) 947-9919
www.crittercontrol.com

Irritants (taste)

Animal Control Products
P.O. Box 398
215 South McKay
Spring Valley, WI 54767 US
Email: barons@svtel.net
800-729-8056

Bird-X
300 N. Elizabeth St.
Chicago, IL 60607
800-662-5021
Fax: 312-226-2473
Fax: 715-778-5633
www.bird-x.com

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(888)229-0102
www.pestpest.com

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Mission Viejo, CA 92629
(800)-392-6915
www.birdbgone.com

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Frederick, MD 21702
(301)694-6072
1-888-422-DEER (3337)
Fax:(301)694-9254
www.deer-busters.com

Miller Chemistry and Fertilizer Corp
PO Box 333 Radio Rd
Hanover, PA 17331
(800)233-2040

Pest Bird & Animal Control
1 - 877 266 3532
www.pest-bird-animal-control.com

Burlington Scientific Corp.
222 Sherwood Ave.
Farmingdale, NY 11735
(516)694-9000 `

Snow Pond Farm Supply (Goose repellent)
699 Adams Street
P.O. Box 115
North Abington, MA 02351
781-878-5581
Fax781-878-5398
www.snow-pond.com

J.C. Ehrlich Chemical Co
500 Spring Ridge Drive
Reading, PA 19612-3848
(800) 488-9495
Fax (610) 378-9744
email: CustomerServiceRespond@jcehrlich.com

Wildlife Management Supplies
9435 E. Cherry Bend Rd.
Traverse City Michigan 49684
(800) 451-6544
Fax: (231) 947-9919
www.crittercontrol.com

Roost Inhibitors

Animal Control Products
P.O. Box 398
215 South McKay
Spring Valley, WI 54767 US
Email: barons@svtel.net
800-729-8056
Fax: 715-778-5633

Bird Guard
100 State St Suite 312
Erie, PA 16507
(800) 331-2973
www.birdgaurd.com

Bird-X
300 N. Elizabeth St.
Chicago, IL 60607

800-662-5021
Fax: 312-226-2473
www.bird-x.com

Pest Bird & Animal Control
1 - 877 266 3532
www.pest-bird-animal control.com

Southern Aquaculture Supply
931 Saint Mary's Street
Lake Village, Arkansas 71653
800-850-7274
870-265-3584
fax: 870-265-4146
www.southernaquaculturesupply.com

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9435 E. Cherry Bend Rd.
Traverse City Michigan 49684
(800) 451-6544
Fax: (231) 947-9919
www.crittercontrol.com

Toxicants

4-aminopyridine

(See Frightening Devices

Starlicide Complete

Fischer's Mill Inc.
210 N South
Kingston WI
920-394-9335

Central Wisconsin Coop
Stratford WI
(715)687-4136

Purina Mills, Inc.
1401 S Hanley Rd.
St.Louis,MO 63144
(314) 768-4100

Marathon Town and Country Store
Wausau WI
(715)675-1700

Compound DRC 1339

Pocatello Supply Depot
UDSA-APHIS-Animal Damage Control
238 E. Dillon St.
Pocatello, ID 83202
(208) 236-6920
Fax: (208) 236-6922

Traps (Live Catch)

House Sparrow

Animal Control Products
P.O. Box 398
215 South McKay
Spring Valley, WI 54767 US
Email: barons@svtel.net
800-729-8056
Fax: 715-778-5633

Fly-Bye
(800)820-1980
www.flyebye.com

Kness Mfg. Co.
Box 70 Hwy 5 S
Albia, IA 52531
(641) 932-7846
(800) 247-5062
Fax: (641) 932-2456

Last Perch
Box 430
Mitchellville, IA 50169
(515) 967-0295
Fax: (515) 967-2207

Tomahawk Live Trap Co.
Box 323
Tomahawk, Wi 54487
(715)453-3550
(800)27-A-TRAP
Fax: (715)-453-4326

Wildlife Management Supplies
9435 E. Cherry Bend Rd.
Traverse City Michigan 49684
(800) 451-6544
Fax: (231) 947-9919
www.crittercontrol.com

Pigeon

Animal Control Products
P.O. Box 398
215 South McKay
Spring Valley, WI 54767 US
Email: barons@svtel.net
800-729-8056
Fax: 715-778-5633

