U.S. Fish & Wildlife Service

Webless Migratory Game Bird Research Program

Project Abstracts – 2008

Sandhill cranes from the Rocky Mountain Population at Grays Lake National Wildlife Refuge, Idaho. Abstract on page 32. *Photo by Steve Sherman.*

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compiled by David D. Dolton
Project Officer

U.S. Fish and Wildlife Service
Division of Migratory Bird Management
PO Box 25486 DFC
Denver, CO 80225-0486

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History and Administration of the Webless Migratory Game Bird Research Program, 1995-2008

DAVID D. DOLTON, U.S. Fish and Wildlife Service, Office of Migratory Bird Management, PO Box 25486 DFC, Denver, CO 80225-0486, USA (David_Dolton@fws.gov)

HISTORY

Introduction

The Webless Migratory Game Bird Research (WMGBR) Program was established in December 1994 with the first projects being funded in 1995. It was designed to provide cooperative funding from the U.S. Fish and Wildlife Service (USFWS), state wildlife agencies, and other sources for research on migratory game birds other than waterfowl (e.g., doves, pigeons, cranes, woodcock, snipe, and rails). Information from these studies will be used to more effectively manage these Awebless@ species.

Formation of the program was not easy and what follows is an attempt to document the events and the individuals associated with it=s evolution. This historical overview was derived primarily through use of unpublished minutes from meetings between 1984 and 1995 of the Migratory Shore and Upland Game Bird (MSUGB) Subcommittee (named Committee between 1991-1996) of the International Association of Fish and Wildlife Agencies (IAFWA). The WMGBR Program is similar to the preceding Accelerated Research Program which was discontinued in 1982. After its formation in 1984, the MSUGB Subcommittee worked for 9 years to reinstate a research program for migratory shore and upland game birds. These efforts were realized finally when H. Ronald Pulliam, Director of the National Biological Survey (NBS; now U.S. Geological Survey-Biological Resources Division), contributed $300,000 for the program for FY1995/96. Subsequently, John G. Rogers, Deputy Director of the USFWS, authorized the Division of Federal Aid to allocate $150,000 per year as an annual funding item for the program beginning in FY1996. In FY1998, the USFWS contributed $300,000 for the WMGBR Program, thanks to the efforts of Paul R. Schmidt and Robert Blohm (USFWS) who worked to get an additional $150,000 for the Program in the budget for the Office [now Division] of Migratory Bird Management (DMBM)]. Beginning in FY1999, however, only $150,000 from the DMBM budget was available. In 2003 and 2004, funding was suspended due to budget limitations. Funding was reinstated in 2005 at a level of $250,000 ($30,000 of which was obligated for webless projects in the Northeast annually from 2005-07.) In 2008, $280,000 was available.

The Accelerated Research Program, 1967-82

The history of the Accelerated Research Program (ARP) was documented by MacDonald and Evans (1970). In July 1967, Congress appropriated $250,000 for the program. Support for this appropriation came from the Southeastern Association of Game and Fish Commissioners and the International Association of Game, Fish, and Conservation Commissioners (predecessor to the IAFWA). Also, Leonard E. Foote (Wildlife Management Institute) was instrumental in development of and gaining support for the program (R.E. Tomlinson, USFWS, personal communication). Internal support within the USFWS (then Bureau of Sport Fisheries and Wildlife) came principally from Walter F. Crissey, Director of the Migratory Bird Population Station (MBPS); significant input for justifying the program was provided by Aelred D. Geis, William H. Goudy, Howard M. Wight, and Roy E. Tomlinson (H.M. Reeves, USFWS, personal communication). Subsequent to the appropriation, the International Association created a National Program Planning Committee for Shore and Upland Game Birds (later known as the National Program Planning Group [NPPG]). The ARP was designed to provide funding for migratory shore and upland game bird research. The NPPG was formed to solicit, screen, and select projects for funding under the program (Sanderson 1977).

Congressional funding of the ARP was $250,000 annually. Of this total, $175,000 was contracted to states; $50,000 was used directly by the USFWS to support 2 field stationsCone in Maine to study American woodcock and one in South Carolina to study mourning doves; and, $25,000 was retained by the USFWS to administer the program. William Russell was the first biologist at the Maine woodcock station followed by William Krohn. Spencer Amend initiated the dove study in South Carolina, followed by George Haas. The dove study site was later moved to Georgia. Henry M. Reeves administered the program until March 1968 when Duncan MacDonald was hired for this purpose. In 1971, Fant Martin took over, followed in 1975 by Richard Coon and in 1980 by Thomas Dwyer.

In the 16 years the program was in operation (1967-82), 122 research projects were completed in 41 states. Over the years, funding for state projects amounted to about $2.5 million. The ARP ended in October 1982 when funding for the program was eliminated, primarily because of fiscal constraints upon the USFWS.

Formation of the Migratory Shore and Upland Game Bird Subcommittee

When the ARP was terminated, the NPPG, which served as an advisory group for the ARP, became inactive in 1982. Consequently, a new group was deemed necessary for focusing attention on MSUGB issues. Accordingly, and largely due to the efforts of Roy Tomlinson (USFWS), and Ronnie George and Ted Clark (Texas Parks and Wildlife Department), the MSUGB Subcommittee was established in 1984 by Mr. Clark, who was Chairman of the IAFWA=s Migratory Wildlife Committee. The Subcommittee quickly became a force in migratory bird management.

Development of the Webless Migratory Game Bird Research Program

After its formation, the MSUGB Subcommittee sought to obtain information about the contributions made through the ARP and to determine whether or not the state wildlife agencies wanted to support Subcommittee efforts to have it reinstated. Clait Braun (Colorado Division of Wildlife) outlined 20 specific benefits of ARP to state wildlife agencies (letter attached to MSUGB Subcommittee minutes, March 1985). In summary, he showed that ARP facilitated substantial interchange of ideas among individuals working within regions and different agencies, which greatly expanded our knowledge about this important group of birds.

In 1985, Ronnie George, Chairman of the MSUGB Subcommittee, conducted a survey of all state wildlife agency directors about current MSUGB research needs and the ARP; all 50 states responded to the questionnaire. Results were summarized in a March 1986 report by Mr. George, entitled *Results of the Accelerated Research Program Questionnaire*. All but 3 states indicated MSUGB needs that had not been addressed to date. Thirty-two states felt that [future] MSUGB research needs could best be undertaken through combined USFWS and state wildlife agency funding. Forty-seven states believed ARP served a useful purpose considering the cost, and 49 states favored reestablishment of ARP (or a similar program) as a Congressionally-funded *addition* to the USFWS budget. Only 17 states, however, gave unqualified approval to redirecting current USFWS funds to an ARP-type program.

In a second March 1986 report, entitled *Summary of Accelerated Research Program Publications by Region and State*, Mr. George listed references for 340 publications known to have directly resulted from ARP. One of the most significant contributions was the book, *Management of Migratory Shore and Upland Game Bird Species in North America* (Sanderson 1977). These publications detail the wealth of information that was learned through the research program.

After confirming that state agencies had been pleased with the program and desired a similar program to be organized, the MSUGB Subcommittee passed a resolution in March 1986 asking the IAFWA to support reestablishment of ARP (or a similar program) as a Congressionally-funded $350,000 annual addition to the USFWS budget. The IAFWA also passed the resolution, but did not take further action because they did not feel the timing was right. At the March 1988 MSUGB Subcommittee meeting, a USFWS representative stated that the need exists for such a program, but that the USFWS was faced with rather severe budget limitations and there was a reluctance by the current administration to initiate new funding activities. He also stated that to effect such a resumption, enthusiasm and pressure from the Subcommittee was necessary. Consequently, another motion was made for the current Chairman, Kenneth Babcock, to reiterate the need for immediate study on several declining populations and ask the IAFWA Budget Committee to address those concerns when they testified before Congress on budget considerations. Once again, the IAFWA voiced support of their efforts but decided it was not the appropriate time to make a request before Congress.

In March 1990, a different strategy was undertaken by the Subcommittee, whereby Chairman Babcock was asked to write directly to Director John Turner of the USFWS, pointing out the success of the past program, the current needs, and requesting the addition of a $350,000 line item by the USFWS. Two letters eventually were written. In the telephone reply to the second letter, Deputy Director Richard Smith indicated that the USFWS would consider the request in its 1992 budget deliberations.

At the March 1991 MSUGB Committee (new name) meeting, Mr. Babcock reported that Max Peterson, Executive Vice President of the IAFWA, acted on their past recommendations and provided testimony before the House Appropriations Committee for the FY1992 budget. In this testimony, the IAFWA strongly recommended addition of $350,000 to the USFWS budget for the development of a research program to address existing data deficiencies on webless migratory game birds. Subsequent to the meeting, Chairman Babcock contacted directors of all state wildlife agencies to urge their congressional delegations to support the add-on to the budget. Many state agencies did contact their delegations. Mr. Peterson then testified before the USFWS Appropriations Subcommittee and asked that they add an item to the budget specifically for this work. Unfortunately, these efforts failed.

In 1992, the MSUGB Committee decided to change direction and develop a proposal for an entirely new program that would be submitted to the USFWS. Chairman Babcock (personal communication) then asked John H. Schulz (Missouri Department of Conservation) to take the lead in formulating a proposal for a fresh type of research effort. Although his name did not appear on the document, Mr. Schulz prepared the first draft of a proposal, entitled *Proposal for a Webless Game Bird Research Program*, with input from others. According to Schulz (personal communication), Roy Tomlinson (USFWS) provided the most detailed and lengthy comments, while substantive comments were also provided by Clait Braun, Richard Jachowski (NBS), Thomas Tacha (Texas A&M University-Kingsville), and Ronnie George. The proposal was distributed to MSUGB Committee members for review in August 1992. In the package, the USFWS was asked to establish an annual, line-item-funded research program for migratory shore and upland game bird species. One significant difference from earlier efforts was a request of $750,000 that would fund cooperative state-federal studies. These monies were envisioned to be matched at some level with state or other funding. It was suggested that 12.5% of the funds allocated for such a program be retained by the USFWS for administrative costs. The proposal package included a detailed screening process utilizing committees to review and prioritize submitted proposals. The MSUGB Committee would then review the lists and recommend studies to the USFWS for funding. A suggestion was made to give greater weight to studies supported by population management plans. After input from MSUGB Committee members, a revised proposal was sent to all state wildlife agency directors and USFWS Director Turner on 10 December 1992. The USFWS replied favorably to the plan on 18 March 1993, but several concerns were expressed in an attached review of the proposal by the Office of Migratory Bird Management. Chairman Babcock expressed his appreciation to the USFWS in a letter dated 28 May 1993, and offered suggestions for resolving the concerns raised.

The MSUGB Committee decided in September 1993 to recommend that an ad hoc Task Force, consisting of 2-3 committee members and an equal number from the USFWS, be formed to work out the details of a final joint proposal. The USFWS concurred. Subsequently, Ronnie George was named Chairman of the Task Force with the following members: Duane Shroufe (Arizona Game and Fish Commission), Cal DuBrock (Pennsylvania Game Commission), Roy Tomlinson [David Dolton replaced Roy after his retirement in June 1994] and Robert Blohm (USFWS), and Russell Hall (NBS). This group met to finalize the proposal for a webless research program, and developed details for a review process and evaluation criteria for research proposals under the program.

In August of 1994, Kenneth Babcock met with USFWS Director Mollie Beattie to urge her support for the webless research program. Also, he met with Ronald Pulliam and F. Eugene Hester (NBS) to enlist their support (K. M. Babcock, personal communication). The effort was successful. Mr. Babcock stated that Noreen Clough (who worked in the Director=s Office at the time) helped arrange the meeting and that Paul Schmidt (Chief, MBM) helped set the stage by briefing the Director beforehand.

On 13 September 1994, Ronnie George transmitted the final version of *Recommendations for a Webless Migratory Game Bird Research Program*, prepared by the Webless Migratory Game Bird Research Task Force, to MSUGB Committee Chairman Kenneth Babcock.

Key recommendations included the designation of 4 Technical Committees to evaluate proposals, a WMGBR Review Committee appointed by the MSUGB Committee to make the final project selection, the designation of a Project Officer within MBM to coordinate this activity, a USFWS budget line item of $750,000 annually, and that the United States Congress be urged to pass a budget, including a Webless Migratory Game Bird Research Program.

The efforts and persistence of the MSUGB Committee finally came to fruition in the fall of 1994 when funding became available, as stated in the Introduction. One stipulation was that 1/3 of the project cost must come from non-federal dollars. Also, funds were to be given for the life of the project rather than for just one year, as was done under the ARP.

Even though the amount of funding was not at the level recommended in the original proposal, the WMGBR Program has been successful thus far. MBM absorbed the administrative cost of the program without taking any of the research funds and designated David Dolton as Project Officer and program coordinator.

Another key contribution made by the MSUGB Committee was the publication of the book entitled *Migratory Shore and Upland Game Bird Management in North America* (Tacha and Braun 1994). This was a revised and updated version of the book edited by Sanderson (1977). As stated in the Preface to the book, key individuals responsible for planning, authorship selection, and other aspects of the publishing process included the editors and ad hoc committee members T. C. Tacha, C. E. Braun, J. M. Anderson, R. R. George, and R. E. Tomlinson. Authors of individual chapters were recognized authorities in their field. Immediately after publication, the book began to serve as a guide for research on species described therein.

There remains support to increase funding to the level originally recommended. On 26 July 1996, and again on 28 July 2000, the 4 Flyway Councils passed a Joint Recommendation requesting that the USFWS and the National Biological Service [USGS in 2000 version] seek additional revenue to fully fund the WMGBR Program at the recommended level of $750,000 per year. In December 1998, an IAFWA Ad Hoc Committee on Migratory Bird Funding met with USFWS personnel in Washington, D.C. to discuss funding needs for migratory birds. One of the recommendations was to fund the WMGBR Program at the full recommended level.

WMGBR PROGRAM ADMINISTRATION

At least 1/3 of the total project cost must be paid with non-federal dollars. In-kind services, such as salaries of state employees and vehicle expenses, are acceptable as matching funds. Study proposals may be on any webless migratory game bird topic identified as a research need in a national, regional, or state management plan or other document, or in the 1994 book entitled *Migratory Shore and Upland Game Bird Management in North America.* Additionally, a letter of support is required for each proposal from the state in which it originates.

A call for proposals is distributed by the USFWS Project Officer in July each year to USFWS Flyway Representatives and Migratory Bird Coordinators, and USGS-Biological Research Division (BRD) Regional Offices and the Cooperative Research Units office. Flyway Representatives are responsible for distributing the letter to biologists in their respective states. State biologists, in turn, are asked to send the information to other state personnel, universities, and any others who may be interested. Migratory Bird Coordinators forward the letter to National Wildlife Refuges and other federal offices. USGS-BRD Regional Offices are asked to forward the letter to all their respective Science and Technology Centers, while the Cooperative Research Units office distributes the call to all Cooperative Fish and Wildlife Research Units.

The review process is as follows. Proposals are sent by 15 November to the Project Officer for the program (David Dolton, USFWS/DMBM). He checks the proposals for budget and support letter compliance and sends these materials to 4 Regional Technical Committees (Appendix 1). These committees review all the proposals submitted within their respective region and provide David with an evaluation of each project. The evaluations are based upon criteria that have been developed for this program and also upon regional needs (Appendix 2). Additionally, the projects are ranked in priority order. A compilation of all evaluations and rankings, along with the proposals, are then sent to members of a WMGBR Review Committee for review. Ronnie George (Texas Parks and Wildlife Department) served as the first Chairman of the Review Committee from 1994-96. Committee members for 2008 included Bob Boyd, Chairman, (Pennsylvania Game Commission) and David Dolton (USFWS), along with the Chairmen of the 4 Technical Committees: Western: Mike Rabe

(Arizona Game and Fish Department); Central: John Schulz (Missouri Department of Conservation); Northeastern: Ed Robinson (New Hampshire Fish and Game Department); and Southeastern: Billy Dukes (South Carolina Department of Natural Resources).

In February, the WMGBR Review Committee discusses the evaluations and rankings, and selects projects for funding. Funds become available as soon as contracts can be completed and signed.

To date, $2,111,219 in WMGBR Program funds has been expended to support 53 research projects and 1 workshop with a total value of $8,090,964 (Table 1). Proceedings of the Marshbird Monitoring Workshop are available from David Dolton. The uneven Grand Total for WMGBR funds is due to NBS contributing an additional $5,578 to the program in 1996 and an unused $395 in 1999. Although not reflected in the Grand Total, USGS-BRD (formerly NBS) provided additional support in 1997, 1998, and 1999 by contributing a total of $30,000 directly to 3 of the projects selected. In 2003, 2 projects were selected for funding prior to the suspension of funds. Later, however, the U.S. Fish and Wildlife Service committed to fund one of the projects for $119,000 (pilot reward banding study of mourning doves) using other funds. Additionally, in order for 2 USGS studies to be completed, the USGS-BRD funded the second project on sandhill cranes ($30,900) along with another one on band-tailed pigeons ($19,215). For 2007, 9 proposals with a total value of $1,336,363 were received, requesting $475,254 in WMGBR funds.

The WMGBR Program is invaluable in providing much-needed funding for webless species who receive considerably less attention than waterfowl. The current level of funding will not begin to meet the needs identified in the 1994 management book mentioned previously, but it is a start. This is a very cost-effective program and it is hoped that funding can be increased in the future.

Table 1. Projects funded through the Webless Migratory Game Bird Research (WMGBR) Program, 1995-08.

Species	Number of projects	WMGBR Program funds	Total project cost
Mourning dove	14	$642,620	$2,479,051
American woodcock	11	$483,286[a]	$2,161,074
Marsh game birds	12	$358,274	$1,469,862
Band-tailed pigeon	8	$468,700[b]	$1,242,375
Sandhill crane	11	$379,624[c]	$1,497,446
White-winged dove	2	$51,862	$147,552
Marshbird Monitoring Workshop	–	$6,853[d]	–
GRAND TOTAL	58	$2,391,219[e]	$8,997,360

[a] An additional $13,000 was given to 1 project by the U.S. Geological Survey (Biological Resources Division) in 1997.

[b] An additional $11,000 was given to 1 project by the U.S. Geological Survey (Biological Resources Division) in 1998; $6,000 was given to 1 project in 1999; and, $19,215 was given to 1 project in 2003.

[c] An additional $30,900 was given to 1 project by the U.S. Geological Survey (Biological Resources Division) in 2003.

[d] An additional $6,046 was provided for the workshop by the the U.S. Geological Survey (Biological Resources Division) in 1998. Other funding support came from a variety of state and federal agencies, the Canadian Wildlife Service, and private organizations.

[e] The National Biological Service contributed $5,578 to the WMGBR Program in 1996.

ACKNOWLEDGMENTS

I am grateful for the comprehensive minutes prepared by R. E. Tomlinson for each meeting of the MSUGB Subcommittee between 1984 and 1994. Without them, a detailed historical account of events and programs would not have been possible. Additionally, I want to thank R. E. Tomlinson, J. H. Schulz, R. R. George, H.M. Reeves, R. J. Blohm, D. MacDonald, and K. M. Babcock for reviewing the first versions of this paper for the 1997 and 1998 reports, and providing information and suggestions for improvement.

LITERATURE CITED

Much of the information contained herein is from minutes and reports on file in the author=s USFWS office. Additionally, all remaining copies of Tacha and Braun (1994) are being stored there. Copies of either the minutes or the book can be obtained upon request.

MacDonald, D. and T.R. Evans. 1970. Accelerated research on migratory webless game birds. Transactions of the Thirty-fifth North American Wildlife and Natural Resources Conference. Wildlife Management Institute, Washington, D.C. 35:149-156.

Sanderson, G.C., editor. 1977. Management of migratory shore and upland game birds in North America. International Association of Fish and Wildlife Agencies, Washington, D.C. 358 pp.

Tacha, T.C., and C.E. Braun, editors. 1994. Migratory shore and upland game bird management in North America. International Association of Fish and Wildlife Agencies. Washington, D.C. 223 pp.

Appendix 1. Technical Committees for evaluating and prioritizing Webless Migratory Game Bird Research Program proposals.

Western	**Central**	**Northeastern**	**Southeastern**
Alaska	Arkansas	Connecticut	Alabama
Arizona	Colorado	Delaware	Florida
California	Iowa	Illinois	Georgia
Hawaii	Kansas	Indiana	Kentucky
Idaho	Minnesota	Maine	Louisiana
Oregon	Missouri	Massachusetts	Maryland
Utah	Montana	Michigan	Mississippi
Washington	Nebraska	New hampshire	North Carolina
	New Mexico	New Jersey	South Carolina
	North Dakota	New York	Tennessee
	Oklahoma	Ohio	Virginia
	South Dakota	Pennsylvania	West Virginia
	Texas	Rhode Island	
	Wyoming	Vermont	
		Wisconsin	

Appendix 2. Evaluation criteria for Webless Migratory Game Bird Research Program proposals (Revised July 20, 1998).

Possible points	Criteria
10	**I. Existing information data base related to the problem in question for this species/population**
	10 pts. Little known
	5 pts. Moderately known
	2 pts. Extensive
20	**II. Information needs**
	20 pts. Addresses an immediate need identified in a management plan (national, regional, or state), the 1994 book *Migratory Shore and Upland Game Bird Management in North America*, or a regional technical committee priority list.
	10 pts. Addresses a future need identified in a management plan (national, regional, or state), the 1994 book *Migratory Shore and Upland Game Bird Management in North America*, or a regional technical committee priority list.
	2 pts. Addresses a need identified only in the proposal.
30	**III. Status of the species/population**
	A. Population
	15 pts. Decreasing
	13 pts. Unknown
	7 pts. Stable
	2 pts. Increasing
	B. Habitat
	15 pts. Decreasing
	13 pts. Unknown
	7 pts. Stable
	2 pts. Increasing
20	**IV. Management applicability**
	A. Range
	15 pts. Results applicable throughout
	10 pts. Results applicable to > 50% of range
	5 pts. Results applicable to < 50% of range
	B. Applicability
	5 pts. Multi-species (Biodiversity approach)
	3 pts. Single species
30	**V. Scientific merit**
	30 pts. Objectives are clearly stated, procedures are well designed, results are attainable, quantifiable estimates will be statistically reliable and comparable to other studies, manpower and budget are adequate.
	15 pts. Objectives are clearly stated, most procedures are well designed, important results are attainable, quantifiable estimates will be statistically reliable and comparable to other studies, manpower and budget are generally adequate.
	0 pts. Objectives fuzzy, poor design or results not attainable, results will not be statistically reliable or will be difficult to compare, budget and manpower are inadequate (zero value automatically kills the proposal).
10	**VI. Funding**
	10 pts. > 75% of funding from other sources
	7 pts. 50-75% of funding from other sources
	5 pts. 33-49% of funding from other sources
	0 pts. <33% of funding from other sources (zero value automatically kills the proposal).
120	**TOTAL**

Webless Migratory Game Bird Research Program Projects *Progress to Date*

Mourning Doves

Development of Harvest Strategies for Mourning Doves

DAVID L. OTIS, U.S. Geological Survey, Iowa Cooperative Fish and Wildlife Research Unit, Iowa State University, Ames, IA 50011, USA (dotis@iastate.edu)
PHILIP DIXON, Iowa State University, Ames, IA 50011, USA
JOHN R. SAUER, U.S. Geological Survey, Patuxent Wildlife Research Center, Laurel, MD 20708, USA

Expected completion: 2008

Introduction and Objectives

Dove harvest regulations have historically been based on informal examination of trends derived from the annual Call Count Survey (CCS). No significant changes in hunting regulations have occurred during the past several decades, with the exception of a decreased bag limit initiated in 1987 in the Western Management Unit.

