U.S. Fish & Wildlife Service

Webless Migratory Game Bird Research Program

Project Abstracts – 2007

Ripe fruit from Saguaro Cacti in the Sonoran desert in Arizona were used to validate the source of hydrogen isotopes in feathers of white-winged doves. (Abstract on page 23).

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April 2008

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History and Administration of the Webless Migratory Game Bird Research Program, 1995-2007

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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 "webless" 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 This historical overview was derived primarily through use of unpublished minutes from meetings between 1984 and 1995 of the Migratory Shore and Upland Game Bird (MSUGB) Subcommittee (named Committee between 1991-1996) of the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.

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 stations—one 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. Current committee members include Robert Boyd, Chairman, (Pennsylvania Game Commission) and David Dolton (USFWS), along with the 2007 Chairmen of the 4 Technical Committees: Western–Mike Rabe (Arizona Game and Fish

Department); Central–John H. 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, 1995-07.

Species	Number of projects	WMGBR Program funds	Total project cost
Mourning dove	14	$642,620	$2,479,051
American woodcock	9	$370,086[a]	$1,574,418
Marsh game birds	10	$246,274	$1,232,262
Band-tailed pigeon	8	$468,700[b]	$1,242,375
Sandhill crane	10	$324,824[c]	$1,415,306
White-winged dove	2	$51,862	$147,552
Marshbird Monitoring Workshop	–	$6,853[d]	—
GRAND TOTAL	53	$2,111,219[e]	$8,090,964

[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

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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

In consultation with state and federal dove harvest management biologists, it was decided that a composite estimator of annual trend derived from application of Bayesian hierarchial 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 - 2006), as well as population estimates derived from harvest data (2003 - 2006), constitute input into the statistical model. Estimates of retrospective trends and their posterior probability distributions for several alternative time periods have been derived from this composite model, and initial simulated results of the performance of alternative harvest management strategies based on these estimates were provided to the management unit technical committees in 2007. Finalized harvest strategies based on these results will be presented for approval by the flyway technical committees in 2008, with expected implementation in the 2009 dove harvest regulation cycle.

Development and Evaluation of Methods for Regional Monitoring of Mourning Dove Recruitment

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Graduate Student: David Miller(Ph.D.); **expected completion**: 2008

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 4 Flyway Councils and IAFWA recently approved a Mourning Dove National Strategic Harvest Management Plan. The Strategic 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, a pilot harvest wing survey project was initiated in the fall of 2005.

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 included 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

Thanks to the enthusiastic effort of the participating states the pilot program has been successful in meeting and exceeding goals for the wing collection portion of the study. During 2007, one additional state (Illinois) joined the effort. During the first three years, 22 states have collected > 90,000 wings from more than 58 unique degree blocks. In almost all cases, states have been successful in meeting the goals of collecting 400 wings and banding 200 birds per block. In January, 2008, wings collected in September, 2007 will be scored at the third annual Mourning Dove Wing Bee.

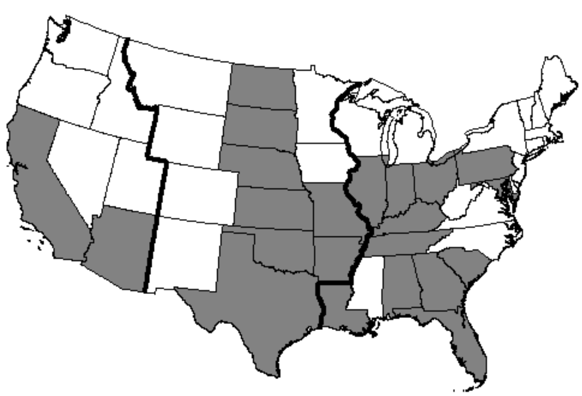
We are continuing our work to calibrate wing survey estimates to account for unknown age birds. Classification of unknown age wings has focused on projecting primary molt scores hatch year and after hatch year birds caught during late summer when almost all can be aged to the time of harvest. The best non-linear least squares fit between the two distributions is being used to estimate molt rates and corrected harvest age ratios. Initial simulation results using 2005-2006 data suggested we can successfully correct estimates to account for unknown age wings. We are currently working to generate estimates of variance for estimates and methods for selecting between different models of molt rate.

A field study on dove reproductive biology has been conducted in central Iowa during the 2005-2007 breeding seasons. We have monitored > 200 nests in each of the three years. More than 100 adults have been trapped on nests, measured, and marked, and a blood sample taken. Current lab work is focused on measuring hormone levels from blood samples in an effort to better understand the physiological changes that occur in nesting birds throughout the summer. In addition, blood samples were taken from ~700 squabs in order to determine their sex using PCR techniques. This information will help to determine whether there are sex specific patterns in growth and recruitment for the population. Additional field work was focused on measuring growth rates of squabs and focused on understanding factors that effect growth and development during the nestling stage. In addition, we will examine the role of hatching asynchrony on growth, the importance of egg size and composition on growth of squabs, and whether squabs adjust growth of wings when under stress to speed up fledging time. In 2007, clutch size was manipulated during the nesting stage to create 1, 2, and 3 squab nests. We then brought 96 squabs into captivity at 10-11 d of age, and assigned them to 3 feeding levels up to 25 d of age. We measured growth of nestling up to 90 d of age and measured flight ability during growth. In addition, a subset of birds was collected to examine growth of muscles and internal organs. This experiment will be used to determine the effects of early stress on growth, adult size, and flight ability.