Fly-Bye
(800)820-1980
www.flyebye.com

Kness Mfg. Co.
Box 70 Hwy 5 S
Albia, IA 52531
(641) 932-7846

(800) 247-5062
Fax: (641) 932-2456

Tomahawk Live Trap Co.
Box 323
Tomahawk, Wi 54487
(715)453-3550
(800)27-A-TRAP
Fax: (715)-453-4326

Wildlife Management Supplies
9435 E. Cherry Bend Rd.
Traverse City Michigan 49684
(800) 451-6544
Fax: (231) 947-9919
www.crittercontrol.com

Starling

Fly-Bye
(800)820-1980
www.flyebye.com

Wildlife Management Supplies
9435 E. Cherry Bend Rd.
Traverse City Michigan 49684
(800) 451-6544
Fax: (231) 947-9919
www.crittercontrol.com

Stupefying Agents (alpha-chloralose)

Pocatello Supply Depot
UDSA-APHIS-Animal Damage Control
238 E. Dillon St.
Pocatello, ID 83202
(208) 236-6920
Fax: (208) 236-6922

MAMMAL DAMAGE CONTROL

Bat Exclusion

Allen Special Products Inc.
Box 605
Montgomeryville, PA 18936
(800) 848-6805
Fax: (215) 997-6654

Bay Area Bat Protection
1312 Shiloh Rd.
Sturgeon Bay, WI 54235
920-743-9049

Chim-a-Lator Co.
5205 208th St
Farmington, MN 55024
800-729-9505

651-460-1080
Fax: 651-460-6080

InterNet Inc.
2730 Nevada Ave.
Minneapolis, MN 55427
(612)541-9690
(800) 328-8456
Fax: (612) 541-9692

Wildlife Control Supplies
P.O. Box 653, Simsbury, CT 06070
Order Toll Free: 877-684-7262
860-844-0101
Fax: 860-844-0102
www.wildlifecontrolsupplies.com

WildLife Control Technology
2501 N. Sunnyside Avenue
Fresno, CA 93727
(800) 235-0262
(559) 490-2262
(559) 490-2260 (Sales fax)
(559) 490-2274 (Service fax)
http://www.wildlife-control.com
wct@wildlife-control.com

Bear Resistant Containers

Garcia Machine
(559) 732-3785
Fax: (559) 732-5010
Email: gmachine@psnw.com

Browsing Mammal Exclusion Devices
(*Plastic Tubes Tree Wraps Netting)*

American Forestry Technology Inc.
7852 W. 200 S.
West Point, IN, 47992
(765) 572-1212
Fax: (765) 572-1222
E-mail address: aft@nlci.com

Do-It-Yourself Pest Control, Inc.
2823 Chamblee-Tucker Rd.
Atlanta, Ga. 30341
770-458-5090
Fax- 770-454-0242
1-800-476-3368

Wildlife Control Supplies
P.O. Box 653, Simsbury, CT 06070
Order Toll Free: 877-684-7262
860-844-0101
Fax: 860-844-0102
www.wildlifecontrolsupplies.com

Electric Fencing

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P.O. Box 708900
San Antonio, Texas 78270
1-800-531-5908
Main Phones: 210-494-5211
Fax 210-494-9364

DeerBusters
9735A Bethel Road
Frederick, MD 21702
(301)694-6072
1-888-422-DEER (3337)
Fax:(301)694-9254

Margo Supplies LTD.
P.O. Box 5400
High River, Alberta, Canada T1V 1M5
Tel. (403) 652-1932
Fax (403) 652-3511
info@margosupplies.com

APPENDIX 15: PERSONAL PROTECTIVE EQUIPMENT SOP.

National Wildlife Research Center
Standard Operating Procedure

Title: Personal Protective Equipment	***Number:*** HS 004.00 ***Effective date:*** JUN 15 1998
	Replaces: A-31.R2
Prepared by: Steven J. Greiner [signature] ***Date:*** 6/8/98	**QAU:** [signature] 6/8/98

1.0 PURPOSE

1.1 To ensure proper personal protective equipment (PPE) is provided, appropriately used, and maintained in a reliable condition to effectively protect employees from hazards present in their work environment.