Based on a renewed emphasis on more informed harvest management for mourning doves, the Mourning Dove National Strategic Harvest Management Plan (National Plan) was approved in 2003 by the Flyway Councils. The foundation of this strategy is a set of population models that predict population growth and harvest as a function of survival and recruitment rates. Model performance is evaluated over time by confronting model predictions with independent measures of population status and harvest. This process provides information that can be used to increase model accuracy and precision and improve our understanding of the consequences of various harvest regulation alternatives.

In 2004, the USFWS became concerned about the need for a more formalized harvest strategy during the time period required for implementation of the National Plan, and it requested that interim harvest strategies be established. These strategies were subsequently developed by the dove management unit (MU) technical committees, but they varied in their reliance on existing dove harvest and survey data. In February, 2006 the Service Regulations Committee asked for revised interim strategies from all MUs that would rely more heavily on survey trends and more rigorously derived regulation change thresholds. Subsequent discussions within the dove management and research community led to the concept of development of interim strategies that utilize CCS and BBS survey databases and population estimates derived from recent harvest and banding data. This strategy and associated statistical technique development were to be constructed as a catalyst for continuous progress toward implementation of the National Plan.

Progress to Date

In consultation with state and federal dove harvest management biologists, it has been decided in 2008 that a composite estimator of annual trend derived from application of Bayesian hierarchical modeling techniques would be used as the basis for making harvest regulation decisions in a new interim strategy. Population indices at the state level from the CCS (both number heard and number seen) and BBS surveys (1966 - 2007), as well as population estimates derived from harvest data (2003 - 2007), will constitute input into the statistical model. Each of the 3 Management Units has made decisions about the time frame, statistical confidence criterion, and population trend values that will be used to choose from 3 harvest regulation alternatives. This system is expected to be implemented for the 2009 dove harvest regulation cycle.

Future Work

With the implementation of the interim harvest strategy, a fresh effort has begun to develop a more informed long-term harvest strategy based on the concepts of the National Plan. The development of this strategy will

again be a cooperative effort between the state and federal management community and a team of USGS, USFWS, and university scientists.
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Development and Evaluation of Methods for Regional Monitoring of Mourning Dove Recruitment

DAVID L. OTIS, U.S. Geological Survey, Iowa Cooperative Fish and Wildlife Research Unit, Iowa State University, Ames, IA 50011, USA (dotis@iastate.edu)
DAVID A. MILLER, Department of Natural Resource Ecology and Management and Ecology and Evolutionary Biology Program, Iowa State University, Ames, IA 50011, USA (millerda@iastate.edu)

Graduate Student: David Miller(Ph.D.); **expected completion**: 2009

Introduction and Objectives

Increased recognition of the importance of sustained recreational use and conservation of the mourning dove (dove; *Zenaida macroura*) has motivated a coordinated effort by state and federal agencies to improve the data sources and analytical tools necessary for informed harvest management. The Mourning Dove National Strategic Harvest Management Plan recognizes 1) the need to improve the knowledge base used for managing harvest of this important game bird and 2) the role of large-scale and long-term monitoring programs in meeting these information gaps. As part of this effort, our project addresses several objectives related to the establishment of long-term national program for monitoring of annual population recruitment.

Parts collections are a traditional method for estimating fall age ratios for game bird species. However, before a reliable operational wing survey can be implemented for doves, a number of issues needed to be addressed. These include the need to calibrate harvest wing age ratios to produce an estimate of true age ratios, to evaluate the efficiency of different sampling protocols to meet the information needs for doves, and to validate the accuracy of age ratio estimates using independent data. Finally, there is a continuing need to increase our understanding of the basic breeding biology of the species, which will in turn assist with interpretation of recruitment estimates.

The following objectives, all of which are important steps in the implementation of a national demographic monitoring program for doves, were included in our original proposal.

1. Calibrate juvenile to adult ratios of harvested doves in order to produce an unbiased estimate of annual recruitment of juveniles into the fall population from wing collections by:
   a. Estimation of regional primary molt rate of adult and juvenile doves and the age-specific proportion of molt completed birds obtained from a wing survey.
   b. Correct harvest age ratios for differential harvest vulnerability of juveniles and adults.
2. Evaluate potential sampling designs and logistical constraints for a national harvest wing survey for monitoring recruitment.
3. Determine the potential for employing recaptures from an intensive banding program to generate independent estimates of age ratios that can be used to validate wing survey estimates.
4. Improve understanding of intra-annual variation in reproductive output of breeding doves.

Progress to Date

During the 2005 – 2007 late summer and early fall field seasons, 22 states banded >40,000 doves and collected nearly 100,000 wings from 58 unique degree blocks. Our estimation technique uses the data to assigns age classes to dove wings of unknown age at the time of the harvest survey based on projecting molt scores of doves banded in late summer to the time of the fall harvest. Almost all birds trapped as part of the late summer banding program can be identified to age, which provides an in initial distribution of molt scores in the local population. Our approach is to project this distribution forward to the beginning of hunting season, when a second independent molt distribution is derived from a sample of harvested wings. Estimates of molt

Mourning Dove Wingbee participants, December 2008.

rates and the proportion of unknown birds in each age class are obtained by finding the best statistical fit of the 2 molt distributions. During the past year we finalized development of our estimation model, including testing the model with simulated data sets. The models performed well, producing age ratio estimates that were nearly unbiased. We are finalizing analyses based on this model, and completing work on development of a predictive equation that can be used to correct future estimates of harvest age ratios.

In 2007, the US Fish and Wildlife Service (Division of Migratory Bird Management's Branch of Harvest Surveys) initiated a companion 3-year nationwide mail survey wing- collection program. The goal of this complementary survey is to compare efficiency of field and mail sample collection protocols to inform the design of an operational harvest wing survey program. Approximately 25,000 wings were returned by >3,000 cooperating hunters nationwide in both 2007 and 2008.

Photos by David Dolton.

Future Work

We are finalizing harvest age ratio analyses based on our estimation model, and will complete work on development of a predictive equation that can be used to correct future estimates of harvest age ratios. Estimates of recruitment derived from harvest age ratios corrected for unknowns and relative vulnerability will be used in an exploratory analysis of spatial and temporal patterns of recruitment and environmental variables.

After the final year of companion wing surveys in 2009, comparative analyses of harvest age ratios and relative costs will be used by USFWS staff to make recommendations on the design of an operation wing collection program.

Data analyses and manuscripts of field studies and enclosure experiments conducted in Iowa on dove growth and developmental biology will be completed and included as chapters the the Ph.D. dissertation to be submitted as a final report.

Mourning Dove Demographics and Harvest Management in an Agroforestry Complex

JOHN H. SCHULZ, Missouri Department of Conservation, Resource Science Center, 1110 South College Avenue, Columbia, MO 65201, USA (John.H.Schulz@mdc.mo.gov)
JOSHUA J. MILLSPAUGH, School of Natural Resources, University of Missouri-Columbia, 302 Anheuser-Busch Natural Resources Building, Columbia, MO 65211, USA
RICK BREDESEN, James A. Reed Memorial Wildlife Area, Lee's Summit, MO 64082, USA
TONY W. MONG, School of Natural Resources, University of Missouri-Columbia, 302 Anheuser-Busch Natural Resources Building, Columbia, MO 65211, USA
DAN DEY, North Central Research Station, U.S. Forest Service, University of Missouri-Columbia, 202 Anheuser-Busch Natural Resources Building, Columbia, MO 65211, USA

Expected completion: June 2011

The National Mourning Dove Strategic Harvest Management Plan shows that future harvest management decisions will be based upon mechanistic population models, requiring modern estimates of demographic characteristics (e.g., recruitment, survival). Broad spatial scale estimates of survival and recruitment can be obtained from a sample of banded individuals along with a sample of wings from hunter-killed doves. However, the impacts of intensively utilized local populations are uncertain. Therefore, our objectives are (1) to estimate local mourning dove population characteristics (e.g., recruitment, survival) and local harvest characteristics (e.g., harvest rates, crippling rates) during 2005-2010, and (2) evaluate agroforestry practices while determining the efficacy of associated number of sunflower fields and field size to attract mourning doves for harvest on James A. Reed Memorial Wildlife Area (JARMWA) during 2005-2010. Knowledge generated from this project will also guide management decisions for private landowners combining agroforestry practices and managed dove hunting fields, provide information about relationships between observed recruitment from radio marked doves and fall age-ratios from hunter-killed doves, provide comparisons of actual and reported crippling rates during the hunting season, and provide information on harvest rates on a heavily harvested local population of mourning doves.

As mentioned earlier, one aspect of this project is to provide management recommendations for private landowners concerning dove hunting and dove field management, especially within the context of an agroforestry complex. Following is brief summary of book chapter describing the wildlife benefits of agroforestry, and specific details and recommendations for mourning dove management on private lands (Millspaugh, J. J., J. H. Schulz, T. W. Mong, D. Burhans, D. Walters, R. Bredesen, R. D. Pritchert, and D. C. Dey. 2009. Agroforestry and wildlife benefits. In press *in* North American Agroforestry, H. E. Garrett and M. Gold, editors. Second edition).

Agroforestry in Missouri is a combination of forestry and agriculture. To expand the long-term financial benefits of growing commercial timber products, agricultural crops can be used to attract and concentrate wildlife to increase farm income through lease hunting. Landowners willing to invest in wildlife habitat and expend the energy in establishing pay-to-hunt arrangements can generate immediate income while waiting for future timber harvest income. There are several challenges, however, for landowners to consider before implementing lease hunting. Most importantly, landowners must have reasonable and flexible expectations. The type and quantity of game animals depend upon the existing local conditions. Also, the

Photo by Dennis Browning.

available type and quantity of game species will evolve as the agroforestry trees move through different growth phases and change the surrounding habitat (Figure 1). The most profitable pay-to-hunt operations are often the most labor and management intensive for the landowner. Fee hunting also has the potential to be an important tool to help slow the long-term decline in hunter numbers by providing additional hunting opportunities.

Mourning doves provide numerous advantages when considering lease hunting in combination with agroforestry. Doves are granivorous ground feeders preferring bare ground and open areas devoid of dense vegetation. This characteristic is complementary with newly established agroforestry plots; the open land between tree plantings can be planted to crops to attract feeding mourning doves.

A landowner with an agroforestry lease hunt program wants to reliably attract mourning doves each year, resulting in a clientele of satisfied hunters year after year. Sunflowers have been shown to be a consistent attractant for local and migrating mourning doves. The concepts behind mourning dove field shooting management are relatively simple. Sunflowers are planted early in the growing season so they are available at least 4-6 weeks prior to the opening of the hunting season. As summer progresses and the sunflower seeds become available on bare ground, local doves will begin to congregate around the field to feed. With a consistent food supply, mourning doves will remain throughout late summer and early fall regardless of weather conditions.

The sunflower plants and remainder of the field must be managed to eventually provide a situation where the majority of the hunting field is bare ground covered with nothing but sunflower seeds, with the field edges consisting of a few rows of standing sunflowers to conceal hunters. Given precipitation during the summer, weeds will begin to decrease the openness of the field, and early mowed sections of the field will need to be disked or plowed to keep the bare soil available.

Although sunflower management is labor intensive, the landowner has an opportunity to derive significant additional income from a daily-use fee hunting operation with 4-5 hunters/acre killing 19-20 doves/acre. Depending upon local conditions, the effective season length would be 1-5 days (Figure 2). Given roughly three days of hunting on a 10 acre managed sunflower with 50 hunters paying $25.00 on Day-1, 25 hunters on Day-2, and 10 hunters on Day-3, a landowner could obtain $2,125 in daily-use fees. The costs associated with planting, herbicides, cultivating, and mowing a managed sunflower field would be similar to planting a harvesting a soybean crop.

These are preliminary results from the first 4-years of a 5-year project. The project is a cooperative venture including the Webless Migratory Game Bird Research Program (U.S. Fish and Wildlife Service), University of Missouri's Center for Agroforestry, University of Missouri School of Fisheries and Wildlife Sciences, U.S. Forest Service - North Central Forest Experiment Station, and Resource Science Division of the Missouri Department of Conservation.

In young agroforestry plots, strips of mature sunflowers mowed in late summer provide attractive feeding areas for mourning doves which in turn provide hunting opportunities that many hunters are willing pay for. *Photos by John H. Schulz.*

Tree rotation (year)	1	20	40	60
Management intensity	High	→	→	Low
Lease type	Daily-use	Daily-use and Seasonal	Daily-use and Seasonal	Annual or multi-year
Type of Hunting and Species	Mourning doves	Mourning doves and quail	Doves, quail, rabbits, deer, turkey	Deer and turkey

Figure 1. Relationships showing how tree growth through an agroforestry tree rotation changes the corresponding wildlife habitat and resulting lease hunting options.

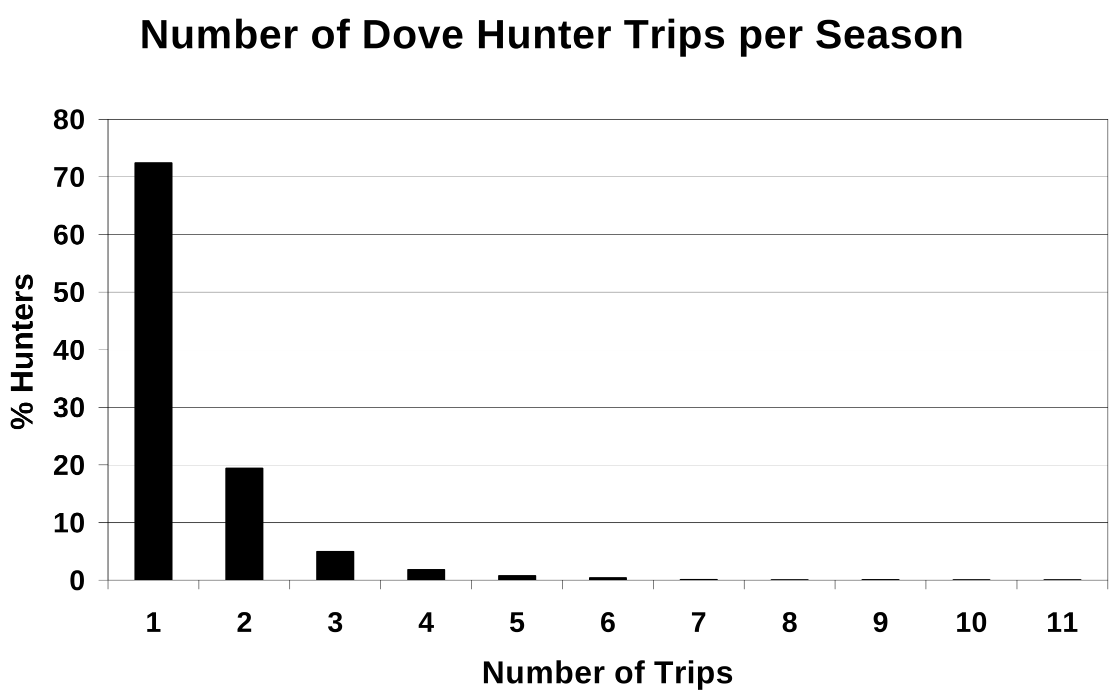


Figure 2. Number of dove hunting trips made by hunters during September 2006 on 12 public hunting areas specifically managed for mourning doves.

Mourning Dove Recruitment in Tennessee

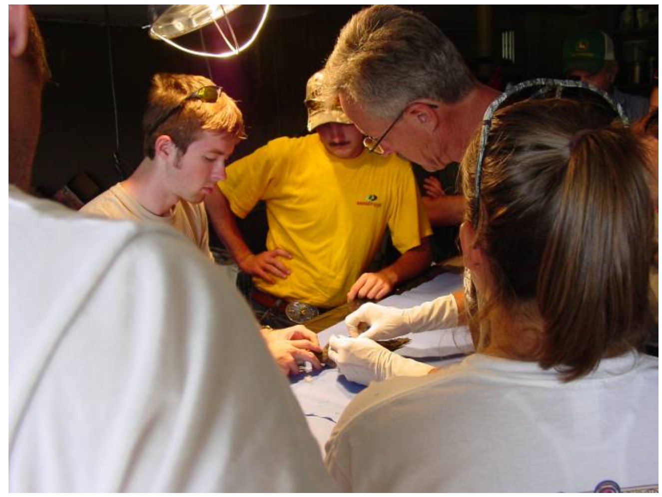
RUSSELL R. SKOGLUND, Tennessee Wildlife Resources Agency, Ellington Agricultural Center, P.O. Box 41489, Nashville, TN 37204, USA
STEVEN E. HAYSLETTE, Department of Biology, Box 5063, Tennessee Technological University, Cookeville, TN 38505, USA (shayslette@tntech.edu)

Graduate student: Russell R. Skoglund (Ph.D.); **expected completion date:** June 2009

Current nationwide efforts to better understand mourning dove population dynamics require estimates of annual recruitment. Previous mourning dove nesting studies have generated estimates of reproductive parameters such as nesting success and fledglings produced/minimum number of nesting pairs, but such studies do not permit direct documentation of reproductive output per female and do not address fledgling survival. Radiotelemetry offers an alternative approach to estimating recruitment that addresses both of these limitations. This study will document survival (nesting females, nests, and post-fledging juveniles) and recruitment in an EMU mourning dove population, to complement ongoing mourning dove recruitment research in other units.

This study took place during March-September 2007 and 2008 on Stonewall Farm, a 162-ha former cattle farm in western Wilson County, Tennessee. During 2007, we trapped and subcutaneously implanted radiotransmitters in 71 mourning doves during May-August. Of these, only 15 were AHY doves, including 10 males and 5 females. The remaining 56 radiomarked doves were HY doves, including 11 males, 1 female, and 44 of unknown gender. During 2008, we trapped and implanted radiotransmitters in 184 mourning doves. Of these, 35 were AHY doves, including 28 males and 7 females. The remaining 149 radiomarked doves were HY doves, including 2 males, 3 female, and 144 of unknown gender.

Radiomarked doves were monitored daily from date of implant through 30 September each year. We documented 18 non-harvest-related mortalities among radiomarked doves during the study period in 2007, and 46 in 2008. Additionally, 3 radiomarked doves were harvested each year during a 2-day hunt on the first weekend in September, and 4 and 2 radiomarked doves were crippled but not recovered by hunters during those hunts in 2007 and 2008, respectively. Among the 5 AHY females radiomarked in 2007, 2 were tracked to active nests. These females were monitored through a total of 4 nesting attempts; mean total fledglings/female during this monitoring period was 2.0. In 2008, 4 male AHY doves were tracked to active nests. These males were monitored through a total of 5 nesting attempts; mean total fledglings/male during this monitoring period was 1.3.



Ph.D. student and Tennessee Wildlife Resources Agency manager Russ Skoglund surgically implants a radiotransmitter in a mourning dove as Tennessee Tech University students watch, Stonewall Farm, Wilson County, Tennessee, July 2007.

Field work for this 2-year study has been completed. Ongoing analyses will estimate survival of trapped and marked HY and AHY doves from date of radio implant

Nest of radiomarked mourning dove found during telemetry studies, Stonewall Farm, Wilson County, TN, June 2008.

through 1 September each year using radiotelemetry records. Additionally, age ratio (HY:AHY:U) among wings collected during the 2-day hunt will be determined, and productivity (fledglings recruited/adult female) will be estimated using these wing ratios. An attempt will be made to resolve the unknown age component of the wing collection using molt progression information from trapping records during the breeding season. The final report and manuscript for this project will be completed by June 2009. Funding and/or other support for this project are provided by the Webless Migratory Game Bird Research Program (U.S. Fish and Wildlife Service); Tennessee Wildlife Resources Agency; Center for Management, Utilization, and Protection of Water Resources at Tennessee Tech University (TTU); TTU Environmental Science Ph.D. Program; and TTU Department of Biology.

Voluntary Lead Shot Ingestion Rate of Mourning Doves (*Zenaida macroura*)

DONALD W. SPARLING, Cooperative Wildlife Research Lab, Southern Illinois UniversityCarbondale,Carbondale, IL 62901, USA (dsparl@siu.edu)
RICHARD S. HALBROOK, Southern Illinois University Carbondale, Carbondale IL 62966, USA
STEPHANIE C. PLAUTZ, Southern Illinois University Carbondale, Carbondale IL 62966, USA

Graduate Student: Stephanie Plautz, M.S. **Expected completion:** May 2009

Introduction and Objectives

In an effort to halt declining hunter participation and provide easily accessible mourning dove (*Zenaida macroura*) hunting areas, many state and federal agencies are managing plots of land specifically to attract doves. Fields are planted with crops favored by doves such as wheat, millet, or sunflowers, and managed so that relatively bare ground is available adjacent to or within the food plot shortly before dove season begins. While these activities concentrate mourning doves and provide increased hunting opportunities, they also concentrate the lead (Pb) shot deposited by hunters. Some of this spent shot is then ingested by foraging doves. Several studies have shown that ingested lead is toxic to migratory birds including waterfowl and mourning doves.

There is uncertainty concerning how prevalent Pb shot ingestion is among wild mourning doves and, to date, most research concerning mourning doves and Pb ingestion has been done in highly artificial laboratory conditions. The resulting data have been controversial because they are used by policy makers when they consider nontoxic shot regulations. Therefore, this study attempts to mimic conditions encountered by wild birds as closely as possible. Its objective is to determine if there is a relationship between the rate of lead shot ingestion in mourning doves and the density of Pb shot available on the bare soil of a disked agricultural field.