2.0 AUTHORITY

2.1 Code of Federal Regulations (CFR) Title 29, Parts 1910.132 to 138: Subpart I - Personal Protective Equipment (OSHA).

3.0 PROCEDURES

3.1 Adequate and safe protective equipment for eyes, face, head, extremities, clothing, and respiration will be provided, used, and maintained in a sanitary and reliable condition wherever it is necessary to prevent injury or impairment from absorption, inhalation, or physical contact. To ensure maximum protection, the materials used in protective equipment will be specific for the type, intensity, and duration of potential hazards. Defective or damaged equipment will not be used. Employees will notify their supervisor of any specific concerns or personal needs regarding protective equipment.

3.2 Supervisors will be responsible for ensuring work areas are assessed to determine the actual and potential hazards which may reasonably exist, along with the proper PPE to be used in that area to protect employees from those hazards. Workplace hazard assessment documentation will include the identity of the work area, the date the assessment was performed, and a certification by the evaluator to verify the workplace was assessed (Attachment 1). Contact the NWRC Safety Officer for guidance concerning the assessment of hazards or the selection and use of PPE.

3.3 All PPE will be maintained for maximum effectiveness against the hazard(s) for which it is designed. Periodic inspections and preventive maintenance should be performed to ensure the equipment is in proper working condition (see instruction manual for specific procedures). Protective equipment which is defective, worn, or damaged to the extent that which it is no longer effective will be taken out of service for repair or replacement. All protective equipment to be used for emergency situations will be kept in a highly visible and readily accessible location.

3.4 **Training**

3.4.1 Supervisors will be responsible for ensuring that each employee who wears PPE is trained (documentation required) and demonstrates an understanding of the following:

a. When PPE is necessary.
b. What PPE is necessary.
c. How to properly put-on, take-off, adjust, and wear PPE.
d. The limitations of the PPE.
e. The proper care, use, maintenance, useful life, and disposal of the PPE.

3.4.2 Training documentation will include the names of the employees trained, the date of the training, a list of the subjects taught, and a certification by the instructor to verify that those employees have received and understood the required training. Re-training will occur whenever new forms of PPE or hazards are brought into the work area. Contact the NWRC Safety Officer for training materials or guidance.

3.5 **Requirements for Specific Types of PPE:**

3.5.1 Appropriate eye and face protection will be selected to protect against the specific hazard(s) which may be encountered in the work area (e.g., chemical splashes, vapors, flying particles, dust, sparks, or intense light). Minimum requirements for filter lenses must be worn during different types of welding operations. The employer must accommodate those employees who wear corrective lenses with either prescription eye protection or appropriate protection to cover prescription lenses. All protective equipment for the eyes and face must comply with American National Standard Institute (ANSI) minimum specifications.

3.5.2 Protective helmets will be worn in the working area whenever there exists a reasonable potential for falling objects, or where the head may be exposed to overhead electrical hazards. All protective equipment for the head must comply with ANSI minimum specifications.

3.5.3 Protective footwear will be worn in work areas where there exists a reasonable potential for falling or rolling objects, objects capable of piercing the sole, or where the feet may be exposed to ground level electrical hazards. All protective equipment for the feet must comply with ANSI minimum specifications.

3.5.4 Protective equipment for the hands or skin will be worn in work areas where there exists a reasonable potential for skin absorption of harmful substances, severe cuts, lacerations, abrasions, punctures, chemical burns, or temperature extremes. Employees will use only those protective gloves and clothing which provide the maximum protection against the specific hazard(s) being handled.

3.5.5 Employees who work in atmospheres which contain chemical concentrations above the "Permissible Exposure Limits" (see 29 C.F.R. §1910.1000), will be equipped with respiratory protection. Respirator cartridges are specific for individual or groups of chemicals. Employees should read all manufacturer's instructions and warnings before use. See NWRC Standard Operating Procedure HS 003 "Respiratory Protection".

3.5.6 Employees who work in areas where there exists a sustained noise at 85 decibels or above for 8 hours a day or at a time weighted average equivalent will use appropriate hearing protection and participate in periodic hearing exams.

4.0 ATTACHMENTS

Attachment 1: APHIS form 270-R: APHIS Hazard Assessment Form

HS 004.00
Attachment 1

U.S. Department of Agriculture
Animal and Plant Health Inspection Service

APHIS HAZARD ASSESSMENT FORM

In accordance with 29 Code of Federal Regulations, Part 1910, Subpart I, Personal Protective Equipment, APHIS facilities are required to perform health hazard assessments to identify those work practices and areas which require personal protective equipment. The assessments must be documented and should be performed in conjunction with required safety and health inspections. This form is intended to provide managers and supervisors with documentation of the assessments. The

Name of Inspector: ____________________ **Date of Inspection:** __________
Position or Title: ____________________
Work Location(s): ____________________ **Type of Work Activity:** ____________________

1. Eye and Face Protective Equipment: Equipment includes safety glasses, goggles, face shields, welding helmets, etc. In addition to other areas, eye protective devices are required where employees work with corrosive chemicals or other hazardous substances, machine or hand tools, welding, cutting, soldering, or grinding equipment, woodworking equipment, or are potentially exposed to ultraviolet radiation, infra-red radiation, or hazardous gases, mists, fumes, or dust.