Progress

A total of 361 wild mourning doves were trapped using modified Kniffin traps in Carbondale, Illinois. One dove showed signs of avian pox and was released. At time of capture, doves were aged and assigned to gender. Birds were marked using a uniquely numbered, non-FWS metal leg band and housed in 0.91 x 2.1 x 0.91 m (3 x 7 x 3 ft) roofed outdoor cages constructed from PVC pipe and hardware cloth at a density of ≤ 25 birds per cage. The doves were provided with *ad libitum* mixed seed, water, and ground oystershell grit.

Five mourning doves and two cowbirds trapped in modified Kniffin traps. *Photo by Stephanie Plautz.*

Mourning dove trapped with modified Kniffin trap.

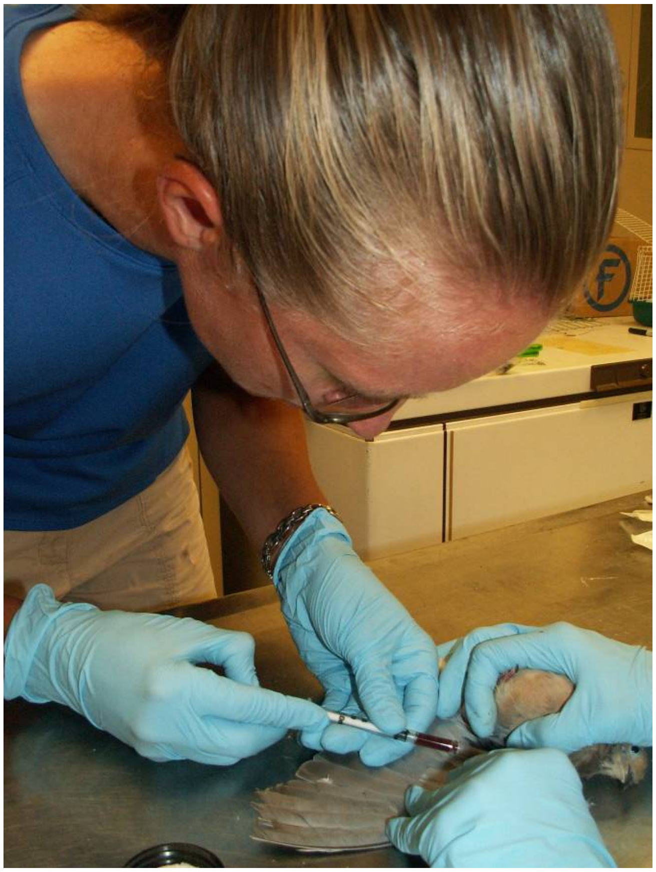
Doves were held in captivity for ≥ 5-weeks prior to the beginning of treatment to allow for acclimation to captivity, assure that they were not diseased, and ensure a similar nutritional plane among individuals. In early spring 2008, prior to the experiment an approximately 0.25 ha fallow field was mowed and disked several times to produce a bare area resembling an agricultural field ready for planting. In fact, the field had been similarly mowed, disked, fertilized and planted into sunflowers and millet the previous year as part of the study but the resulting crops did not produce much seed. The field was further disked at least twice between each trial in 2008. Two soil samples from each end of the treatment field were tested for particle size using the hydrometer method of measuring particle size distribution. We assumed there were no available Pb pellets in the field pretreatment because the field used for the treatments had no history of hunting.

Three trials were conducted using 80 doves apiece, for a total of 240 birds. Seven days prior to experimental treatment each bird was weighed to the nearest 0.1 g and a 0.3-cc volume of blood was collected from the alar vein using a 1-cc syringe and 27-guage needle. Birds were then placed one to a cage in roofed field pens and housed there for seven days to allow them to habituate to their new surroundings. Pens were 0.61 x 0.61 x 0.61 m (2 x 2 x 2 ft), open-bottomed, and a perch and *ad libitum* water were provided. Two aluminum 0.23 x 0.33 m (9 x 13 inch) pans painted brown were buried in the soil in each cage so that the top of the soil in the pan was level with the ground. The soil in each pan was loosely packed to help prevent shot and seed from falling between pieces of soil and becoming inaccessible to the doves. Mixed seed was scattered uniformly on the soil in these pans.

Following the 7-day pretreatment period, birds were temporarily confined and the contents of each feed pan replaced with new soil, 125 mL of mixed seed, and uniformly scattered #7.5 Pb shot at a density of 0, 150, or 2,950 pellets/m^2. These densities corresponded to 0, 1.5 million and 29.5 million pellets/ha. In each trial, 35 birds were used in each of the 150 and 2,950 pellets/m^2 treatments and 10 birds served as controls (0 pellets/m^2). In the second and third trials, 5 control birds were gavage-dosed with 2 Pb pellets apiece. Birds were released back into their pens and allowed to feed for 4 days. On day 2, birds were collected and x-rayed for the presence of Pb shot in their digestive systems before being released back into their treatment pens. Mixed seed (125 mL) was added to each feed pan at this time. On day 4 of treatment, birds were collected, x-rayed, bled, weighed and euthanized using CO_2 asphyxiation. The kidneys and liver of each bird were removed and frozen at -80 ºC for analysis. All handling procedures and euthanasia techniques were approved by SIUC's Institutional Animal Care and Use Committee (protocol A-3078-01).

We are examining several end points of interest. These include the presence and retention of lead shot pellets during the treatment period. Blood parameters include: 1) the concentration of delta-aminolevulinate dehydratase (ALAD), an enzyme involved with heme synthesis that is very sensitive to lead toxicity; 2) the heterophil:lymphocyte ratio; and 3) packed cell volume. Lead analyses will be conducted in liver, kidney and blood.

Treatment field for lead shot ingestion trails on mourning doves. Eighty birds were housed one to a cage. *Photo by Stephanie Plautz.*


Drawing 0.3cc of blood from a mourning dove pre-treatment using a 1cc syringe and a 27 gauge needle. Carbondale, IL.

Preliminary Results

In the first trial, no birds consumed shot. In the second, 3 birds from the high shot density treatment group each consumed 1 shot. In the third trial, 2 birds from the high shot density treatment consumed 3 and 4 shot, and a bird from the low shot density treatment consumed 1 shot.

The shot ingestion rate was 4.85% for the high Pb shot density treatment and 0.97% for the low Pb shot density treatment. For the treatments combined, the overall shot ingestion rate was 2.9% (Table 1).

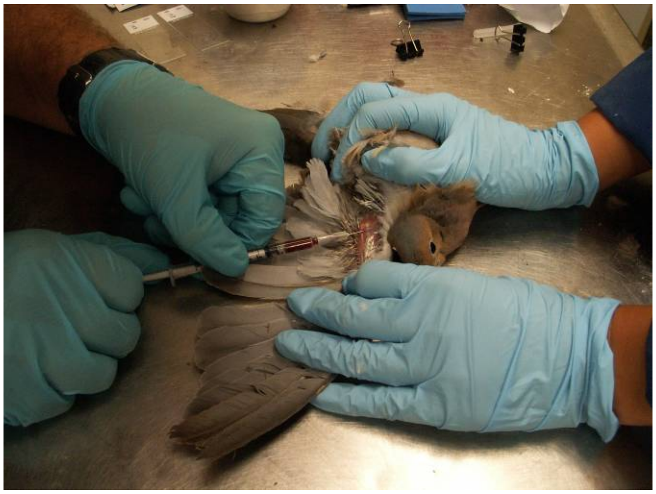

Drawing 0.3cc of blood from a mourning dove post-treatment using a 1cc syringe and a 27 gauge needle. Carbondale, IL.

Table 1. Lead shot ingestion rate of mourning doves on the bare soil of a disked field during captive trials in Carbondale, Illinois, USA, 2008.

	Number of doves (% of treatment group) that ingested shot	
	High density Pb shot	Low density Pb shot
Trial 1	0 (0%)	0 (0%)
Trial 2	3 (8.82%)	0 (0%)
Trial 3	2 (5.71%)	1 (2.86%)
Overall	5 (4.85%)	1 (0.97%)

We have determined blood packed cell volume (PCV) and measured Pb concentrations in kidneys and livers; preliminary kidney and liver Pb concentrations are in Table 2.

Table 2. Number of pellets ingested, liver and kidney lead concentrations, and packed cell volume (PCV) pre and post treatment for mourning doves that ingested lead shot pellets during captive shot ingestion trials in Carbondale, Illinois, USA, 2008.

Bird	Trial	Treatment	Pellets at day 2	Pellets at day 4	Pre/post PCV (%)	Liver Pb (ppm w.w.)	Kidney Pb (ppm w.w.)
160	2	High	1	1	53/51	0.20	0.87
176	2	High	1	1	43/38	0.21	0.54
243	2	High	1	1	48/46	0.56	0.33
120	2	Dosed	2	1	53/17	94.40	322.58
146	2	Dosed	2	1	38/50	71.70	218.30
147	2	Dosed	2	2	NA*/38	41.99	85.95
172	2	Dosed	2	0	42/39	9.88	75.09
244	2	Dosed	2	1	37/41	11.07	140.37
334	3	Low	1	1	43/39	4.88	189.41
316	3	High	4	0	N/A/48	1.90	15.18
319	3	High	3	0	47/48	4.50	56.88
234	3	Dosed	1	0	N/A/38	3.37	346.03
264	3	Dosed	2	2	44/39	11.82	327.57
266	3	Dosed	2	2	44/43	8.56	150.48
275	3	Dosed	2	2	41/33	50.50	236.45
308	3	Dosed	2	0	47/44	4.17	64.74
	Mean	Voluntary				2.04	43.87
	Mean	Dosed				30.75	182.86
		overall				19.98	139.42

Future Work

Blood samples will be analyzed for Pb concentration, heterophil:lymphocyte ratio and ALAD activity. Blood Pb concentration will be evaluated using a graphite furnace atomic absorption spectrophotometer and ALAD will be analyzed spectrophotometrically using a 96-well microplate reader. Heterophil:lymphocyte ratio will be evaluated using blood smears. The data will be used in a master's thesis and presented next year in the final report.

Presentation of Research

The following poster paper was presented:

Plautz, S. C., D. W. Sparling, and R. S. Halbrook. Lead shot ingestion rate of mourning doves on a disked field. 15th Annual The Wildlife Society Meeting, November 8-12, 2008, Miami, Florida, USA.

White-winged Doves

Gender Identification of White-winged Doves

SARA J. OYLER-MCCANCE, U.S. Geological Survey - Fort Collins Science Center, Rocky Mt. Center for Conservation Genetics and Systematics, Department of Biological Sciences, University of Denver, Denver, CO 80208, USA (sara_oyler-mccance@usgs.gov)
CLAIT E. BRAUN, Grouse, Inc. 5572 N. Ventana Vista Rd., Tucson, AZ 85750, USA (sg-wtp@juno.com)

Final report

Introduction and Objective

White-winged doves (*Zenaida asiatica*) are migratory game birds with an expanding distribution (George et al. 1994). Reasons for the range expansion are largely unknown as are the demographic characteristics of populations in newly occupied areas. This species is avidly sought in states having large white-wing dove populations and where it is hunted with specific hunting seasons designed to prevent local over-harvest. Increasing distribution and apparent population size in other states may result in legalizing or liberalization of hunting regulations in those states. Prior to any liberalization, more knowledge is needed on population characteristics including population demography in both the Central Flyway and Pacific Flyway portions of the species range. These needs should be specific by age and gender class as hunting may over exploit one gender (or age class). Harvest rates may be measured through banding programs, hunter bag checks, and through collections of specific parts through parts collection surveys. These rates should be gender specific to examine possible impacts of hunting loss on population composition, which could affect breeding population size.

Gender of white-winged doves based on examination of live birds is difficult even though Cottam and Trefethen (1968) indicate that it can be done based on plumage coloration. Russell (1969) suggested that body mass was a reliable method for assigning gender to white-winged doves. However, Brown et al. (1977) indicated the only useful method to correctly assign gender to white-winged doves was through cloacal examination. This method was further tested (Swanson and Rappole 1992) on a small sample (52 live birds captured on nests and 25 shot birds). These authors reported that all 26 presumed males captured on nests, and those shot and dissected (23 males) had cloacal papillae. However, the opening to the oviduct was found on only 22 of 26 presumed females captured on nests and on 2 of 2 shot and dissected females. These authors claim that cloacal examination should result in a level of accuracy of at least 90% (Swanson and Rappole 1992).

Cloacal examination takes time and, especially in warm climates, can be stressful to live birds. Further, it takes experience and leaves doubt as excreta can obscure either the 2 papillae (males) or the oviductal opening (females). Further, it is ineffective in hatching year birds and in some second-year individuals. Thus, there is a need for a rapid and effective method to ascertain gender of white-winged doves in banding programs, especially those that are likely to result in capture of large numbers of individuals.

Our objective was to test use of length of one of the two central brown tail feathers of white-winged doves to learn if this method can be used to correctly assign gender to live birds. Preliminary work in Arizona (700+ bandings, 40+ recaptures) between 2000 and 2004 indicates there is a difference in tail feather length between males and females of all age classes (AHY-adult or “after hatch year”, SY – subadult or “second year”, HY – juvenile or “hatch year”) although sample sizes for SY’s and HY’s were small. These differences have also been verified on small samples (~ 20 birds) of gonadally checked hunter- harvested white-winged doves in Arizona. Our hypothesis is that central tail feather length (mm) is associated with gender and can be used to reliably assign gender to live or dead white-winged doves.

Methods

***Field Measurements*.**— A central brown tail feather was plucked from a sample of 200 white-winged doves captured in normal banding operations. Feathers were immediately labeled by band number, measured (mm) and stored dry. Tail feathers were then sent to the Rocky Mountain Center for Conservation Genetics and Systematics in Denver, Colorado to determine gender using molecular methods.

***Verification Using Molecular Techniques*.**— Griffiths et al. (1998) designed primers around homologous regions in the chromo-helicase-DNA-binding (CHD) gene on sex chromosomes W and Z in birds. This technique takes advantage of the fact that chromosomes W and Z evolve at different rates. Homologous regions on sex chromosomes typically are different sizes due to mutations involving insertions and deletions of DNA nucleotides. Their method simultaneously amplifies homologous regions on the W and Z chromosome followed by a restriction digest, which allows for differentiation of males (ZZ – 1 band) and females (ZW – 2 bands) in many species of birds with the possible exception of Struthioniformes. Ellegren (1996) developed PCR primers for collared flycatchers (*Ficedula albicollis*) within the CHD gene that resulted in gender identification of closely related species without the restriction digest step. Kahn et al. (1998) designed a different set of primers in a more conserved region of the CHD gene that amplify most avian species. This technique has been used to identify gender of many species including mountain plover (*Charadrius montanus*) (Dinsmore et al. 2002) using feathers and kakapo (*Strigops habroptilus*) from feces (Robertson et al. 1999) and has been shown to work well in white winged doves (S. J. Oyler-McCance and C. E. Braun, unpublished data).

DNA was extracted from all feathers using the Wizard Genomic DNA Purification System (Promega) following the manufacturer's specifications. A standard 25 μl PCR (Kahn et al. 1998) was performed in a PTC-200 thermal cycler (MJ Research) using the sexing primers developed by Kahn et al. (1998) with the forward primer labeled with a fluorescent dye and the reverse primer unlabeled. Each reaction was preheated at 94°C for 30 sec and then amplified for 35 cycles using the following thermal profile: denaturation, 94 °C for 2 min; annealing, 56 °C for 1 min; and extension, 72 °C for 2 min. Amplified products were run on the CEQ 8000 Genetic Analysis System (Beckman Coulter) using the Size Standard-400 and the default Frag 3 method. Males were identified by a single peak and females by 2 peaks.

***Data Analysis*.**— The distribution of adult male tail feather lengths was compared with the distribution of adult female tail feather lengths using a standard t-test with unequal variances. This test was repeated for the sub-adult age class.

Results

In the adult (AHY) age class, 95 individuals were determined to be female and 49 were determined to be male using molecular methods. The mean tail length for females was 11.76 cm (95% CI 11.69 - 11.83) and for males was 12.32 cm (95% CI 12.18 – 12.47). The two distributions were found to be significantly different using a one-tailed *t*-test with unequal variances ($P < 0.001$). The sub-adult (SY) age class was comprised of 16 females and 5 males. Mean tail lengths for females was 11.46 cm (95% CI 11.23 – 11.69) and for males was 12.27 cm (95% CI 11.74 – 12.80). The two distributions of sub-adults were found to be significantly different ($P < 0.001$) using a one-tailed *t*-test with unequal variances. Among the immature (HY) white-winged doves sampled, 15 were female and 19 were male. The mean tail length for females was 10.44 cm (95% CI 10.27 – 10.61) and for males was 10.86 cm (95% CI 10.65 – 11.08). The two distributions of tail feather lengths were significantly different ($P < 0.05$) using a one-tailed *t*-test with unequal variances.

Discussion

We have shown that tail feather length can be used as a predictor of gender in white-winged doves as long as individuals are compared within the appropriate age class. Our sample sizes were large and our power to detect a difference between the genders was high. Adult tail feathers measured to be less than 11.9 cm are reliably female and those measured to be greater than 12.2 cm are reliably male. Any measurement between 11.9 and 12.2 cm cannot reliably be assigned a gender and should be either analyzed with molecular methods to verify gender or left as gender unknown. In the sub-adult age class, tail feathers less than 11.7 cm should be identified as female while those greater identified as male. Among sub-adults the cut off for females is 10.6 cm. Measurements over that value among sub-adults can be considered male.

These results are applicable for banding programs and population studies that assess population demography, examine differential harvest by gender, and gender-specific harvest rates. The findings are also useful for hunter bag-checks where there may be interest in which segment of the population (males or females) is exposed to harvest. Collection of tail feathers of white-winged doves in parts collection surveys should also be feasible. We believe this knowledge addresses an immediate need for all populations of white-winged doves. Further, we believe the results of this study may be applicable range wide and possibly to other species of Columbidae.

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Using GIS, Stable Isotopes, and Genetic Analysis to Differentiate Populations of White-winged Dove that Breed in the United States: Delineating Habitat Use, Post-breeding Dispersal, and Wintering Ground Distribution

SCOTT A. CARLETON, Department of Zoology and Physiology, University of Wyoming, Laramie, WY 82072, USA (scarlet@uwyo.edu)
CARLOS MARTINEZ DEL RIO, Department of Zoology and Physiology, University of Wyoming, Laramie, WY 82072, USA (cmdelrio@uwyo.edu)

Graduate Student: Scott Carleton (Ph.D.); **expected completion** 2008

Introduction

Across their range, white-winged dove populations have exhibited large increases and declines over a relatively short period of time. These fluctuations have been caused, to a large extent, by anthropogenic changes on the landscape. The sources of anthropogenic change on the breeding grounds and their effects on white-winged dove populations have been well documented and addressed. However, our understanding of factors effecting white-winged doves on the wintering grounds are less understood. To investigate white-winged doves on the wintering grounds we identified two objectives that must first be met. *1) We need to better understand the distribution of eastern and western populations on the breeding grounds and 2) we need to determine if the eastern and western populations of white-winged doves can be differentiated from one another.*

Two new analytical methods, stable isotope and genetic marker analysis, have emerged as powerful tools to answer these types of questions. During molt the carbon ($\delta^{13}C$) and hydrogen ($\delta^{2}H$ henceforth referred to as δD) isotopic signatures of the food and water birds consume are incorporated into their tissues. This signature, once incorporated into feather tissue, becomes inert and remains as a record of the breeding ground until the feather is again molted. This is important because hydrogen isotopic composition (δD) of precipitation forms a gradient across North America due roughly to differences in temperature, humidity, evaporation, topography and patterns of rainfall (Figure 1). Because of this gradient, feathers grown in one geographic location are discernible from feathers grown in another geographic location. In addition, genetic markers, such as microsatellite DNA and amplified fragment length polymorphisms (AFLP), are a powerful tool to differentiate populations of closely related species. We wanted to combine these two methods with GIS spatial analysis to differentiate the two populations of white-winged doves that breed in North America and then determine their distribution on the wintering grounds in Southern Mexico.

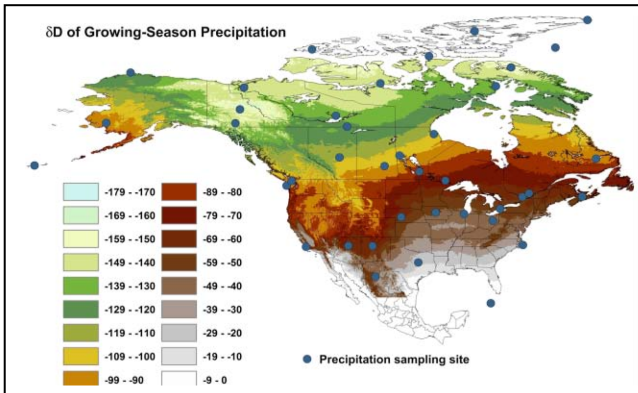

Figure 1. Hydrogen isotope precipitation values across North America show a clear north to south gradient useful for tracking migratory animals (from Meehan et al. 2003).

Progress to date

***Stable isotope analysis*.**— With the help of Texas Parks and Wildlife, New Mexico Game and Fish, California Game and Fish, and Arizona Game and Fish biologists we began collecting wings from hunters in the fall of 2004, 2005, 2007, and 2008. We pulled the earliest molted flight feather as this would have been grown on or near the breeding grounds. Deuterium, δD, isotope analysis of feathers reveals clear differentiation among dove populations across Arizona, New Mexico, and Texas. Discriminant analysis indicate that, isotopically, New Mexico and Texas birds have similar isotopic values and could not be differentiated from one another. However, discriminant analysis differentiated New Mexico and Texas doves from Arizona populations of doves. Furthermore, in Arizona doves inhabiting Sonoran Desert habitats could be differentiated from doves inhabiting agricultural habitats. Figure 2 shows feather δD values across the landscape using a GIS interpolation model. You can clearly see that white-winged dove isotope values show little differentiation from east to west until you reach southern Arizona. The use of saguaro cacti in the Sonoran Desert causes an increase in feather δD values and the influence of flood irrigation utilizing Colorado River water causes a decrease in feather δD values creating a mosaic of values that are revealed using GIS spatial analysis. Not only can we differentiate eastern and western populations, we can differentiate desert from agricultural doves in Arizona. Determining the distribution of white-winged doves on the wintering grounds relied on our ability to differentiate the two populations from one another. Now that we can differentiate the two populations using stable isotopes, we are continuing to collect doves in the southern states of Mexico. We are currently applying a GIS probability surface model developed by Dr. Michael Wunder at the University of Colorado Denver to determine the breeding ground origins for birds collected in southern Mexico. The results of this data will help determine the location and distribution of eastern and western populations in Southern Mexico during the winter and will be completed in the spring of 2009.

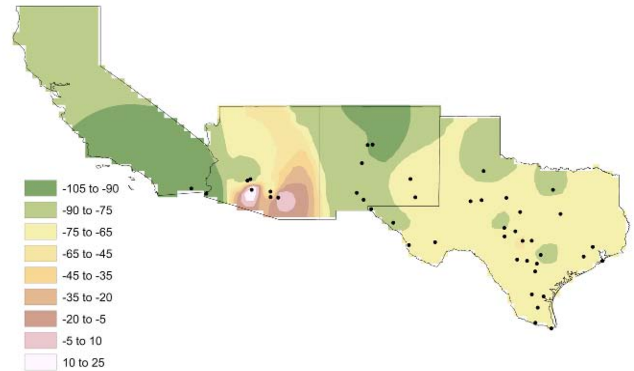

Figure 2. Feather δD values can be used to create 'Isoscapes' across the breeding range. Interpolated surface of feather δD isotope values reveals little differentiation across NM and TX. In AZ habitat use drives very localized feather δD values. Points are collection sites.

To verify that the feather δD signatures observed in fall collected doves were indeed a reflection of habitat use during the breeding season, we collected doves in July, 2007 and 2008 from desert and agricultural sites as well as desert fruits (pulp and water) and agricultural irrigation water for hydrogen isotope analysis (Table 1).

Table 1. Comparison of δD source water and feather δD from the same locations.

Sample	δD	Feather δD
Yuma Irrigation Water	-94.6 ± 1.6	-103.9 ± 8.8
Tucson Irrigation Water	-84.6 ± 2.2	-92.5 ± 12.5
Saguaro Fruit Pulp	-6.3 ± 11.6	-13.7 ± 24.7
Saguaro Fruit Water	83.5 ± 12.9	

What is driving the variation in Arizona feather δD values?

In Arizona the western population of white-winged doves can be divided into two subgroups. These two subgroups are comprised of doves that breed and forage within the Sonoran desert and doves that breed and forage within or near agricultural areas. The heterogeneity of isotope values displayed between these two habitats is the result of photosynthetic pathway differences in food plants and sources of drinking water.

The photosynthetic pathway (C3, C4, CAM) that a plant uses to convert the sun's energy into sugars creates very different carbon isotopic ratios ($\delta^{13}C/\delta^{12}C$) in the tissues of the plant. When an animal consumes the tissues of a plant it incorporates this signal into tissues such as a growing feather during molt. In Arizona, a large proportion of foraging activity of white-winged doves breeding in the desert is on saguaro cacti. Cacti derive their sugars via CAM (crusalacean acid metabolism) photosynthesis ($\delta^{13}C \approx$ -11‰; Figure 3B). In agricultural areas, doves forage on crops that derive their sugars from C3 and C4 photosynthesis ($\delta^{13}C \approx$ -24 and -11‰ respectively; Figure 3B). Interestingly, this difference in foraging alone does not account for the heterogeneity we observe in isotope values between habitats. There is another difference between these two habitats that contributes to the creation of a unique isotopic signature in the tissues of white-winged doves. That difference is derived from the source of drinking water (δD).

Doves feeding in agricultural areas utilize surface waters for drinking. Doves in the Sonoran desert derive a large proportion of their drinking water from the tissues of saguaro cacti. In the Sonoran desert ecosystem saguaro cacti are a very predictable resource, annually producing large crops of flowers and fruits. The predictability of this resource makes it an important source of food and water for desert white-winged doves. Remember, hydrogen forms a gradient across North America due in part to temperature, humidity, topography, and patterns of rainfall. Cacti store large amounts of water and over time, the pool of water inside the cactus becomes isotopically "heavier" as water molecules containing the lighter hydrogen isotope ($\delta^{1}H$) preferentially evaporate leaving a greater proportion of water molecules containing the heavier hydrogen isotope (δD). This causes the hydrogen isotope ratio ($\delta^{1}H/D$) of water from cacti to be more enriched (positive) than surface water (Figure 3B). The result is that doves feeding in the desert incorporate a carbon isotopic signature of the photosynthetic process (CAM) and hydrogen signature of the water they derive from cacti into growing feathers. Agricultural doves incorporate a carbon isotopic signature of crops they feed on (C3, C4) and the hydrogen signature of the surface waters they consume. These combined differences create the heterogeneity we see between habitats (Figure 3B).

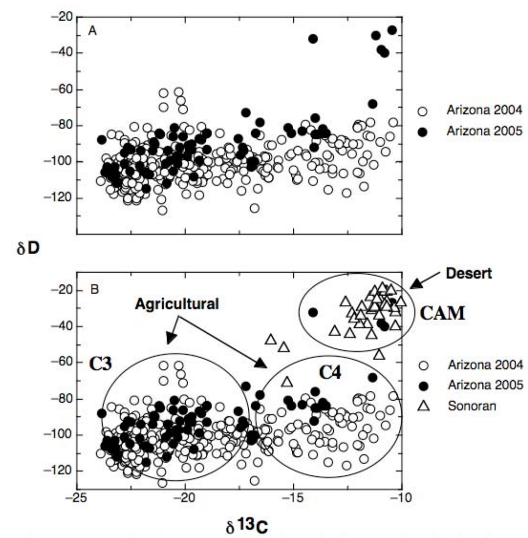

Figure 3. Feather isotope values show little annual variation between 2004 (○) and 2005 (●) collection seasons from hunters in agricultural areas (A). In 2005, five samples fall well outside the range of previously recorded values (A). When you overlay this data with doves collected in the Sonora desert (Δ) in the summer of 2005, the data reveals 1) a clear difference between agricultural and desert habitats and 2) shows that desert birds have moved into agricultural areas prior to migration where they were collected by hunters (B).

Future work

We have completed the tissue extractions and now need to analyze the AFLP data. We plant to compare data collected in two other studies utilizing mitochondrial and microsatellite DNA and make a recommendation whether or not subspecies classification is warranted for *Zenaida asiatica asiatica* and *Z. a. mearnsii*. The final results of this study, including all GIS spatial analysis using isotope data and genetic analysis, will be completed spring 2009.

Our results indicate that in southern Arizona white-winged doves utilize either desert or agricultural habitats and that little movement between sites occurs during the breeding season. However, desert white-wings move into agricultural areas as desert resources dwindle and feed with agricultural birds prior to migration where they are shot. The degree to which these two subpopulations are mutually exclusive during the breeding season is ultimately unclear. It is possible that there is a reduction in the utilization of agricultural sites by desert doves as distance from agricultural sites increases and visa versa for agricultural dove use of desert habitats. I would like to explore this relationship between distance and habitat use for white-winged doves in a future project. I would like to include mourning doves in this study because they are not perch feeders like white-wings. So, in the desert, they can only utilize dehydrated saguaro fruit for food but must obtain water elsewhere. Do they show a similar signature as white-wings between habitats or do mourning doves reveal surface water use in their feather δD indicating the importance of strategically placed water sources in desert habitats?

Left: Battling bees for water samples in the Sonoran Desert. Collecting saguaro fruits.

Right: Collecting saguaro fruits.

Left: Row crop in Arizona. *Middle*: Irrigation canal near Tucson, Arizona. *Right*: Typical Sonoran desert habitat south of Gila Bend, Arizona. *Photos by Scott Carleton.*

Band-tailed Pigeons

Breeding Distribution and Migration Routes of Pacific Coast Band-tailed Pigeons

MICHAEL L. CASAZZA, US Geological Survey, Western Ecological Research Center, 6924 Tremont Road, Dixon, CA 95620, USA (Mike_Casazza@usgs.gov)
CORY T. OVERTON, US Geological Survey, Western Ecological Research Center, 6924 Tremont Road, Dixon, CA 95620, USA (coverton@usgs.gov)

Expected completion: September 2009

We initiated a pilot study in the winter of 2006 to investigate the utility of miniaturized solar-powered PTT transmitters to track band-tailed pigeons throughout the year. This technique enables year-round monitoring of pigeon locations, between year site fidelity to breeding or wintering areas, migration pathways and relative exposure to hunting pressure. Preliminary findings were encouraging and funding was secured through the Webless Migratory Game Bird Research Program, U.S. Fish and Wildlife Service Region 1, California Department of Fish and Game, Oregon Department of Fish and Wildlife, and Washington Department of Fish and Wildlife to expand the study throughout the breeding range of Pacific Coast band-tailed pigeons.

Subsequent to the pilot work in 2006, we marked two band-tailed pigeons 20 km NE of Sacramento, CA with two remaining transmitters from preceding study efforts. The duty cycle for these transmitters was 96 hours off (i.e. for solar charging) and 10 hours on, (i.e. location transmission). Twenty additional transmitters with a shorter duty cycle; 48 hours off and 10 hours on were obtained for deployment during the 2007 breeding season. In August 2007, we marked fourteen band-tailed pigeons at six locations in California, Oregon, Washington, and Nevada (near CA border at Lake Tahoe). We trapped four additional birds in British Columbia, one bird in Washington and two birds in California during the breeding season of 2008 (July/August). This provided a total of twenty one birds marked in 2007-2008 (Figure 1). Success of the 2007 batch of transmitters has been lower than the 2006 batch of transmitters. Intermittent signals and relatively poor battery life have resulted in lower data quality from the 2007 transmitters. We suspect the shorter duty cycle (48 hours) to be insufficient to recharge the solar batteries to ensure reliable transmission of each bird's location.

Migration – Timing

Spring migration started on May 23 in 2006 (n=2), April 25 in 2007 (n=2) and April 16 in 2008 (n=7). The duration of the Spring migration period ranged from 15 to 36 days with an overall mean of 19 days (Figure 2). Most of our data on Fall migration was obtained in 2007 and 2008 with an average start date of September 23, and an average end date of November 7th for a duration averaging 45 days (n=22) (Figure 2).

Migration – Distance

Radio-marked pigeons had a high fidelity to their breeding areas. The average distance between the center of their breeding season home ranges was only 2.9 km (n=9) while the average distance between the center of winter season home ranges was 132 km (n=7). The overall average distance traveled between winter and breeding season use areas was about 740 km (n=35).

Field Visits

We visited winter use areas of PTT marked band-tailed pigeons in May of 2008 to identify habitats utilized during the winter period in both California and Oregon. Habitats identified include both mixed conifer and deciduous forests (Photos 1 & 2).

Mineral Sites

Virtually all birds were located within 35Km of a mineral site during the breeding season. The only exceptions were California marked birds, including the bird marked in Carson City, NV and the two birds marked near Morgan Hill, CA in 2008. The distribution of known mineral sites in California does not include these areas, suggesting unknown mineral sites may be present.

Hunting Season

We are continuing to analyze pigeon location data from the 2008 hunting season. For 2007, no bird had left the original state in which it was trapped by the end of the September hunting season (September 15-23; Figure 3). One bird in Washington still exhibited nesting behavior (highly localized movements) during the hunting season and one had moved from its capture location at Sequim to the east of Kelso, WA. Two birds breeding in Oregon (one from McMinnville the other marked near Sacramento, CA) initiated migration during the hunting season but remained in Oregon throughout. None of the California breeding birds (including the bird marked in Carson City, NV) exhibited any large movements during the early California hunting season. Locations of birds during the hunting season were often found near mineral sites. Of the 14 birds with adequate hunting season locations (excluding one bird from Sequim, WA and the bird marked at the Dutch Canyon, OR mineral site), 9 birds were located at least once within 10Km of a known mineral site. One additional bird was located once 16Km from a mineral site and an additional bird location 27Km. The three birds marked in California were all located >60Km from a known mineral site. The McMinnville bird that initiated fall migration during the hunting season was found within 15 Km of three separate mineral sites during the 9 day hunting season.

Conclusion

The 2008 band-tailed pigeon satellite telemetry season has provided abundant information on Pacific Coast band-tailed pigeon migration patterns. We will continue to develop analytic methods to quantify migratory pathways and timing, assess exposure during hunting seasons, seasonal site fidelity, and evaluate seasonal use areas. In 2009, we will continue to monitor the remaining functional transmitters and prepare a final report. Results from this project can be viewed on our website: http://www.werc.usgs.gov/dixon/pigeon/.

Primary support for this two-year project has been provided through a grant from the Webless Migratory Game Bird Research Program administered by the US Fish and Wildlife Service. Partners include the California, Oregon, and Washington state wildlife agencies, Quail Unlimited and the Canadian Wildlife Service. Final completion of this project is expected in September of 2009.

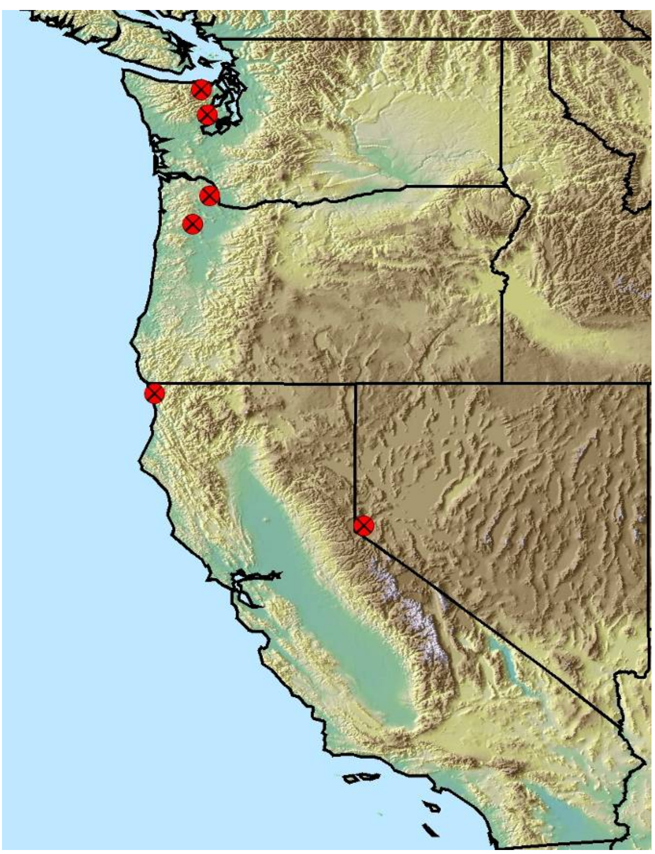

Figure 1. Pacific Coast band-tailed pigeons were captured and fitted with 12 gram back-pack mounted satellite transmitters at six locations in August 2007 (red) and 3 locations in 2008 (green).

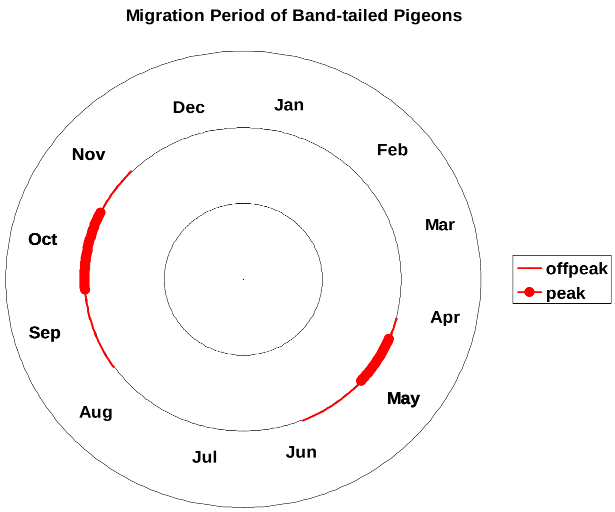

Figure 2. Migration timing of Pacific Coast band-tailed pigeons.

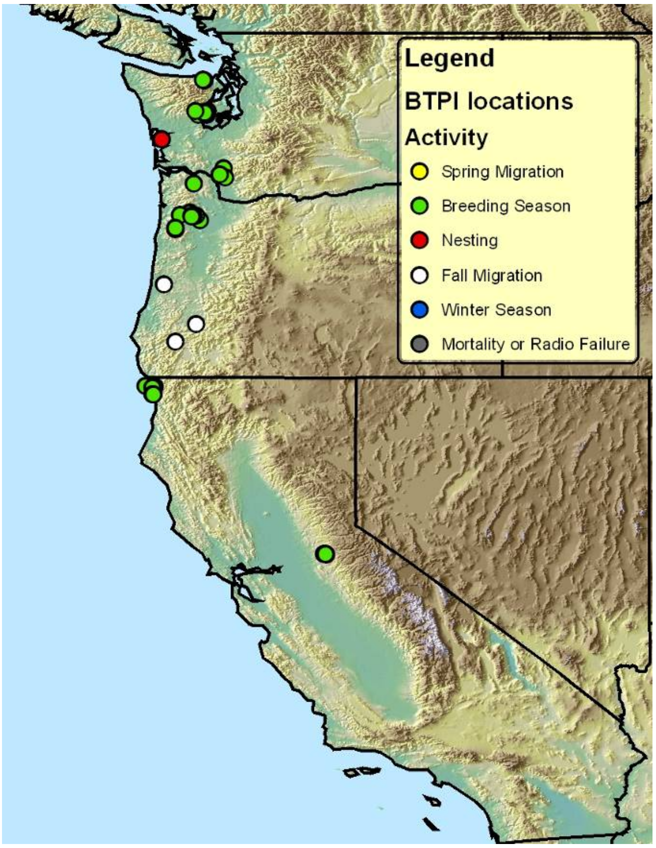

Figure 3. Band-tailed pigeon locations during the September 2007 hunting seasons. All birds remaining within the state in which they were marked, though two had begun southward migrations.

Photo 1. Winter use areas of band-tailed pigeons (coniferous forest) in California. *Photo by Eric Kolada.*

Photo 2. Winter use area of band-tailed pigeons including deciduous and coniferous forest areas during May 2008. *Photo by Eric Kolada.*

Sandhill Cranes

Food Production in Habitats Utilized by the Rocky Mountain Population of Sandhill Cranes during Breeding, Migration, and Wintering

LEIGH H. FREDRICKSON, Department of Wildlife and Fisheries Sciences, South Dakota State University, Brookings, ND 57007, USA (leighfredrickson@wildblue.net)

Graduate students: Tandi Perkins, PhD, **expected completion:** December 2009; Diana Iriarte, MS; Bret Beasley, MS; **Expected completion:** August 2009.

Reporting period: November 2007 through November 2008.

The Rocky Population (RMP) of Sandhill Cranes is faced with increasing habitat loss and degradation from urbanization of historic habitats, changes in agricultural practices, drought, and competing use of surface and ground water that compromise habitat conditions at historic use sites (Figure 1). Biologists and managers lack information about the distribution, availability and quality of wetland foraging habitats at a local landscape scale and the characteristics of wetland systems that provide quality foods throughout the range of RMP cranes (Tacha et al. 1992 and 1994). Information generated during this study will enable resource managers to understand the importance of a wide array of wetlands and the role of wetland management in providing quality feeding habitats for migratory RMP cranes. Information that identifies the distribution, nutrient composition, and abundance of invertebrate and plant foods is critical for RMP crane management. The objectives of this study are: (1) Quantify the availability, distribution, nutritional characteristics of foods produced in temporary, seasonal, and agricultural habitats on public and private lands across the breeding, fall staging, stopover, and wintering grounds of RMP cranes, (2) Compare biomass, gross energy, and crude protein levels of common animal and plant foods (temporary and seasonal wetlands) with agricultural foods (waste grain and alfalfa) on breeding, fall staging, stopover, and wintering grounds of RMP cranes, and (3) Determine the potential of each habitat type to meet nutrient requirements of RMP cranes while on breeding, fall staging, stopover, and wintering grounds, using existing RMP crane energetic models specific to each area and annual cycle event.

One PhD and two M.S. students are assigned to the project. The PhD initiated pilot investigations during September 2004 and field studies were continuous until mid-September 2007. M.S. students initiated field studies in 2006 and completed these field investigations during September 2007. The students returned to South Dakota State University in Brookings, SD to complete coursework, sorting samples, organizing data for analysis, and addressing other Departmental requirements. Three migration sites heavily used by cranes were sampled in Colorado and New Mexico whereas sites in Idaho represented conditions during breeding, brood rearing and fall staging.

M.S. students completed class requirements during spring semester and other requirements in fall 2008. The PhD student also finished classwork during spring semester and initiated data formatting for the dissertation by midsummer. Writing will be a focus for all three students beginning in fall 2008. This progress report is the third for a 2-year study funded by the Webless Migratory Game Bird Research Program (U.S. Fish and Wildlife Service) with additional support provided by two SSP projects (USGS), U.S. Fish and Wildlife Service SCEP program in Regions 2 and 6, with significant in-kind support from Refuges in Region 1, 2, and 6, the South Dakota Cooperative Fish and Wildlife Unit, the Department of Wildlife and Fisheries Sciences South Dakota State University, The Friends of Bosque del Apache NWR, and Wetland Management and Educational Services, Inc.

Figure 1. A pair of sandhill cranes from the Rocky Mountain Population on seasonal wetlands at Grays Lake National Wildlife Refuge, ID. *Photo by Steve Sherman.*

STUDY AREA

Three focus areas in Idaho, Colorado, and New Mexico that are heavily used by the RMP of sandhill cranes were selected for above and below ground food sampling on federally managed sites (Figure 1). These sites represent areas of high use by the RMP of sandhill cranes during breeding, migration, and wintering and include high montane wetland systems in Idaho (breeding) and Colorado (migration) and an important riverine wintering area in New Mexico. All primary sites are under management by US Fish and Wildlife Service on refuges in Regions 1, 2, and 6 and include nearby private lands as well.

Grays Lake is a 20,125 acre USFWS refuge in Region 1 that lies within a high montane basin in Caribou and Bonneville counties in southeastern Idaho. The area has a long history of importance for breeding sandhill cranes and includes temporary, seasonal, and semipermanent wetlands as well as wet meadow habitats at an elevation of 1946 msl. The Grays Lake Basin has largely escaped the urban development so common in many western mountain valleys. The anthropogenic modification on this site primarily results from water issues in combination with perturbations associated with roads and ranching practices. At the turn of the 20th century, water from Grays Lake was diverted from the natural outlet on the northwestern portion of the basin to a man-made outlet on the southwestern portion of the basin that transfers water into the Blackfoot Reservoir under the control of BIA. This transfer of water has stabilized the hydrology within the basin and this stability is reflected in the wetland plant community. The predominate vegetation communities used by cranes include the robust emergent community as well as barley that is planted specifically for crane management.