Identify Areas or Work Practices Requiring Eye or Face Protection and the Type of Equipment Needed:

2. Head Protective Equipment: Equipment includes hard hats, bump caps, and liners. Head protective equipment is required to protect workers from impact or penetration from falling or flying objects, overhead hazards, and from limited electric shock and burn hazards. Common areas requiring head protection include maintenance and work areas where low ceilings, beams, or overhead hazards exist, construction sites, etc.

Identify Areas or Work Practices Requiring Head Protective Equipment and the Type of Equipment Needed:

3. Foot Protection: Equipment includes steel-toe boots, work rubbers, overboots, shoe chains, metatarsal guards, foot guards, toe guards, etc. Foot protective equipment is required in areas where there is a danger of foot injuries due to falling or rolling objects, or objects piercing the sole, or where electrical hazards exist.

Identify Areas or Work Practices Requiring Foot Protection and the Type of Equipment Needed:

4. Hearing Protection: Equipment includes ear plugs, canal caps, and ear muffs. The attenuation characteristics of a particular hearing protector must be considered before it is used for a specific application. When selecting a hearing-protective device, the supervisor or manager should also consider the frequency of exposure to excessive noise. If exposure is relatively infrequent (once a day or once a week), an insert or plug will probably satisfy the requirement. However if the noise exposure is relatively frequent the ear muff protector might be preferable. Facilities must comply with the requirements of 29 CFR, 1910.95, Hearing Conservation if employees are exposed to noise above allowable limits.

Identify Areas or Work Practices Requiring Hearing Protection and the Type of Equipment Needed:

5. Protective Clothing: Includes chemical splash suits, disposable clothing, protective aprons, lab coats, insulating workwear, etc. Protective clothing may be required for employees who work with hazardous chemicals or substances, or when working in extreme environments, such as extremely cold conditions.

Identify Areas or Work Practices Requiring Protective Clothing and the Type of Equipment Needed:

______________________ ______________________
______________________ ______________________
______________________ ______________________

6. Respiratory Protection: Equipment includes air-purifying respirators, disposable respirators, airline respirators, self-contained breathing apparatus, and emergency escape apparatus. Respirators are used as protection against contaminants where engineering and administrative controls are not feasible. Respiratory protection is required to reduce or eliminate injuries caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors. Work practices typically requiring respiratory protection include laboratory work, welding, cutting or brazing, handling hazardous chemicals or substances, and during pesticide application or fumigation.

See Chapter 11, Section 3 of the APHIS Safety and Health Manual and 29 CFR, Section 1910.134 for additional requirements.

Identify Areas or Work Practices Requiring Respiratory Protection and the Type of Equipment Needed:

______________________ ______________________
______________________ ______________________
______________________ ______________________

7. Electrical Protective Equipment: Equipment includes rubber insulating gloves, rubber matting for use around electric apparatus, rubber insulating blankets, hoods, hoses, and sleeves. Equipment is required for electrical workers. Equipment must conform to the requirements established by the American Society for Testing and Materials, and the American National Standards Institute.

Identify Areas or Work Practices Requiring Electrical Protective Equipment and the Type of Equipment Needed:

______________________ ______________________
______________________ ______________________
______________________ ______________________

8. Other Protective Devices: Other items such as antidote kits, poison kits, and portable first aid kits are also considered protective devices.

Identify Areas or Work Practices Requiring Other Protective Devices and the Type of Equipment Needed:

______________________ ______________________
______________________ ______________________
______________________ ______________________

APHIS Form 270-R

APPENDIX 16: EUTHANASIA PROCEDURES: AMERICAN VETERINARY MEDICAL ASSOCIATION.

See 2000 Report of the AVMA Panel on Euthanasia. JAVMA, Volume 218, No. 5. March 1, 2001. Pages 669-696.