The San Luis Valley in southern Colorado is a unique montane basin that includes two distinct geomorphic conditions. The Rio Grande River flows through the southeastern portion of the basin along with several other montane streams. These floodplains have formed riverine wetlands of great importance to the RMP of sandhill cranes. In contrast the northeastern portion of the basin is a closed basin and no surface water flows from the basin naturally. Within this high mountain valley the USFWS has four refuges that have value for and a history of use by sandhill cranes. These include historic sites on Alamosa and Monte Vista NWRs in Alamosa and Rio Grande counties. Alamosa is a floodplain refuge whereas; Monte Vista is sited on a large alluvial fan that developed from water moving from the San Juan Mountains. In addition several state-owned areas are of importance for sandhill cranes including Russell Lakes, Rio Grande, and Hgiel Wildlife Management Areas. Rio Grande and Hgiel are in the floodplain of the Rio Grande River but Russell Lakes in within the closed basin portion of the Valley.

The wintering site for RMP of sandhill cranes is within the Middle Rio Grande south of Albuquerque in New Mexico. The US Fish and Wildlife Service and New Mexico Department of Game and Fish have management areas of great importance of the wintering population of RMP of sandhill cranes. Bosque del Apache National Wildlife Refuge has a long history of management for cranes and more recently several state areas such as Bernardo and La Joya have emphasized management for wetland birds including the sandhill cranes.

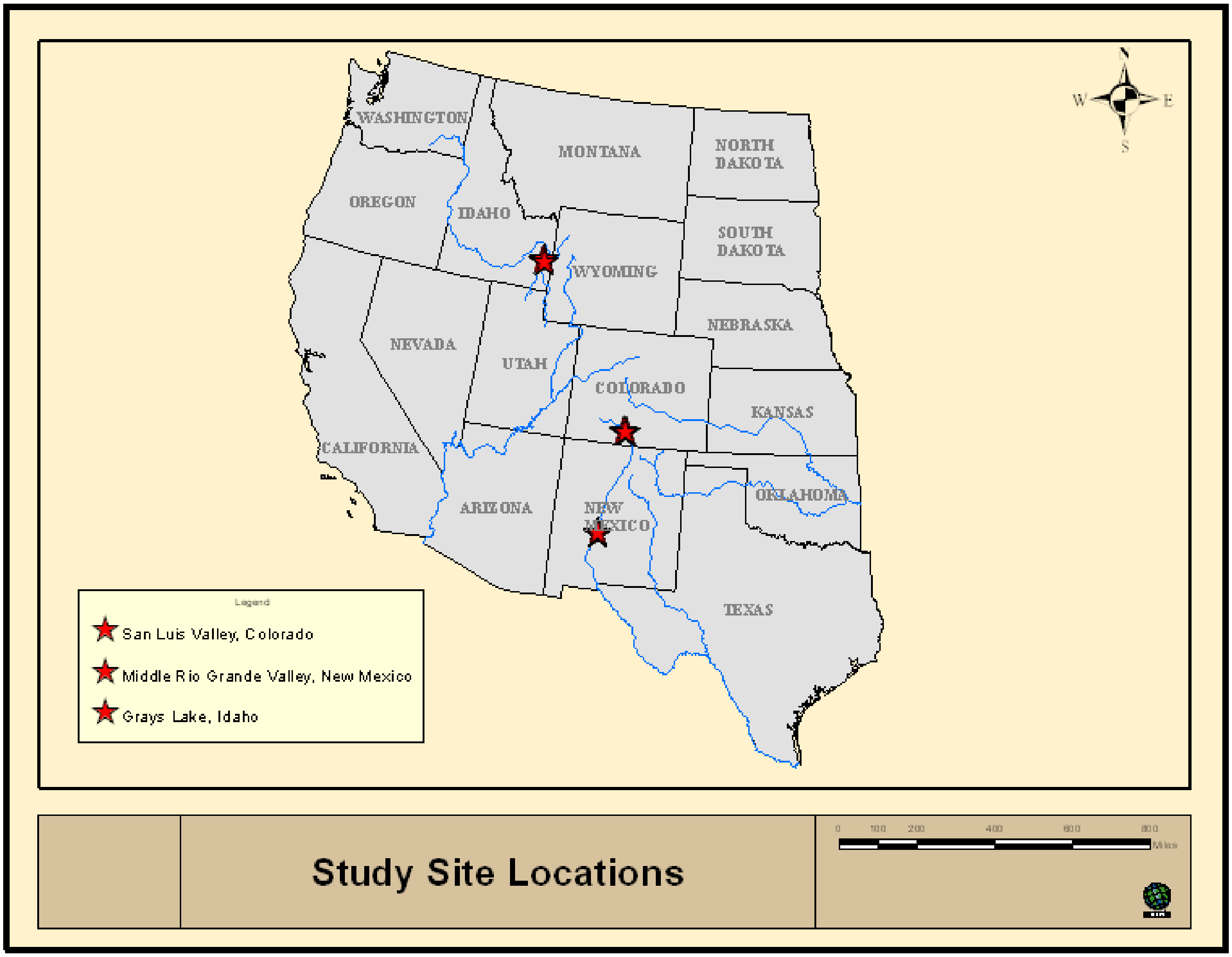

Figure 2. Primary sampling locations associated with sandhill crane use of agricultural , wetland and wet upland/meadow habitats from the breeding grounds to wintering sites within the United States.

METHODS

Sampling Site Selection

Scan sampling identified sites of high crane use across the study area from Idaho to New Mexico (Figure 1). Detailed descriptors of habitat type and condition were identified from remote sensing data in combination with on-site verification of plant species or crop conditions and hydrologic variables. The abundance and distribution of cranes were determined at frequent intervals across the annual cycle and across the habitats utilized. In contrast food sampling was discontinuous with a focus on specific life cycle events depending on the study site (Figure 2). For Grays Lake the timing of sampling was related to food conditions during nesting, at the time that broods were being reared, and during fall staging. In the San Luis Valley, a migration stopover habitat, the sampling was at the mid-point for crane presence at the site. For Bosque del Apache and the middle Rio Grande system sampling occurred soon after arrival on the wintering grounds and immediately before departure from the wintering grounds.

Field Sampling Strategy

A stratified random sampling design was utilized to sample 589 $1m^2$ quadrates for above and belowground food resources between September 2006 and August 2007 throughout the intermountain west corridor. Sample collection occurred during six sampling periods which correlated with the midpoint of the breeding and post-breeding (Grays Lake NWR, ID), spring staging (San Luis Valley, CO), and wintering, and spring migration (Bosque del Apache NWR, NM) life cycle events. Samples were collected within three natural wetland habitats including seasonal, temporary, and ephemeral wetlands in addition to two agricultural habitats including small grains (corn and barley) and alfalfa. Within each habitat type, 3 sites of observed above average use by cranes as determined from scan sampling and 3 sites of no observed use by cranes were randomly chosen for sampling (Figure 3). Within each site, 3 locations were randomly chosen for data collection.

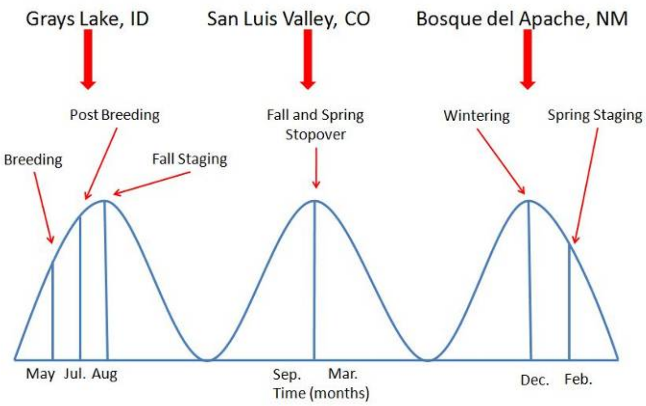

Figure 2. Timing of sampling to determine above and below ground food sources on three study sties in the Rocky Mountain corridor from Idaho to New Mexico that receive heavy use by the Rocky Mountain Population of sandhill cranes.

Data Collection

A suite of variables including vegetation composition/percent cover, weather condition, water quality, and soil characteristics as well as a GPS point were collected at each quadrat and stored into a Trimble Geo XH for further analyses. Aboveground food resources sampling was conducted by vacuuming each quadrat to obtain 95% of all loose components with a modified leaf blower (Penny 2003). Three belowground subsamples were taken with a cylindrical core measuring 10 cm wide x 5 cm deep within the soil horizon from each 1 m² quadrat. Samples were labeled, placed in bags, and stored in a frozen condition.

Laboratory Procedures

All samples were transported to the laboratory at SDSU for sorting. Following sorting, food items were identified, enumerated, dried and weighed (Figure 4). Seeds, tubers, and invertebrates were sorted from above and belowground samples using a 2.36 mm sieve with the assumption that sandhill cranes do not forage on food components smaller than barley seed (2.50 mm). Seeds and tubers were identified to genus and invertebrates were identified to family using identification keys. Seeds and tubers were initially weighed to the fourth decimal place then dried in a forced air dryer at 60°C for 24 hours to obtain dry weight estimates. Invertebrate lengths were measured for use with published length to weight conversion formulas. Soil obtained from the 3 belowground subsamples taken from each quadrat was homogenized and used to measure soil pH and electrical conductivity (EC) utilizing the ECp method.

Figure 3. Depiction of three randomly selected 1 m^2 quadrates within a habitat type (polygon) for above ground food resources and the three cores within each 1 m^2 quadrat for below ground food resources that represented sites with heavy and no sandhill crane use.

Figure 4. Initiation of the sorting process in the Laboratory after thawing the frozen samples and using sieves to separating seeds of a minimum size.

RESULTS

All food samples were sorted by July 2008 and identification was completed by October 2008. The summarization of crane distribution and use data has been completed for the Middle Rio Grande at Bernardo Wildlife Management Area and Bosque del Apache NWR.

A total of 589 1 m^2 quadrats were sampled from three primary study sites where cranes occur in high abundance from Idaho to New Mexico (Table 1). Thus there were 589 above ground samples but three times as many below ground samples or a total of 1767 below ground samples representing food resources on sites where there was heavy crane use and no crane use.

A diverse mix of plant and animal foods were encountered in the above and below ground samples. Eight classes of invertebrates were encountered that represented 12 Orders and 36 Families (Table 1). Classes encountered were the Arachnida, Bivalvia, Chilopoda, Diplopoda, Gastropoda, Insecta, Oligochaeta, and Malacostraca. The Insecta

had the most representative organisms is 29 families. The Order Coleoptera had the riches mix of representatives in 13 families. The Families Anthicidae, Byrrhidae, Cantharidae, Carabidea, Chrysomelidae, Coccinellidae, Curculionidae, Dermestidae, Elaterdae, Scarabeaeidae, Silphidae, Staphylinidae, and Tenebrionidae had representatives in the samples. Quantitative analyses have not been completed but inspection of raw data suggests some organisms used by sandhill cranes were more prevalent in non-use sites as compared to use sites.

Twenty three plants foods were indentified from the above and below ground samples (Table 2). Most of the plant resources identified were seeds but a few below ground resources of great value were encountered in the samples from Bosque del Apache NWR and Grays Lake NWR (Figure 5.).

Table 1. Taxons of invertebrates encountered in 589 above and below ground samples taken from crane habitats distributed from Idaho to New Mexico.

Class	Order	Family
Arachnida	Araneae	
	Pseudoscorpiones	
Bivalvai		Sphaeriidae
Chilopoda	Geophilomorpha	Lithobilidae
Diplopoda		
Gastropoda		Lymnaeidae
		Physidae
		Planorbidae
		Unknown
Insecta	Blattodea	Blattellidae
	Coleoptera	Anthicidae
		Byrrhidae
		Cantharidae
		Carabidae
		Chrysomelidae
		Coccinellidae
		Curculionidae
		Dermestidae
		Elateridae
		Scarabaeidae
		Silphidae
		Staphylinidae
		Tenebrionidae
		Unknown
	Diptera	Strationmyidae
		Tabanidae
		Unknown
	Hemiptera	Cicadellidae
		Cicadidae
		Cydnidae
		Gerridae
		Pentatomidae
		Pseudococcidae
	Hymenoptera	Cimbicidae
		Fprmicidae
		Sphecidae
		Tenthredinidae
		Vespidae
		Unknown
	Lepidoptera	Pyralidae
		Noctuidae
		Unknown
	Odonata	
	Orthoptera	Acrididae
		Unkown
Oligochaeta		
Malacostraca	Isopoda	Armadillidiidae

Figure 5. *Phleum t*ubers commonly used by sandhill cranes in the Grays Lake Basin, Idaho.

Grays Lake had the riches sources of foods for cranes which are most likely related to the fact that food resources sampling from this site took place during the growing season when the widest variety of food resources would be expected for both plant and invertebrates resources.

DISCUSSION:

The above and below ground sampling at Grays Lake during the study focused on sites that were heavily used by sandhill cranes during specific time periods that represented the timing of important life cycle events during breeding. Previous work (Perkins 2003) on invertebrates at Grays Lake provided a more comprehensive overview of the potential for invertebrate resources within a wider suite of wetland habitats on a more continuous basis.

Some preliminary observations from this study suggests the richest source of foods based on above and below ground food resources during the year was encountered at Grays Lake, an important breeding and fall staging area for the RMP of sandhill cranes. All of these samples were taken during the growing season when the production of plant and invertebrate food resources would be expected to be highest. During the period covered by sampling at Grays Lake, sandhill cranes were completing a number of important life cycle events including prebreeding, nest site selection, nesting, brood rearing, post-breeding dispersal, and the early phase of fall staging. These life cycle events have many different nutritional requirements ranging from high energy to high protein needs. The rich source of foods during this period indicates the potential for meeting the needs of breeding birds at Grays Lake.

Table 2. Taxons of plant foods encountered in 589 above and below ground samples taken from wetlands used by sandhill cranes from Idaho to New Mexico.

Genus	Species
Abutilon	theophrasti (seed)
Allium (seed)	
Alopecurus	
Avena	fatua (seed)
Avena	sativa (seed)
Bromus	inermis (seed)
Carex (seed)	
Concolvus (seed)	
Cynoglossum	officinale (seed)
Cyperus	esculentus (tuber)
Datura (seed)	
Elaeaguns	augustifolia (seed)
Helianthus (seed)	
Hordeum	vulgare (seed)
Hordeum	jubatum (seed)
Ipomea (seed)	
Lupinus (seed)	
Malva (seed)	
Phluem	pratense (tuber)
Polygonum (seed)	
Potentilla (pod)	
Tragopgon (seed)	
Viola (seed)	
Xanthium	
Zea	mays (seed)
Unknown (seed)	
Unknown (tuber)	

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Movement patterns of Sandhill Cranes (*Grus canadensis tabida)* wintering along the Lower Colorado River of Arizona

MICHAEL INGRALDI, Arizona Game and Fish Department, 5000 W. Carefree Highway, Phoenix AZ 85086
VINCENT FRARY, Arizona Game and Fish Department, 5000 W. Carefree Highway, Phoenix AZ 85086

Expected completion: October 2010

The Greater Sandhill Crane (*Grus canadensis tabida*) wintering population along the lower Colorado and Gila Rivers of Arizona are unique due to their short migration pathway; nesting primarily in scattered intermountain wetlands of northeastern Nevada, and southwestern Idaho and wintering in Arizona and California (Figure 1). This local population of Greater Sandhill Cranes, designated the Lower Colorado River Valley (LCRV) population, is the smallest of the five management populations recognized in the United States (Drewien and Lewis 1987 and Meine and Archibald 1996). In a recent environmental assessment of proposed hunting regulations for LCRV cranes within the Pacific Flyway the issue was raised regarding the discrepancy between the breeding and wintering population numbers. Specifically, there appear to be more birds in the LCRV wintering population than can be accounted for on the breeding grounds (e.g., only approximately 30% of the wintering population has been located within the Nevada summer range). This discrepancy suggests one or more of the following possibilities: 1) the summer range includes a larger area than currently identified (i.e., not all the birds are being counted), 2) the summer ranges of the LCRV population and/or the Rocky Mountain and Central Valley populations are not mutually exclusive, 3) there is only one population of western Greater Sandhill Cranes with subpopulations utilizing distinct wintering areas and/or, 4) summer ranges are distinct with some ‘mixing’ of populations occurring during migration and on winter ranges.

The objective of this study is to monitor seasonal movements of LCRV cranes using satellite transmitters and re-sighting of visual identification (VID) bands in order to clarify the dilemma described above. Attempts at trapping cranes for this project began in November 2008, and are currently ongoing. All trapping has been conducted at Cibola National Wildlife Refuge (CNWR) in Cibola, Arizona (Figure 2). We have tested three crane capture methods including cannon netting over baited sites, cannon netting using crane decoys as an attractant, and spotlight/hand-capturing cranes after dark.

Thus far, we have trapped 3 LCRV cranes during a single successful cannon-net capture over a baited site. Unfortunately, at the time when cranes were trapped we had not yet received satellite transmitters from the manufacturer. Trapped cranes were banded with a VID band and a United States Fish and Wildlife Service (USFWS) aluminum band. All band information was reported to the U.S. Department of the Interior Bird Banding Laboratory.

We are planning to continue trapping cranes until they depart CNWR (anticipated mid-March) in attempts to deploy all six satellite transmitters currently on-hand in addition to banding individuals. We are also planning to travel to Nevada during the crane breeding season in order to search for VID bands and to observe nesting locations of any satellite-transmittered LCRV cranes.

These are results thus far from an ongoing single-year study funded through the USFWS Webless Migratory Game Bird Research Program and the Arizona Game and Fish Department.

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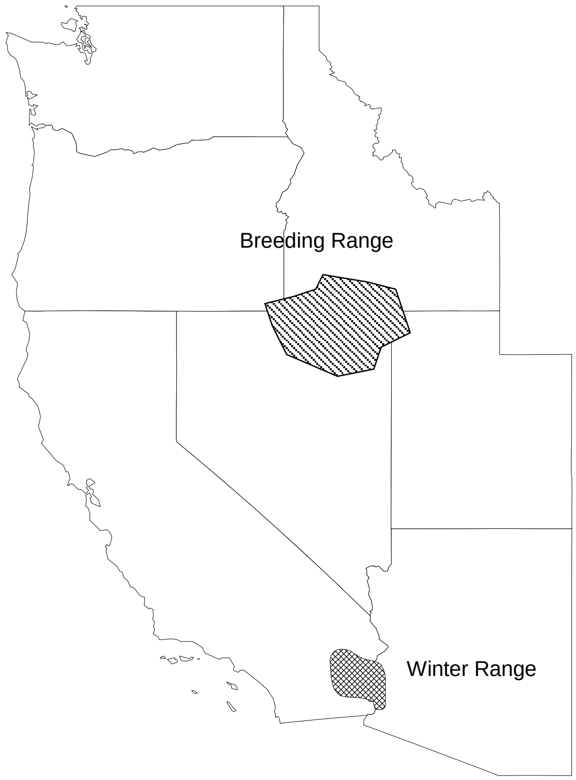


Figure 1. Approximate breeding and wintering distribution of the Lower Colorado River Valley Population of Sandhill Cranes. Only an estimated 30% of the wintering population can be accounted for on breeding grounds in Nevada and Idaho.

Figure 2. Sandhill crane trap site at Cibola National Wildlife Refuge in Cibola, Arizona. Cranes are attracted to trap sites using corn, millet, and/or barley, and trapped using cannon nets.

American Woodcock

American Woodcock Singing-ground Surveys in the Western Great Lakes Region: Assessment of Trends in Woodcock Counts, Forest Cover Types along Survey Routes, and Landscape Cover Type Composition

DAVID E. ANDERSEN, Minnesota Cooperative Fish and Wildlife Research Unit, 200 Hodson Hall, 1980 Folwell Avenue, St. Paul, MN 55108, USA (dea@umn.edu)
MATTHEW NELSON, Minnesota Cooperative Fish and Wildlife Research Unit, Department of Fisheries, Wildlife, and Conservation Biology, University of Minnesota, 200 Hodson Hall, 1980 Folwell Avenue, St. Paul, MN 55108, USA (nels5558@umn.edu)
JAMES R. KELLEY, U.S. Fish and Wildlife Service, Division of Migratory Bird Management, BH Whipple Federal Building, 1 Federal Drive, Fort Snelling, MN 55111-4056, USA (James_R_Kelley@fws.gov)

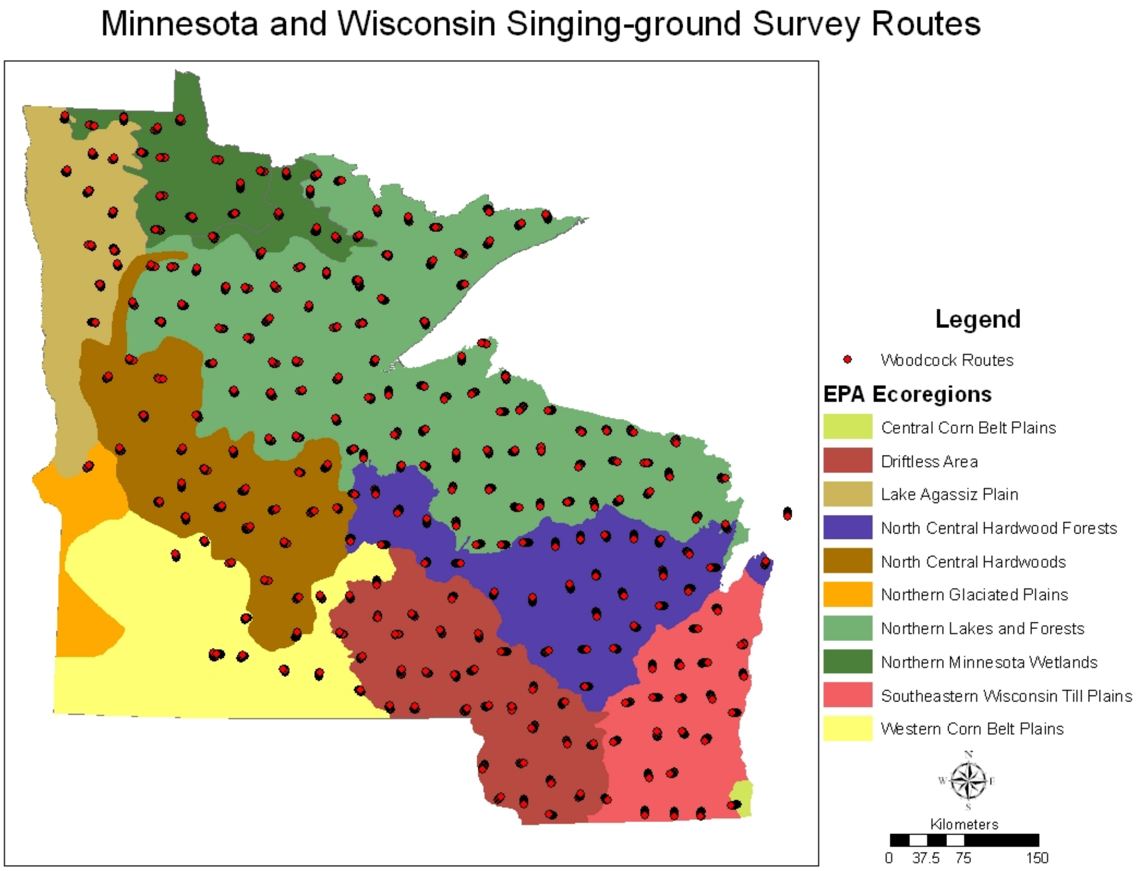
Estimated completion date: 2009

Introduction and Objectives

Declines in the number of American woodcock (*Scolopax minor*) detected on the annual Singing-ground Survey have lead to reductions in hunting bag limit and season length, delaying season framework opening dates, and development of a management plan to increase woodcock population size. However, trends in counts of woodcock along survey routes are difficult to interpret without an understanding of forest cover type composition along survey routes, and how well cover type along routes represents cover type composition in the larger landscape. Woodcock use early successional cover types in forested landscapes for courtship and breeding, and declines in counts on the Singing-ground Survey may reflect changes in extent and distribution of cover types along survey routes. Because the location of survey routes does not change, and because survey routes are generally located along secondary roads that existed at the time the survey was developed (1968), it is not known whether survey routes are currently representative of the landscapes in which they occur. The relationship between cover type characteristics along existing survey routes and cover type characteristics of the larger landscapes in which routes occur has been assessed in only a few locations. In the Central Management Region, only in Michigan has an assessment been completed comparing landscapes covered by Singing-ground Survey routes and land cover across the state, with few and small differences noted.

In the Central Management Region, changes in extent of cover types used by woodcock are thought to have influenced woodcock abundance. Since the mid-1960s, the total area of aspen (*Populus* spp.), an important component of woodcock habitat, decreased by 21% in Michigan, Minnesota, and Wisconsin. However, although the percentage of aspen-dominated cover types in the landscape has decreased throughout the western Great Lakes region, the extent of hardwood seedling-sapling cover types increased 23% in Minnesota from 1962-1990 and 3% in Wisconsin from 1968-1996. During this same period, the number of singing woodcock detected on routes declined 29% in Minnesota and 44% in Wisconsin. Thus, the cause of apparent population declines may vary across the breeding range of woodcock. Similarly, the relationship between extent and distribution of cover types used by woodcock along survey routes and their extent and distribution in the larger landscape may also vary across regions.

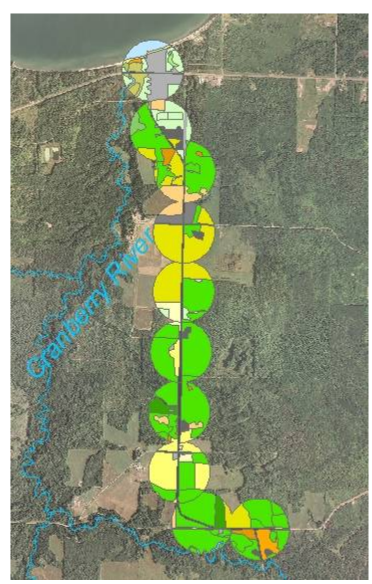
Determining the relationship between extent and distribution of cover types used by woodcock along survey routes and their extent and distribution in the larger landscape is a priority for management of woodcock. Furthermore, how changes in extent and distribution of cover types along survey routes are related to changes in apparent woodcock abundance can be different in different landscapes, and as indicated above, reasons for changes in apparent abundance in Minnesota and Wisconsin are not currently evident. Change across the breeding range from early successional forest types and old fields to landscapes with more mature forested habitat is widely regarded as the reason for apparent



Location of American woodcock Singing-ground Survey routes by Ecoregion in Minnesota and Wisconsin.

woodcock population declines, and woodcock abundance appears to be negatively correlated with an increase in the extent of urban-industrial land uses in the northeast U.S. It is not evident whether these same factors are operating in the Central Management Region.

To address these issues in the Central Management Region, our overall project objective is to better understand the relationship(s) between changes in counts of woodcock on Singing-ground Surveys in Minnesota and Wisconsin and forest land cover. We propose to (1) assess patterns in annual counts of woodcock along existing survey routes, (2) assess changes in time in land cover types along these routes, (3) relate temporal changes in woodcock counts to changes in land cover composition, and (4) compare current cover type composition along routes to current landscape cover type composition. If possible, we will also compare past cover type composition along survey routes to landscape cover composition.



Buffered stops and associated habitats as delineated from aerial photographs along an American woodcock Singing-ground Survey route in northern Wisconsin.

Progress to Date

To date, we have verified the locations of all Minnesota woodcock routes and are in the final steps of verification for Wisconsin routes. Based on location, consistency of being surveyed, and trends in counts, we selected 52 Minnesota routes and 48 Wisconsin routes that will be used to examine how woodcock counts are related to changes in landcover. We have compiled large-scale landcover data for Minnesota and Wisconsin for multiple time periods and are in the process of delineating landcover surrounding selected routes. We have compiled SGS count data and conducted preliminary analyses of trends in counts by route and state. We are also evaluating analytical methods to determine the best approach to relate count data and landcover.

Future Work

During the next year, we will work to accomplish the following:

(1) Compile local landcover data for selected routes and validate a portion of those routes to determine classification accuracy.

(2) Assess trends in woodcock counts from SGS routes in Minnesota and Wisconsin and evaluate changes in landcover along survey routes.

(3) Determine appropriate analytical approaches to relate woodcock counts to landcover data and comoplete data analyses.

This is a summary of the second year of a 3-year study funded by the Webless Migratory Game Bird Research Program (U.S. Fish and Wildlife Service), the Minnesota Department of Natural Resources, the Wisconsin Department of Natural Resources, Woodcock Minnesota, and the Minnesota Cooperative Fish and Wildlife Research Unit (U.S. Geological Survey and the University of Minnesota).

Agricultural Wintering Habitat as a Limiting Factor for Woodcock in the Southeast: Thirty Years of Agroecosystem Change

EMILY BLACKMAN, Fisheries and Wildlife Sciences Program, North Carolina State University, Box 7646, Tuner House, Raleigh, NC 27695, USA

CHRISTOPHER S. DePERNO, Fisheries and Wildlife Sciences Program, North Carolina State University, Box 7646, Tuner House, Raleigh, NC 27695, USA (csdepern@ncsu.edu)

M. NILS PETERSON, Fisheries and Wildlife Sciences Program, North Carolina State University, Box 7646, Tuner House, Raleigh, NC 27695, USA

CHRISTOPHER E. MOORMAN, Fisheries and Wildlife Sciences Program, North Carolina State University, Box 7646, Tuner House, Raleigh, NC 27695, USA

RICHARD A. LANCIA, Fisheries and Wildlife Sciences Program, North Carolina State University, Box 7646, Tuner House, Raleigh, NC 27695, USA

RON W. HEINIGER, Vernon G. James Research and Extension Center North Carolina State University, 207 Research Station Road, Plymouth, NC 27962, USA

Graduate Student: Emily Blackman (M.S.); **expected completion:** 2009

Introduction and Objectives

American woodcock habitat and populations have declined in North Carolina, across the Southeast, and range-wide. American woodcock populations declined 1.0% per year between 1966 and 2000 and 6.8% per year between 1980 and 2003. Woodcock are listed as a Species of High Concern by the U.S. Shorebird Conservation Plan, a Game Bird Below Desired Condition by the U.S. Fish and Wildlife Service, and a "yellow list" species in slow decline and of national conservation concern by the National Audubon Society. Little is known about the reasons behind the decline of this shorebird. Potential causes include changes in habitat from new agricultural methods, hunting mortality, the disruption of food webs by invasive earthworm species, and disease.

We are studying woodcock in eastern North Carolina, near Lake Mattamuskeet National Wildlife Refuge.

Agricultural changes between 1970 and 2006 may have had the greatest impact on American woodcock populations in this area. In the early 1970s, corn, soybean, and small grains were the dominant crop types. However, changes in the prices paid for small grains in relationship to corn and soybean have resulted in changes in crop rotation. Today, soybean and cotton are the primary crops on many farms. Other changes over the past 30 years include reductions in tillage, narrower row spacing, adjustments in seeding rate, and adoption of transgenic cultivars.

Research by North Carolina State University faculty and graduate students in the 1970s and early 1980s showed that woodcock primarily used soybean fields in a ridge and furrow system. In our current study, we will revisit the same location and compare current woodcock habitat use and diet with previous results. Also, we will test for avian influenza and woodcock reovirus in the population.

Progress to Date

We have compiled information on current agricultural practices on the study site. Fields have been classified into three cropping systems (no-tilled, tilled, or bedded) and four crop types (soybean, corn, cotton and winter wheat). Currently, there are tilled soybean, corn, cotton, winter wheat fields, no-tilled soybean fields, and one traditional furrow soybean field.

Future Work

This winter, we will conduct surveys of woodcock in the different field types to determine nocturnal habitat use. We will collect soil and earthworms from randomized locations in these same fields; soil samples will be analyzed for nutrient content and pesticides, and earthworms will be identified to species. Also, we will collect earthworm samples from sites where birds are seen to compare use vs. availability. Several woodcock will be captured for diet analysis and tested for avian influenza and reovirus. Results will be compared with previous research.

This summary describes a pilot project funded by the Webless Migratory Game Bird Research Program (U.S. Fish and Wildlife Service) and North Carolina State University.

Investigate Communication Strategies to Support Implementation Strategies of the North American Woodcock Conservation Plan

SCOT J. WILLIAMSON, Wildlife Management Institute, 69 Clinton Avenue, St. Johnsbury, VT 05819, USA (wmisw@together.net)
DAVID J. CASE, D.J. Case & Associates, 317 E. Jefferson Boulevard, Mishawaka, IN 46545, USA (dave@djcase.com)
REBECCA CHRISTOFFEL, D.J. Case & Associates, 317 E. Jefferson Boulevard, Mishawaka, IN 46545, USA (rebecca@djcase.com)

Expected completion: 2009

Introduction and Objectives

The draft *American Woodcock Conservation Plan* has established a goal of producing an additional 3.2 million acres of early successional habitat (ESH) to existing ESH levels in Bird Conservation Region (BCR) 14 to advance full recovery of woodcock populations to 1970 levels. In BCR 28, the Appalachian Mountain Region, the recovery goal demands 3.0 million acres of ESH. To achieve these goals, management on private lands to increase ESH habitat is critical. Equally important, before funds are spent on habitat management, the expected response of woodcock populations to management must be understood and equitable to the investment.

The Wildlife Management Institute (WMI) and the U.S. Fish and Wildlife Service (US FWS) have begun implementation of the draft *American Woodcock Conservation Plan* through a program of woodcock habitat improvements focused initially on Bird Conservation Region (BCR)14.

The approach of the Initiative is a linked set of six strategies:

1. Develop Best Management Practices (BMPs) for American Woodcock in diverse habitat types. BMPs will be based on meta-population theory to aggregate the variety of habitats important for woodcock to create distinct source populations.
2. Implement and test BMPs on selected public and private land demonstration areas. Demonstration areas will reflect the diversity of habitat types available for woodcock.
3. Develop monitoring protocols for woodcock that measure on a scale sensitive to population response to site-specific activities and include both measures of abundance and woodcock vital rates.
4. Use monitoring protocols to monitor the population response of woodcock to habitat management.
5. Create case histories for each demonstration area that showcase habitat management BMPs and the response of woodcock populations.
6. ***Use modern communications techniques to determine effective outreach strategies to private landowners with BMPs, demonstration areas and case histories as key instructional tools. Techniques will include identification of primary audiences, evaluation of impediments, construction of key messages, development of effective outreach tools and responsive monitoring strategies.***

This abstract reports on progress made toward achieving the sixth strategy listed above.

Progress

A communications team of six individuals was formed in June 2008. The team includes Judy Stokes, Chief of Public Affairs, NH Fish & Game Department; Terri Edwards, Office of External Affairs, US FWS; Carl Graybill, Jr., retired (formerly of PA Game Commission); Scot Williamson, Vice President, Wildlife Management Institute; Dave Case, President, D.J. Case & Associates; and Rebecca Christoffel, Project Manager and Human Dimensions Specialist, D.J. Case & Associates.

A group workspace was constructed for team communications about the project. Updates and queries are posted periodically by team members and files are uploaded to the site for team members' review and comments. The team met in person at the Association of Fish and Wildlife Agencies' annual meeting in Saratoga, New York this past September to review progress, provide input on the project and modify the project's timeline.

During the summer and fall of 2008, an annotated bibliography of research related to private landowners' motivations for owning and managing woodlands, characteristics of private woodland owners, and beliefs and attitudes of private woodland owners regarding forest management was constructed.

To date, 29 telephone interviews have been conducted with natural resource (NR) professionals in BCRs 14 and 28. NR professionals were queried regarding their work in early successional (ES) forests and outreach associated with this habitat and its management. NR professionals identified perceived barriers and opportunities for ES habitat management on private lands.

Four focus groups were held in BCRs 14 and 28 during November, 2008. Focus groups were held in New Hampshire (1), New York (1), and Pennsylvania (2). Eleven landowners, primarily Coverts cooperators, attended the focus group meeting held at New Hampshire Fish & Game headquarters in Concord. Nine landowners, all of whom had worked with the local New York State Department of Environmental Conservation foresters, attended the Cortland, New York focus group. Twenty-two individuals, all of whom were Forest Stewards, attended two focus groups held concurrently at Pennsylvania State University in State College, Pennsylvania. Landowners were queried regarding the barriers and opportunities that they perceived in managing their land for ES habitat. In addition, eight messages were tested at the focus group meetings to get a feel for the degree of appeal each message had for landowners, in terms of encouraging them to manage for ES habitat.

A draft communications strategy is being developed based on existing research included in the annotated bibliography, results of 29 interviews and four focus groups.

Future Work

Based on the work described above, a survey of private woodland owners (with parcel size ≤ 100 acres) in ten states (ME, CT, VT, NH, NY, PA, OH, WV, VA, MD) will be conducted. Objectives of the survey include determining landowner:

- motives underlying landowners' management practices and decisions
- awareness of and attitudes toward managing for young trees or brush and the wildlife associated with such habitat
- willingness to manage for young trees or brush and what, if any, incentives would be necessary to induce landowners to undertake such management
- perceptions of the need for additional conservation of wildlife dependent on young tree and brush habitat
- preferences for sources of conservation information
- selected characteristics of private woodland owners and the lands they own and manage.

Two hundred landowners will be randomly selected from each state for a total sample of 2,000 landowners.

Based on the results of the survey and input from project team members, the draft communications strategy will be revised and finalized. The final communications strategy will be presented to team members by June 30, 2009.

Marsh Birds

Distribution of King Rails (*Rallus elegans*) along the Mississippi Flyway

DAVID G. KREMENTZ, USGS Arkansas Cooperative Fish and Wildlife Research Unit, University of Arkansas, Department of Biological Sciences, University of Arkansas, Fayetteville, AR 72701, USA (Krementz@uark.edu)
ABIGAIL J. DARRAH, Arkansas Cooperative Fish and Wildlife Research Unit, University of Arkansas, Department of Biological Sciences, University of Arkansas, Fayetteville, AR 72701, USA (adarrah@uark.edu)

Graduate student: Abigail Darrah (MS)**; Final report**

The migratory population of the king rail (*Rallus elegans*) has declined dramatically over the last 40 years, and research is needed to determine habitat requirements of king rails. To assess the distribution and habitat use of king rails along the Upper Mississippi Valley, we conducted repeated call-broadcast surveys at 83 sites in 2006 and 114 sites in 2007. We detected king rails at 8 sites in 2006 and 14 sites in 2007. We found king rails concentrated at Clarence Cannon National Wildlife Refuge, an adjacent private Wetland Reserve Program land, and B. K. Leach Conservation Area; these areas were located in the Mississippi River floodplain in northeast Missouri. Using the program PRESENCE, we estimated detection probability and incorporated habitat covariates into the estimation of site occupancy. We tested the fit of our data across a series of models which included percent cover of tall emergent vegetation (e.g. *Typha latifolia*, *Sparganium americanum*), short emergent vegetation (e.g. *Eleocharis palustris*, *Leersia oryzoides*), woody vegetation, and interspersion of water and vegetation (2007 only) within 50 m of the survey location. We found that the top occupancy model for 2006 included woody vegetation while the top occupancy model for 2007 included short emergent vegetation, tall emergent vegetation, interspersion, and woody vegetation. Site occupancy was negatively related to woody vegetation cover in both years and was positively related to interspersion (measured in 2007 only), while there was no consistent relationship between occupancy and tall or short emergent vegetation. To compare the habitat use of nesting and brood-rearing king rails, we randomly sampled 5-m plots within used and unused habitats during the nesting and brood-rearing seasons to measure water depth and determine dominant cover type. We fit logistic regression models to the data and selected among candidate models using AIC_c. We used the regression coefficient of top models to calculate odds ratios for habitat use. Nesting adults were more likely to use sites dominated by short emergent vegetation and deeper water, while broods were more likely to use sites dominated by short emergent vegetation and shallower water, and avoided areas dominated by tall emergent vegetation. During the nesting season throughout our study area, king rails occupied wetlands that were characterized by high coverage of short emergent vegetation, moderate coverage of tall emergent vegetation, high water-vegetation interspersion, and little or no coverage by woody vegetation. Nesting king rails used areas of deeper water, possibly as protection against mammalian predators, while broods may require shallower water for mobility and prey capture. Broods avoided areas with tall emergents, contrary to findings in other studies.

King rail. *Photo by Noppadol Poathong*, Missouri Department of Conservation.

Habitat used by foraging king rails broods at Clarence Cannon National Wildlife Refuge, Missouri. *Photo by Abby Darrah*.

Field technician Jessica Shaw in habitat used by nesting king rails at Clarence Cannon National Wildlife Refuge, Missouri. Photo by Abby Darrah.

Habitat occupied by king rails at B.K. Leach Conservation Area, Missouri. *Photo by Abby Darrah.*

Estimating Population Trends, Relative Abundance, and Effects of Management Actions on 7 Species of Webless Migratory Game Birds

COURTNEY J. CONWAY, USGS Arizona Cooperative Fish and Wildlife Research Unit, School of Natural Resources, 325 Biological Sciences East, University of Arizona, Tucson, AZ 85721, USA
CHRISTOPHER P. NADEAU, USGS Arizona Cooperative Fish and Wildlife Research Unit, School of Natural Resources, 325 Biological Sciences East, University of Arizona, Tucson, AZ 85721, USA

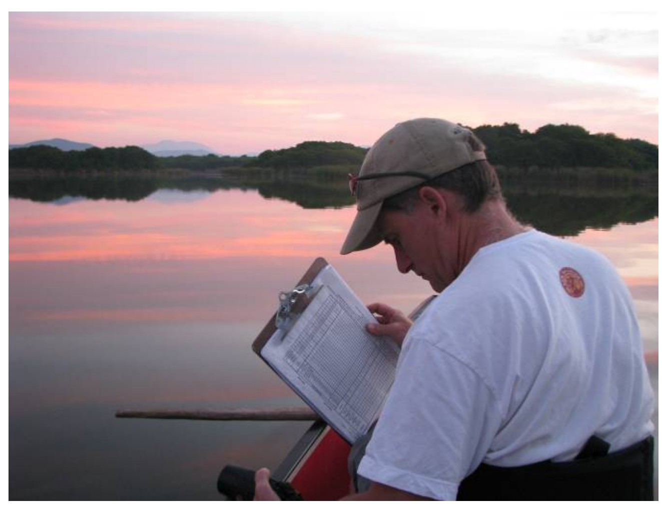
Expected completion: January 2011

Populations of many species of webless migratory game birds that inhabit marshes (rails, American coots, common moorhens, purple gallinules, Wilson's snipe) are thought to be declining in North America. Marsh birds are under-sampled by large-scale monitoring programs because they vocalize infrequently and emergent marshes are often localized and infrequently bisected by roadways. Approximately 100 U.S. Fish and Wildlife Service (USFWS) entities have collected survey data using a standardized protocol and data has also been collected by approximately 40 participants from outside USFWS. Participants have used the protocol in 47 states, 3 Canadian provinces, and 3 Mexican states. Data from each participant is pooled in a large relational database so that various analyses can be conducted at local, regional, and continental scales. Currently the database contains data on >150,000 detections.

The objectives of this study are to: **(1)** maintain and expand the National Marsh Bird Monitoring Program for 2 more years, **(2)** estimate population trends, and relative abundance for seven focal species (American coot, common moorhen, purple gallinule, clapper rail, king rail, Virginia rail, and sora) of management concern at local and regional scales in each of the four flyways, **(3)** determine the effectiveness of call-broadcast for monitoring Wilson's snipe, and **(4)** determine the effect of various management practices and environmental factors on occupancy and abundance of seven focal species (American coot, common moorhen, purple gallinule, clapper rail, king rail, Virginia rail, and sora).

Over the past year, we have continued to distribute protocols to state, federal, and non governmental personnel around the country who are conducting standardized marsh bird surveys in both managed and unmanaged wetlands. We are also have initiated marsh bird surveys in several areas where survey data was formerly lacking. We are in the process of contacting participants that have conducted surveys in the past to collect auxiliary data at their survey points. We have worked with scientists at Patuxent Wildlife Research Center to launch and continue to improve an online data entry module http://www.pwrc.usgs.gov/point/mb/ We have also developed a website http://ag.arizona.edu/srnr/research/coop/azfwru/NationalMarshBird/ for state and federal agency personnel to download the standardized survey protocols and datasheets, and to obtain relevant information regarding the nationwide marsh bird survey effort. We are in the process of expanding this website so participants of the program will have a central repository for survey information and field material.

Courtney Conway preparing to start a standardized survey for secretive marshbirds at daybreak at Laguna Cuyutlan, Colima, Mexico. *Photo by Helen Trefry.*



Adult sora coming out of cattails onto mudflat after hearing call-broadcast during a secretive marsh bird survey at Laguna Cuyutlan, Colima, Mexico. *Photo by Geoffrey Holroyd.*

We have held marsh bird training workshops annually and have another one planned for April 2009 to assure that the participants conducting surveys are proficient in their ability to properly identify wetland-dependent birds. We have analyzed data to examine the effectiveness of call-broadcast on Wilson's snipe.

Results from 918 detections suggest that call-broadcast does significantly increase the probability of detection. The numbers detected during 1-min of call-broadcast were 18% higher than during 1-min of a conventional passive point-count survey. These results have been written up and are included in a draft manuscript that we are preparing for submission to a journal. We are currently working with a subset of locations in the U.S. to install staff gauges to measure water depth and automated data loggers to measure water quality and salinity in areas where marsh bird surveys are being conducted. We will use these data to compare the abundance and occupancy of marsh birds in management areas with different wetland qualities and characteristics.

Nesting, Brood Rearing and Winter Habitat Selection of King Rails and Clapper Rails within the ACE Basin, SC

WILLIAM E. MILLS, Nemours Wildlife Foundation, Seabrook, SC 29940, USA (emills@nemourswildlife.org)
ERNIE P. WIGGERS, Nemours Wildlife Foundation, Seabrook, SC 29940, USA

Graduate Student: Cathy Ricketts (MS); **expected completion:** December 2010

Introduction and Objectives

Secretive marsh birds in the family *Rallidae* received relatively little attention through scientific study. Species within this family, such as king rails and clapper rails are harvested as game birds in some regions and are listed as threatened or endangered in other regions (Tacha and Braun, eds., 1994). The lack of knowledge regarding population status and habitat needs increases the importance of addressing the knowledge gaps for these species. Because these birds inhabit emergent marshes with thick vegetation they are more often heard than seen. Their secretive nature, reluctance to fly, and difficulty in accessing their habitat makes capturing these birds in sufficient sample sizes for scientific study difficult. Our study will try to gather information on a sample of king and clapper rails that will address these knowledge gaps.

The objectives of our study are to: 1) evaluate the effectiveness of 2 capture techniques for king rails and clapper rails for the purpose of attaching radio transmitters; 2) to use radio telemetry to examine winter habitat selection, home range, nest site selection, and survival of king rails and clapper rails using impoundments and tidal marshes in the ACE Basin region of South Carolina.

Progress to Date

The first 6 months of the project focused on developing effective rail capture and transmitter attachment techniques. During spring and summer of 2008 we used cloverleaf traps with drift fences with periodic call broadcasts of rail vocalizations (Kearns et al. 1998) to capture 15 clapper rails and 2 Virginia rails over a 3 month period that included approximately 310 trap nights. We were unsuccessful on 4 attempts at using a john boat on night time high tide events to catch rails with spotlights and dip nets. No rails were located or captured using this technique. This was due mainly to the inability to move through the marsh vegetation with a prop driven boat even at high tide.

Our most successful capture technique developed to date involves the use of a thermal imaging camera from an airboat at high tide. The thermal imaging camera enabled us to locate rails in thick vegetation that were undetectable with spotlights alone. The airboat provided access to portions of the marsh that were inaccessible using other methods. Once a rail was located with the thermal imaging camera, the driver would maneuver the airboat alongside and the rail would be then be captured with a dip net. This method produced a rate of 19 clapper rail captures per hour, far exceeding the other methods we used. This will become our primary technique in future capture efforts.

We evaluated the effectiveness of both necklace and backpack style transmitters on a sample of 24 clapper rails. In a previous study we had found the backpack transmitter attached using the leg loop harness (Haramis and Kearns 2000) to be difficult to attach properly. We elected to try necklace style attachment which would be easier to attach and potentially reduce stress on the birds. However, after increased experience with the leg loop harness and the lower retention rate for the necklaces, we will use the backpack transmitters exclusively as we go forward with the study.

Future Work

During 2009 and 2010 we will use our newly developed trapping technique to attempt to radio mark 50 birds (approximately 25 king rails and 25 clapper rails) in each of those years. Rails will be located 2 to 3 times per week to gather data for estimating home ranges, examine wintering, nesting, and brood rearing habitat selection, and estimating survival of king and clapper rails in managed impoundments and tidal wetlands in the ACE Basin region of South Carolina.

This summary is for the first 6 months of a 2.5 year study funded by the USFWS's Webless Migratory Game Bird Research Program and the Nemours Wildlife Foundation. The study will go towards fulfillment of an MS for graduate student Cathy Ricketts from the University of Georgia under the advisement of Dr. Sara H. Schweitzer. Final reports are expected by December of 2010.

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Other Webless Research Projects

Mourning Doves, White-winged Doves, and Eurasian Collared-doves

Studies of Native Columbiformes in Tucson, Arizona, 2008

CLAIT E. BRAUN, Grouse Inc., 5572 North Ventana Vista Road, Tucson, AZ 85750, USA (sg-wtp@juno.com)

Banding of Mourning (*Zenaida macroura*) and White-winged doves (*Z. asiatica*) continued in 2008. Four hundred and thirty Mourning Doves and 98 White-winged Doves were banded. Only two Inca Doves (*Columbina inca*) were seen at the trap location (Catalina Foothills, northeast Tucson) in 2008. All bandings were between 4 April and 8 October although Mourning Doves were present at the trap site in substantial numbers every day. Breeding activities (calling and flap-glide flights) of Mourning Doves began between 10 and 15 January and calling continued until 15 September. The first HY Mourning Dove was banded on 11 April. White-winged Doves arrived in the area of the trap location in late March and most departed in mid to late August with few remaining into September. Breeding activity of White-winged Doves commenced in April and mostly ended by mid August. Reported band recoveries remained low for both species.

Trichomoniasis (caused by *Trichomonas gallinae*) in Mourning Doves was again observed and verified (microscopic examination of throat swabs) in 2008 starting in mid March, increasing into late May, and then decreasing but continuing into August. Trichomoniasis has not been observed in White-winged Doves during 2000-2008. Cooper's Hawks (*Accipter cooperi*) again were almost daily visitors to the trap site and successfully bred and reared young 200 m northwest.

The Ecology of the Eurasian Collared-dove (*Streptopelia decaocto*) and Mourning Dove (*Zenaida macroura*) in Urban Habitats in Southern Illinois

DONALD W. SPARLING, Cooperative Wildlife Research Laboratory, Southern Illinois University, Carbondale, IL 62901, USA (dsparl@siu.edu)
ERIC C. HELLGREN, Cooperative Wildlife Research Laboratory, Southern Illinois University, Carbondale, IL 62901, USA (hellgren@siu.edu)
TIFFANY L. YORK OSBORNE, Cooperative Wildlife Research Laboratory, Southern Illinois University, Carbondale, IL 62901, USA

Graduate student: Tiffany L. York Osborne (Ph. D.)**; expected completion:** 2010

Biologists speculate that the Eurasian collared-dove (ECDO, *Streptopelia decaocto)* has the potential to become a competitor of the native mourning dove (MODO, *Zenaida macroura*) (Romagosa 2002). these two species (Romagosa et al. 1999, Romagosa et

Resource and habitat requirements such as food selection, nest sites, and nesting materials are analogous between

al. 2000). Temple (1992) recognized the lack of information on life histories and ecological relationships concerning exotic birds, and stressed the need to educate the public on these issues. Aspects of ECDO life history in the USA still need to be documented and further research needs to take place to supplement available records. The objectives of this research are to: 1) estimate abundance of MODOs and ECDOs during the breeding season in an urban-rural gradient; 2) identify MODO and ECDO home-range size in urban environments during the breeding season; 3) compare MODO and ECDO nest-site and habitat selection in urban environments; and 4) evaluate band recovery rates of MODOs and ECDOs from urban harvest statistics.

Work Completed to Date

Abundance surveys for ECDOs in all seasons in Herrin, Marion, West Frankfort, and Carterville in 2008 showed an average of 7$\pm$ 0.6, 8 $\pm$ 2.3, 4 $\pm$ 0.7, and 0 doves observed/survey, respectively. At three study sites, seasonal ratios showed the number of MODOs observed to increase from March to June, then decrease in September. No seasonal differences were observed for ECDOs. We used Kniffin modified funnel traps, Thompson traps, and fall traps at each study site to capture doves. All doves captured in 2007-2008, either MODO (n = 356; 197 M, 97 F, 11 unknown, 51 immature) or ECDO (n = 4; 1 M, 2 F, 1 immature), were aged and sexed according to Cannell (1983) and fitted with a federal band. Morphological measurements were taken for each dove. MODO (n = 20) and ECDO (n = 3) were surgically implanted with radiotransmitters to determine home-range size, nest site and habitat selection. We found 46 MODO nests in 21 different species of tree and on one man-made object. We also found 17 ECDO nests in 10 different species of tree and on 2 man-made objects. Twenty-three MODOs captured in urban areas were reported as harvested.

These are results from the first 2 years of a 3-year study funded by the Illinois Department of Natural Resources, Federal Aid Project W-106-R-17.

Figure 1. Eurasian collared-dove fledglings. *Photo by Douglas C. Osborne.*

Effects of Urbanization on Harvest and Recruitment of Mourning Doves

ERIC SCHAUBER, Cooperative Wildlife Research Laboratory, Southern Illinois University, Carbondale, IL 62901, USA (Schauber@siu.edu)
DONALD W. SPARLING, Cooperative Wildlife Research Laboratory, Southern Illinois University, Carbondale, IL 62901, USA (dsparl@siu.edu)
DAN STOELB, Cooperative Wildlife Research Laboratory, Southern Illinois University, Carbondale, IL 62901, USA

Graduate student: Dan Stoelb (M.S.); **Final report**

INTRODUCTION AND OBJECTIVES

The mourning dove (*Zenaida macroura*) is a habitat generalist, and one of the most plentiful and widest ranging bird species in North America. It is an important watchable and game species, with over one million hunters spending millions of dollars in pursuit of doves annually (Dolton and Rau 2008). Mourning doves live in every continental U.S. state, often at high abundance (Aldrich 1993) in both rural and urban areas. The distributions of people and land use have changed dramatically in the U.S within the last 100 years. Since 1950, the U.S. population has doubled and low-density rural home development has been the fastest-growing form of land use in the United States (Hansen et al. 2005). The costs and benefits of these changes to wildlife are understudied or undocumented.

STUDY AREA

The study area consisted of eight sites >8 km apart in Williamson and Franklin counties in southern Illinois. Study sites were categorized by degree of urbanization, based on size of the human population. Urban sites had human populations >11,000, semi-urban sites had 5,000-13,000 residents, exurban sites were towns with <2000 residents, and rural sites were very sparsely populated with <100 people per km². Human population densities within city limits in our study sites ranged from 106 to 749 people/km², and housing densities ranged from 20 to 488 homes/km² (U.S. Census Bureau 2000). Rural sites were dominated by soybeans and corn intermixed with blocks of deciduous and coniferous trees.

NEST SUCCESS AND SITE-SELECTION

Methods

We searched for nests and monitored nest success from April through August in 2008 in exurban sites (Zeigler and Pittsburg, IL). We located 39 dove nests by looking in vegetation along roads and alleys. We also followed three radio-marked birds to their nests, and found seven nests by following doves that were gathering nesting material. We determined coordinates for each nest by using a Garmin™ Legend global positioning system receiver (Garmin Inc. Olathe, Kansas, USA). Species of the nest tree or shrub, nest height above ground, nest tree height, nest tree diameter at breast height (DBH), percent canopy closure, nest location within the tree (crotch, limb, etc.), and limb structure of the nest tree (horizontal or vertical) were recorded. Limb structure was based on the overall shape of the tree, and the orientation of the largest branches. We used a clinometer to measure both nest tree height and nest height. We used a spherical densitometer to estimate percent canopy closure by averaging four measurements taken 10 m from the base of the nest tree in the four cardinal directions.

Nest Success.— We monitored each the fate (active, failed, or fledged) of each nest at least twice each week, spending as little time in an area as possible to minimize disturbance. We used the Program MARK (White and Burnham 1999) to estimate nest success (fledging $\geq$1 young), to determine which habitat characteristics (nest tree type: deciduous or coniferous, nest height, landcover composition within 200 m of the nest site [see Nest Habitat Selection below], etc.) were associated with nest success, and to test whether nest success differed between Zeigler and Pittsburg. The model with the lowest small-sample Akaike Information Criterion (AIC_c) value was selected to estimate nest success, and models within 2 AIC_c points were considered well-supported. We could not incorporate seasonal factors in the model due to small sample size, and could not incorporate limb structure because all nests in trees with vertically-structured limbs were successful, resulting in daily survival estimates without any measure of uncertainty.

Nest Density.— We measured minimum nest density within each of the exurban sites by overlaying a layer of the discovered nest sites onto a map of each town in ArcMap (ESRI Corp. Redlands, California, USA). We calculated the number of active nests/ha using the city limits as boundaries.

Nest Habitat Selection.— We measured vegetation characteristics around 44 nests in urban and semi-urban sites and 49 nests in exurban sites, although nest success was only monitored for exurban nests. However, not all vegetative characteristics could be measured for 10 nests, which were excluded from the analysis, leaving a sample size of 83 nests. To test whether nest site characteristics was related to urbanization, we used multiple linear regression with human population size as the independent variable, and DBH, nest height, nest tree height, and canopy closure as dependent variables.

To test whether selection of landcover composition surrounding nest sites differed along the urbanization gradient, we used compositional analysis (Aebischer et al. 1993) to compare landcover surrounding an equal number of nest locations and random locations at each site. We characterized landcover with eight types based on vegetative characteristics and human-related development: Coniferous, Deciduous, Grassland, Buildings, Lawn, Road (including parking lots and power lines along roads), Mineland, and Water. We used aerial photography and ArcMap (ESRI Corp. Redlands, California, USA) to calculate landcover composition within a 200-m buffer around each nest location and each random site. Multivariate analysis of variance (MANOVA) was conducted in the Statistical Analysis System (SAS Institute, Cary, North Carolina, USA) to test for habitat selection, and a matrix of t-tests yielded pairwise comparisons of relative selection between landcover types.

Results

Nest Success.— In 2008, we located 49 active mourning dove nests in exurban sites, 16 of which were found in Pittsburg and 33 in Zeigler. The number of nests we located within the two sites each month ranged from 2 in July, to 24 in June. We monitored success of nests in 14 tree species within Zeigler and Pittsburg. Apparent nest success ranged from 66% in April to 100% in July for the two sites combined, with an overall apparent nest success of 76.5%. The top-ranking model included effects of both canopy closure and nest height, producing an estimated daily nest survival rate of 0.9887 (C.I. 0.978 – 0.994) and an estimated nest success rate of 69.4% (C.I. 49.1 – 82.5%) over the 32-day nest period. Nest success was negatively related to percent canopy closure and nest height. The single-variable models using nest height and canopy closure were also well-supported. The null model {S(.)} was the 4^{th} most-supported model, and was only 1.2 ΔAIC_c points from the top-ranking model. Models incorporating DBH, site (Pittsburg/Zeigler), nest tree type, and % landcover types (% Buildings etc.) had little support.

Nest Density.— We discovered 16 active mourning dove nests in a 134-ha area of Pittsburg, Illinois from April-August, yielding a minimum active nest density of 0.12 active nests/ha. We searched a 178-ha area in Zeigler, and found 35 nests from April-August, yielding a nest density of 0.19 nests/ha.

Nest-Site Use and Selection.— Both nest height (t_{82} = -3.65, p = 0.0004) and percent canopy closure (t_{82} = -2.76, p = 0.0069) decreased significantly with increasing human population. The nest-tree height (t_{82} = -1.18, p = 0.24) and the DBH (t_{82} = 1.26, p = 0.21) were not significantly related to human population size. We were unable to test for nest-site landcover preferences in Carterville, due to the small number of nests found in this site (n = 3). However, in all other sites, there was evidence that mourning doves do not randomly select nest sites (all $p < 0.001$). In all study sites, lawn and buildings were in the top three most preferred landcover types, while grasslands, farmland, and water were consistently preferred the least (i.e., selected against) by nesting mourning doves. We found no discernable pattern of tree-type selection, suggesting there is not a strong preference for nesting in coniferous or deciduous trees.

Discussion

Canopy closure and nest height were the variables most strongly related to nest success in southern Illinois, but evidence for their effect was weak. The apparent negative effect of nest height contradicts results from previous studies. For example, Harris et al. (1963) postulated that doves prefer the dense cover provided by spruce trees, but our results again contradict these findings by suggesting doves preferred more open nesting areas. Interestingly, we did not find that the percent of coniferous trees, deciduous trees, and buildings around nest-sites greatly affected nesting success, although some studies suggest mourning doves prefer coniferous nesting substrates (Hanson and Kossack 1963, Caldwell 1964).

The estimate of 69.4% nest success for these exurban mourning doves is consistent with or higher than previous estimates of nest success for mourning doves (Harris et al. 1963), and is similar to the 64% nest success Hanson and Kossack (1963) reported for Illinois mourning doves. Southern Illinois mourning doves nesting in orchards had nest success rates of 25-80% (Putera et al. 1985), although these sites had vastly different vegetative characteristics from our sites. Because we only monitored nest success in exurban sites, however, there is not enough evidence to say that nest success of mourning doves is elevated in developed areas in southern Illinois.

The low sample size undoubtedly influenced which variables we found significantly affect nest success. Harris et al. (1963) found that limb structure, along with nest location within the tree, influenced nest success. We found 10 nests in trees with a vertical limb structure but, because all these nests were successful, we could not include this variable in our analysis. Even fewer (n = 6) nests were located in tree crotches, obscuring any differences in nest success between nests located on limbs and those found in tree crotches. A larger sample pool covering more study sites would provide more information about factors affecting nest success. We recommend estimating nest success in more developed areas in southern Illinois, and compare these survival rates with those we found in the exurban sites.

Sayre and Silvy (1993) cited numerous sources detailing mourning dove nest density, with estimates ranging from 0.01 - 40 nests/ha, although most ranged between 0.1 and 2.0 nests/ha. Putera et al. (1985) found from 0.25 - 5.2 nests/ha in southern Illinois fruit orchards. Our estimated nest densities (0.12-0.19 nests/ha) are slightly smaller than these values, although they are admittedly minimum values and some nests were almost certainly missed. Several old nests were found in areas we had not searched earlier year and, with a larger workforce, many of these nests would have been found while active.

Previous studies suggest that mourning doves select coniferous substrates (Hanson and Kossack 1963,), dense canopy cover (Harris et al. 1963), and horizontal limbs or crotches (Harris et al. 1963, Putera et al. 1985). Mourning doves in more urban sites have been found nesting in ornamental shrubs and are associated with deciduous trees, shrub volume, and area of weedy vegetation (DeGraaf and Stihler 1979). Our findings are inconsistent with previous reports, as nest height and canopy closure around nests decreased with increasing urbanization. Also, canopy closure negatively affected nest success in this study, and canopy closure decreased as the human population increased.

Except for West Frankfort, "Buildings" were either the most preferred or second most preferred landcover type in every site. Mourning doves prefer to nest in areas with greater housing densities, as these areas can provide many, if not all life requisites for doves during most of the year. Lawn was also consistently one of the 3 most preferred landcover types in all sites. This may corroborate the findings of Swank (1955), who found that mourning doves preferred sparse cover in which to gather nesting material. Mourning doves in southern Illinois did not show a strong preference for coniferous or deciduous trees. This is contradictory to previous literature where mourning doves appeared to select coniferous nesting substrates, even when these vegetation types were scarce (Harris et al. 1963). Nests located in coniferous trees may have a lower detection probability due to the dense foliage. If we discovered more nests in coniferous trees, perhaps a greater preference for this tree type may have been observed.

In summary, some trends in landcover preferences have emerged along the urbanization gradient in southern Illinois. The number of mourning dove nests in many study sites was small, making it difficult to confidently say which landcover types mourning doves prefer for nesting. A larger sampling pool would of course provide more accurate results, and may also reduce some bias in regards to which habitats nests were found in. For example, nests are often difficult to find in coniferous trees, and a greater number of nests in this tree type may increase the preference for a coniferous component. Nests in very tall trees are more difficult to find than nests that are closer to the ground

RELATIVE ABUNDANCE TRENDS AND RELATIONSHIPS WITH LANDCOVER

Methods

Call-Count Surveys.— Current CCS transects in southern Illinois do not contain urban areas, so we established new transects in our study sites. Because of the small size of our more developed study sites, we used 3 - 4 stops 1.6 km apart per transect to listen for calls in each of the urban, semi-urban, and exurban sites. The rural sites were somewhat larger, with 8-10 stop locations in each of these sites. We conducted call-counts in each study site from 26 May through 20 June

2007 and 2008, until a total of 20 stop-counts were recorded for each site, resulting in 2-5 observations for each stop and year. Counts began 30 minutes before sunrise and continued for two hours. We listened for three minutes at each stop. Time, weather condition, number of doves heard, doves seen, the number of calls heard, and the number of doves seen between stops was recorded. The same sites and stops were used during 2007 and 2008. Typically, we conducted call-counts along 2 - 4 different transects per morning. We staggered the timing of repeat visits to each site.

We used mixed-model multiple regression analysis (SAS PROC MIXED) and the randomized block design, treating each stop location as a random block-effect, to test whether mourning dove relative abundance varied between years (2007 and 2008), and along the urban-to-rural cline. We used both the number of calls heard and the number of doves seen (both log(x+1) transformed) as dependent variables, while year and human population size of each site were independent variables.

Relationship Between Relative Abundance and Landcover.— We used ArcMap and the same landcover classifications as in the nesting analysis to characterize landcover within 400 m of each call-count location. We used mixed-model linear regression, again treating each stop location as a random subject, to test for relationships between stop-level relative abundance of doves (log(# calls heard + 1) and landcover composition around each location.

Results

Call-Count Survey Trends.— During 2007, we heard the most mourning dove calls in rural Zeigler, and the fewest in West Frankfort. In 2008, we recorded the greatest number of calls in the two urban sites, with the fewest calls in Pittsburg. While driving between call-count points in 2007, the greatest number of doves was seen in Marion, with the fewest in rural Pittsburg. This pattern continued in 2008, with Marion and Herrin yielding the greatest number of doves seen, while rural Pittsburg again had the fewest.

We found no significant change in the number of calls heard from 2007 to 2008 (t_{283} = 0.79, p = 0.43). However, the number of calls heard increased with human population size (t_{35} = 2.56, p = 0.01) (Figure 1A). This slope of log-transformed data converts to 2.9 times as many doves heard in the most urban sites than in the rural sites. The number of doves seen decreased from 2007 to 2008 (t_{293} = -5.35, p < 0.0001), with a slope of 0.40 doves/yr (C.I. 0.25 – 0.55). The number of mourning doves seen increased as the human population of a site increased (t_{44} = 6.86, p < 0.0001) (Figure 1B), with 5.3 times as many doves seen in our most urban sites than in rural sites.

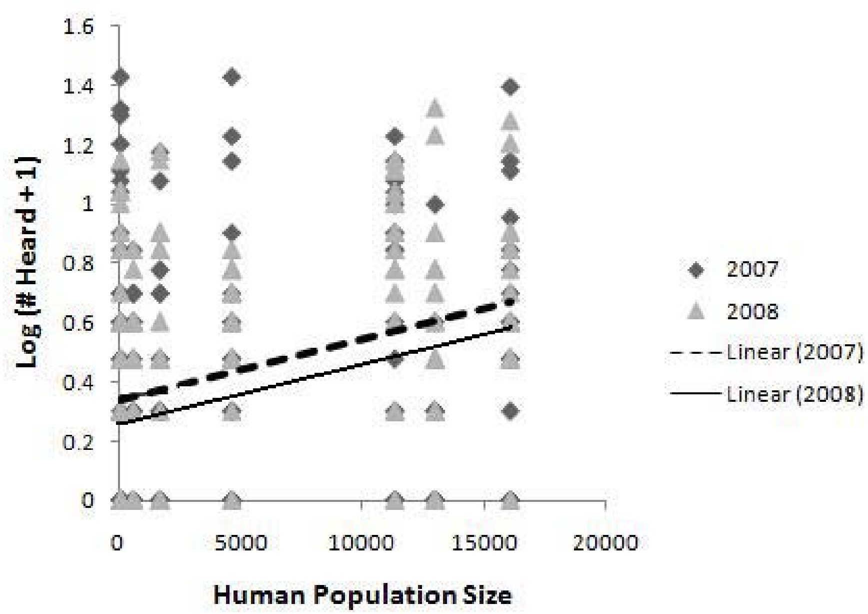
Relationship Between Relative Abundance and Landcover.— The number of calls heard was positively related to the percentage of buildings around call-count points (t_{46} = 2.64, p = 0.011), with a slope of 0.054 (C.I. 0.013 – 0.095). This slope indicates nearly 20 times as many doves were heard in sites containing the largest percentage of buildings compared to sites that contain the smallest. The relationships between the number of mourning dove calls detected and the percentages of coniferous trees, deciduous trees, road, lawn, and farmland were not statistically significant (all p > 0.342). When the percentage of each landcover type was analyzed within each site, no significant relationships emerged (all p > 0.304).

Discussion

Relationship to Urbanization.— We found greater relative abundance of mourning doves in areas with larger human population sizes in southern Illinois. Rural sites with a large forested component are highly suitable for mourning doves (Harris et al. 1963), but our rural sites were dominated by farmland, where fragmentation and conversion of nesting cover may explain the lower dove abundance we observed. If urban resident doves become an increasing fraction of the mourning dove population, results from the CCS may continue to indicate a downward trend even if the overall population is stable or increasing, as current CCS routes do not contain urban areas (Dolton 1993). It would be useful to develop standardized methods to census mourning doves in urban areas, as both fractions of the population need to be monitored to accurately assess population dynamics. However, anthropogenic noise levels can differ greatly between rural and urban areas, posing a challenge to standardized survey methods.

Relationship to Landcover.— The percentage of buildings was the landcover type most associated with the number of mourning dove calls detected from 2007-2008. However, mourning doves did not appear to select

A.



B.

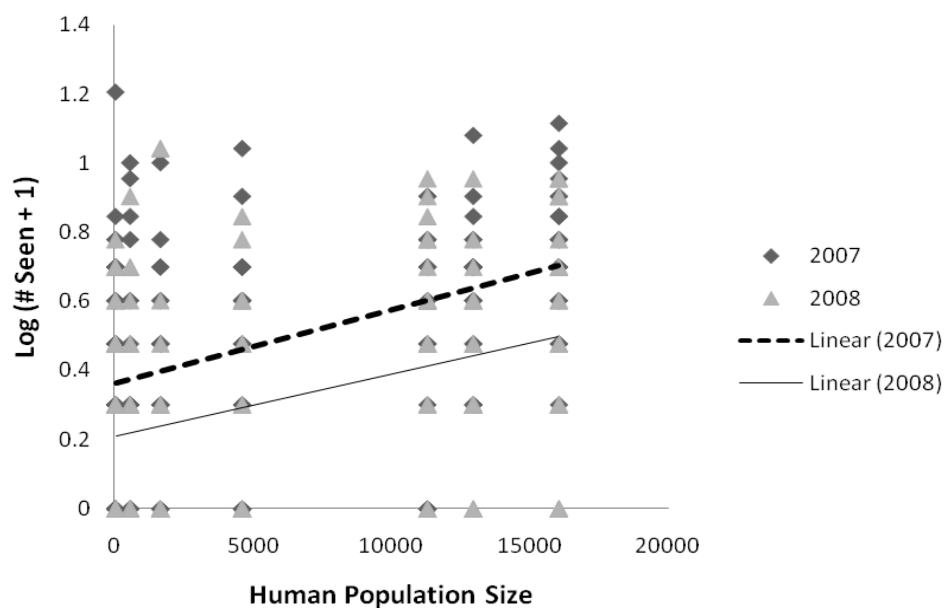


Figure 1. Relationship between human population size and (A) mourning dove calls heard and (B) mourning doves seen in southern Illinois, 2007- 2008.

areas within the sites with the largest percentage of buildings. These large-scale developed areas may allow for open viewing and flight paths, but areas with the largest building densities may also have the lowest amount of trees for nesting and cover on a small scale. Our findings contrast with those of Elmore et al. (2007), who found that mourning doves were more abundant in farmlands than in areas with high levels of edge density, but they examined a larger scale. We are unaware of any dove studies that use such a detailed classification system as this study to assess landcover correlations with mourning dove abundance in urban areas. This is probably a result of the lack of mourning dove surveys in urban environments. Mourning doves can thrive in many environments, and may select different habitat types in different physiographic regions.

The higher relative abundance of doves near buildings agrees with the positive relationship between relative abundance and human population size we found. The lack of significant relationships between relative abundance and forest composition is surprising because mourning doves utilize and many times favor coniferous trees for nesting (Harris et al. 1963, Caldwell 1964, Sayre and Silvy 1993). A better understanding of how human disturbance correlates with mourning dove abundance is crucial in the management of this species. Our surveys can also provide additional support to trends derived from existing CCS routes, as our surveys are totally independent of those conducted by the USFWS, but are conducted during the same time of year. If urban areas contain large populations of doves, perhaps no active management would be necessary. More rigorous monitoring of mourning dove nest success and abundance needs to be conducted to confidently assess these populations however.

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Effects of Spinning-wing Decoys on Mourning Dove Harvest-related Parameters in Tennessee

RUSSELL R. SKOGLUND, Tennessee Wildlife Resources Agency, Ellington Agricultural Center, P.O. Box 41489, Nashville, TN 37204, USA
STEVEN E. HAYSLETTE, Department of Biology, Box 5063, Tennessee Technological University, Cookeville, TN 38505, USA (shayslette@tntech.edu)

Graduate student: Russell R. Skoglund (Ph.D.); **expected completion date:** December 2009

Nationwide call count surveys of doves heard have indicated a long-term decline in mourning dove populations in the EMU and nationwide, raising concerns regarding factors affecting mourning dove mortality and related population status. Several studies have documented increased vulnerability to harvest among waterfowl when spinning-wing decoys (SWDs) are used, and a recent study in Tennessee documented attraction of mourning doves to SWDs in a simulated hunting setting. The objectives of this study are to determine effects of spinning-wing decoys on dove harvest-related parameters, including kill and crippling rates, in actual dove hunting situations.

Seventeen experimental hunts were conducted each year on fields managed for dove hunting by the Tennessee Wildlife Resources Agency (TWRA) and/or private landowners in central and eastern Tennessee on 1 September 2007 and 2008. Each hunt was conducted during normal shooting hours (noon-0.5 hours after sunset) by a volunteer hunter positioned near (approximately 10-30 m from) a single battery-powered SWD. Volunteer hunters were experienced dove hunters, and were instructed to hunt as they normally would. Fields were otherwise open to the public, and a number of other hunters usually were present on each field. Activity of the SWD (ON versus OFF) was alternated during successive 15-minute periods during each hunt; start activity was determined randomly. A volunteer observer positioned near the hunter operated the SWD, retrieved downed doves, and recorded the following information for each 15-minute period: SWD activity mode (on versus off), shots fired, doves killed, doves crippled but not recovered, and doves missed. For analysis, the latter 4 parameters were summed by SWD activity mode for each hunt, and converted to rates (number/15-minute period). Each of these dependent variables (rates) was compared between SWD activity modes (on versus off) in a pairwise fashion using non-parametric Wilcoxon signed-rank tests and hunts as experimental units.

Using 2007 data, we found no differences in harvest-related parameters between SWD activity modes. Shots fired, doves killed, doves crippled, and doves missed all were similar ($P \geq 0.297$) between periods with wings spinning and wings stationary. These first-year results suggest that SWDs have little overall impact on mourning dove harvest-related parameters during typical dove hunts in central and eastern Tennessee. Although attraction of doves to SWDs in non-hunting situations has been demonstrated, characteristics of typical public doves hunts (e.g., large fields, long-term dove use of fields for feeding, shooting and other disturbance) may mitigate the degree to which this attraction results in changes in kill rate and/or crippling rate.

Analyses of data collected during the second year (2008) are ongoing. Experimental hunts may be conducted on these and possibly other dove fields during September 2009, if analyses of data from the first 2 years of study indicate that additional data are needed to resolve this issue. Final data analyses will follow the conclusion of these third-year hunts, and the final report and manuscript for this project will be completed by December 2009. Funding and other support are provided by the Tennessee Tech University (TTU) Faculty Research Grant Program, TTU Department of Biology, and Tennessee Wildlife Resources Agency.

Spinning-wing decoy in use during an experimental mourning dove hunt in Wilson County, Tennessee, 1 September 2008.

The Effects of Management Practices on Lead Shot Deposition in Publicly-managed Mourning Dove (*Zenaida macroura*) Fields in North Carolina

KELLY E. DOUGLASS, North Carolina Wildlife Resources Commission, 1722 Mail Service Center, Raleigh, NC 27699-1722, USA. (kelly.douglass@ncwildlife.org)
DAVID T. COBB, North Carolina Wildlife Resources Commission, 1722 Mail Service Center, Raleigh, NC 27699-1722, USA.
PHILLIP D. DOERR, North Carolina State University, Box 7646, Raleigh, NC 27695, USA.

Graduate student: Kelly E. Douglass, M.S.; **expected completion date:** December 2010

Much recent lead shot toxicity research has focused on upland game birds such as mourning doves (*Zenaida macroura*). As a result of shot deposition in potential foraging areas, doves and other granivorous birds using similar habitats are typically exposed to higher concentrations of lead. Mourning doves have been shown to ingest lead shot pellets while foraging or collecting grit particles, and as a result may suffer from both long- and short-term health effects, including direct and indirect mortality. Lead shot deposition has been measured in several states where high concentrations of lead shot were found in fields managed for mourning dove hunting, especially during and immediately following the hunting season. Despite the research on lead shot ingestion, lead shot deposition, and health effects on mourning doves in other states, there has been no research on the effects of land management, when applied as treatments, on shot concentrations in fields managed for dove hunting.

The main goals of this project are to determine lead shot deposition in publicly-managed mourning dove fields at Roanoke River Wetlands Game Land in coastal North Carolina and to examine the effects of management treatments on shot concentrations. The objectives of this study include estimating the concentration of lead shot pellets in soil; examining difference in shot concentrations over time, among crop types, and among management treatments; and estimating hunter effort during the hunting season.

The results of this study will provide a basic understanding of lead shot deposition and pellet concentrations in publicly-managed dove fields in North Carolina, neither of which have been previously studied. The results of this study may also have implications for the management of other publicly-managed dove fields in North Carolina and may help land managers in selecting management practices that maximally reduce lead shot concentrations while remaining feasible and within the scope of land management objectives.

The dove fields being used in this study are located within the Roanoke River Wetlands Game Land in the coastal region of North Carolina. These dove fields have been managed intensively for mourning dove hunting since 1997 and receive relatively heavy hunter use every year. These fields were chosen because of their general proximity to one another, so that variances in environmental factors (e.g., climate, precipitation, topography, erosion, soil type, and elevation) and differences in previously used management practices are minimized.

The study site includes 5 dove fields, which range in size from approximately 1.5 ha to 13.4 ha. Twelve plots, or crop strips, have been established within these 5 fields using the following plantings and management treatments: 3 crops (sunflower, corn, and millet) each receiving 2 treatments (till and no-till) with 2 replications of each. Sample size per plot will remain equal among plots and among sampling periods, as data collected will be a measure of shot density. Sample locations within each plot are randomly determined before each sampling event; any previously sampled locations are excluded from the list of possible sample locations for remaining sampling periods within a year to avoid sample bias.

Crops and treatments will remain the same within plots over the study period. Although crops are typically rotated each year during field management, crop rotation has been suspended on the 12 study plots during the course of the study to prevent bias in sample results. Each plot is planted in sunflower, millet, or corn; these crops were chosen because they are representative of the three most common crops planted on publicly-managed dove fields in the state. Foraging ability of doves likely varies among crops. Correspondingly, soil samples from each plot will be analyzed separately from other plots (by crop) but will also be analyzed within crops by treatment type. Herbicides or fertilizers that are used are only applied as needed to control weeds and maintain crops.

Soil samples are collected from each plot pre- and post-hunt and pre- and post-treatment as follows:

1. Pre-hunting season – the time prior to the opening of the first split in the dove season, but after all management has been completed for the first split;
2. Mid-hunting season – the time immediately following the first split in the dove season, but prior to the opening of the second split in the hunting season;
3. Post-hunting season (i.e. pre-treatment) – the time immediately after the close of the third split in the dove season, but prior to any field management (including spring planting); and
4. Post-treatment (i.e. pre-hunt sampling for the next year) – the time after all management treatments have been applied (including spring planting and mowing), but prior to the dove hunting season the following year.

Each plot will receive one of 2 treatments over the course of the study: 1) no-till planting of crops in the spring and mowing strips prior to each of the 3 splits in the hunting season and 2) conventional tillage planting (disked to approximately 15 cm) of crops in the spring and mowing strips prior to each of the 3 splits in the dove hunting season.

Soil sample collections began in August 2007 and will continue through September 2009. As of January 2009, 5 of the 7 sample collections have been completed resulting in 3,000 samples. Of those samples, over 1,200 have been examined for lead shot pellets. Preliminary results show an increase in lead shot deposition from pre-hunt to mid-hunt sampling periods, and a difference in shot deposition among the 5 dove fields.

Data are being collected on the number of lead shot pellets per sample; mean number of pellets per plot (i.e., crop type), per treatment type, and per sampling period (including standard deviations or variances); and the percentage of plots containing lead shot pellets. The total concentration of lead shot pellets per hectare will be estimated. Shot deposition in plots will be compared among plots, including percentage of samples with shot, amount of shot (number of pellets), and variance between plots, and will compared between treatments and over time.

Hunter use and success information is also being collected using mail surveys from individuals receiving special hunt and point-of-sale permits for the study site. Total hunter hours, birds bagged, and shots fired for each field is being estimated for each dove hunting season. Survey data will be used to examine when most shot is deposited on the fields during the season, how many hours each field is hunted, how many hunters used the area, how much shot is potentially being deposited in these fields, how many birds are being harvested, and the average number of shots fired per harvested bird.

Surveys have been mailed to all individuals (N=845) legally permitted to hunt doves on the study site over the 2007-08 and 2008-09 dove seasons. All survey mailings, including both original and follow up mailings, have been completed. As of the last mailing in February 2009, 589 surveys had been returned and 14 were undeliverable. Based on data from last year, we anticipate additional surveys to be returned over the next few months in response to the last survey mailing. Survey data are currently being analyzed.

Field work will continue through December 2009, and will include the collection of 1,200 more soil samples and the examination of the remaining samples for lead shot pellets. Final data analysis should be completed by May 2010 and the final report completed by December 2010. Funding and/or other support for this project is provided by the North Carolina Wildlife Resources Commission and North Carolina State University.

Random soil samples locations are generated in ArcGIS, and sample coordinates are uploaded into a Trimble GPS unit to be located in the field. Each sample is marked with a fluorescent wire flag, labeled with the plot and sample number. *Photo of Mark Lee by Kelly Douglass.*

The steel shovel is inserted into the soil slightly below the sample collection box. *Photo of Tommy Hughes and Andrew Cole by Kelly Douglass.*

For each sample, standing vegetation is cut off at ground level and heavy vegetative debris on the soil surface (excluding leafy layers that may collect spent shot pellets) is removed. *Photo of Shane Felts and Jim Wilson by Andrew Cole.*

The steel shovel is then driven completely under the sample in a fashion similar to a post driver. Weight or pressure is applied to the collection box to keep the sample from moving while the shovel is being driven under the sample. *Photo of Dale Davis, Kelly Douglass, and David Turner by Andrew Cole.*

Once the steel shovel has been driven completely under the sample, the shovel and sample are lifted from the ground, inverted together, and the sample box (now right side up) is slid from beneath the shovel. *Photo of Andrew Cole by Kelly Douglass.*

Excess soil is scraped off the top of the sample, level with the edges of the collection box, so a relatively uniform volume of soil is collected for each sample. *Photo of Vic French and Mike Carraway by Jane Anderson.*

Once soil samples are collected in the box, they are transferred from the box to a bucket. *Photo of Kelly Douglass and Dale Davis by Andrew Cole.*

Soil samples are then transferred from the bucket to a plastic bag, labeled with the plot and sample number, date collected, and whether or not the sample was located in a mowed area. *Photo of David Rowe and Wynne Hughes by Jane Anderson.*

Monitoring Survival and Harvest of White-winged Doves in Texas and the Southwestern United States

BRET A. COLLIER, Institute of Renewable Natural Resources, Texas A&M University, College Station, Texas 77843 (bret@tamu.edu)

Expected Completion: 2011

White-winged dove population management has received limited attention recently even as populations are expanding across the southern United States from their historic range in northern Mexico and the southwestern United States. Conservation and management of white-winged doves (*Zenaida asiatica*) is of considerable importance as white-winged doves in Texas provide >500,000 hunter days of hunting opportunity and Texas hunters harvest >1 million birds annually. Given the importance of managing and conserving white-winged dove populations for long-term sustainable recreational use, we have initiated a multi-faceted program in Texas to begin collecting demographic information for use as a foundation for future harvest management decisions.

Our initial research focus has been to implement a white-winged dove banding program in Texas. Since the 1978, there has been no operational white-winged dove banding program in place, thus, data are inadequate for estimating survival or harvest at any scale relevant to population management. Banding which has occurred has been limited, usually encompassing between 200 and 500 individuals banded annually across the species range. Thus, use of contemporary techniques to estimate survival and harvest using band recovery data is not practical. However, these estimates are the foundation for development of mechanistic population models so optimal harvest management decisions for white-winged doves can be made.

Concomitant with expansion of white-winged doves is a shift in distribution with increased densities being found in urban environments. Before the 1980's, white-winged doves were confined to northern Mexico, southern Texas, and the southwestern United States. Currently, white-winged doves currently breed in 196 Texas counties versus <10 in 1980. In addition, only 16% of the white-winged dove breeding population in Texas occurs in traditional breeding sites in the Lower Rio Grande Valley. Outside the Rio Grande Valley, white-winged doves are confined almost exclusively to urban environments and most birds breed in the residential core of cities which has unknown impacts on reproduction, survival, and harvest.

The objectives of our project were to (1) develop, pilot, and implement an operational banding program from 2007 to 2011 for white-winged doves in Texas, (2) use band recovery data to provide initial estimates of survival and harvest, and (3) use data collected from this pilot study as a foundation for developing a sampling design for future range-wide banding in support of future population management strategies for white-winged doves.

We implemented our banding program in 2007 with banding quotas based on estimated dove densities and urban area sizes across the state. Texas A&M University undergraduate and graduate students, collaborated with Texas Parks and Wildlife field staff and research staff from other universities in Texas to conduct banding across the state. We began capture operations on 15 May and continued until mid-August. We used walk-in funnel traps baited with cracked corn and milo and all white-winged doves were aged and fitted with a USGS Size 4 leg band. In 2007, traditional 1-800 band were used, but in 2008 we transitioned to putting out traditional and web-based reporting bands in ~1:1 ratio. During 2007, 11,413 white-winged doves were banded across Texas, with 333 direct recoveries during the 2007 hunting season. Of those 333 direct recoveries, 301 were from birds banded within urban environments. Banding quotas remained the same for the 2008 banding season. However, in expectation of additional research occurring in localized areas beginning in 2009, 20,710 white-winged doves were banded in 2008. During the hunting 2008 hunting season, we had 467 direct recoveries with 428 coming from those birds banded in urban environments. Indirect recoveries were low, with 31 indirect recoveries during 2007 and 81 indirect recoveries in 2008. This project is beginning year 3 (2009) and banding operations will continue through the 2011 breeding season. We expect to incorporate other southwestern states into our banding study during 2009.

Dr. Bret Collier banding a juvenile white-winged dove captured in Alice, Texas. *Photo by Kirby Calhoun*.

A banded juvenile white-winged dove in Alice, Texas. *Photo by Kirby Calhoun.*

Jimmy Tillman, undergraduate Wildlife and Fisheries Sciences major at Texas A&M University, removes a white-wing from a holding box for banding. *Photo by James Page.*

Kirby Calhoun shows the unique characteristic of a white-winged dove. *Photo by James Page.*

A walk-in funnel trap full of white-winged doves in Alice, Texas. *Photo by Kirby Calhoun.*

Distribution of direct recoveries from white-winged doves banded in Texas or the State of Tamaulipas, Mexico in 2008.

Division of Migratory Bird Management
PO Box 25486
Denver, CO 80225-0486
303-275-2388

U.S. Fish and Wildlife Service
http://www.fws.gov/

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