Future Work

After data are collected from the 2008 Wing Bee, we will analyze the 2005-2007 banding and wing data to 1) apply our estimation technique to correct observed harvest age ratios, 2) examine initial spatial and annual patterns in corrected age ratios, 3) and make recommendations for determining correction factors for future wing collections. In addition, the USFWS – DMBM Harvest Survey Section began a 3-year pilot nationwide mail survey wing collection program in 2007. These wings will also be scored at the Wing Bee in January. The goal of this complementary survey is to compare efficiency of sample collection protocols to inform the design of an operational harvest wing survey program.

We are in the process of compiling results for the endocrine portion of the field study which will examine the relationship of hormone levels to reproductive investment in doves. We are also currently examining the role of development on future flight ability of doves, and the role of egg size and hatching asynchrony on development and growth of doves. After laying a framework for understanding the role of early growth and development on fitness of nestlings, we will then examine factors affecting the phenology of early growth. The principal goal of this work is to gain a better understanding of the factors that may determine patterns in annual recruitment.



States that have participated in the pilot wing-collection program.

Male mourning dove brooding squabs.

Mourning Dove Demographics and Harvest Management in an Agroforestry Complex

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Expected completion: June 2011

Future improvements in mourning dove harvest management will rely on information that cannot be obtained from simple roadside trend data. Rather, 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.

During 2005–2007 we implanted subcutaneous transmitters with external antennas in 589 doves (Table 1). Of the 589 dove implanted with transmitters, 66 were implanted in nestling doves prior to fledging (2005 = 10 nestlings, 2006 = 35 nestlings, 2007 = 21 nestlings). Time needed to implant transmitters required approximately 9–10 minutes per procedure. For survival analysis, the maximum number of birds at risk during a given day during a field season ranged from 26–46 for AHY and 36–44 for HY (Figure 1); we increased our sample size in late summer each year to increase the precision of survival estimates during the hunting season. We used the Kaplan–Meier product limit estimator with staggered entry to initially estimate survival by age class and year (Figures 2–3). Crippling rates reported by hunters as the number of birds shot and not retrieved averaged 16.8% during the month of September compared to an actual crippling rate estimate of 9.0% using available radio-marked doves available on the area during opening day of the hunting season (Table 2).

These are preliminary results from the first 3-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.

Table 1. Number of mourning doves, by age and gender class, banded and radio-marked on the James A. Reed Memorial Wildlife Area during 2005–2007.

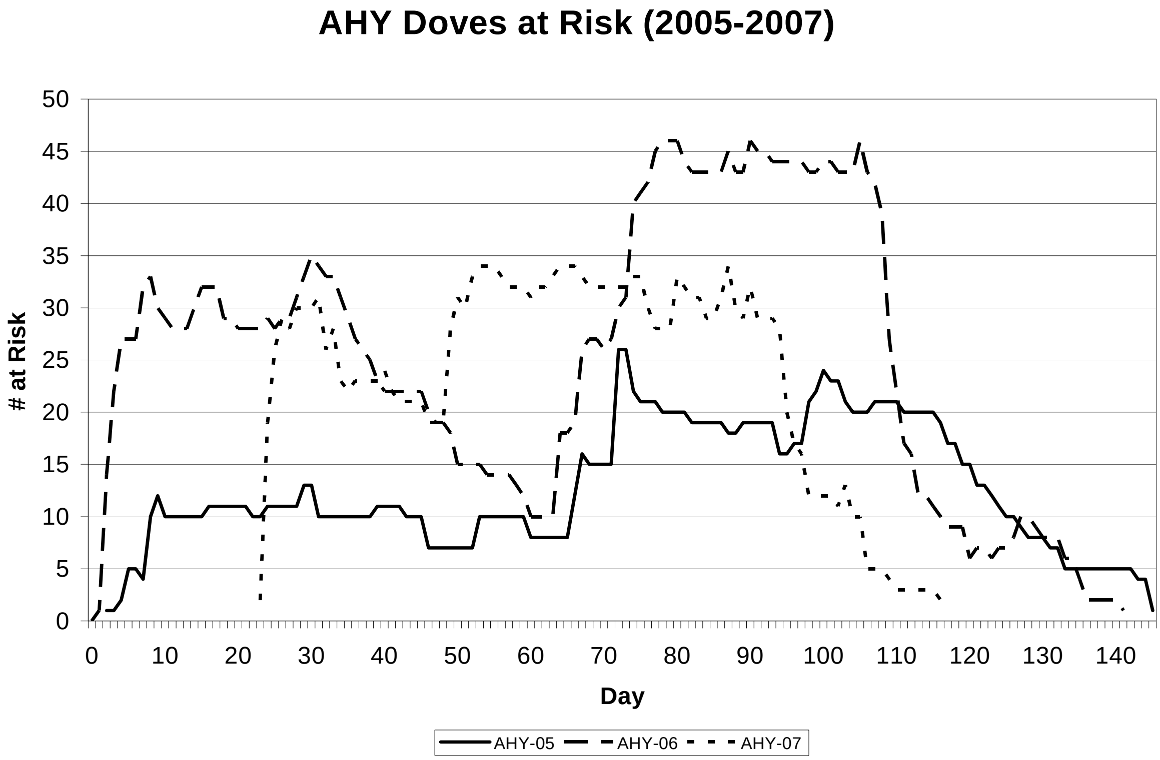
	AHY-F[1]	AHY-M[2]	AHY-U[3]	HY-U[4]	U-U[5]	Grand Total
2005						
BAND ONLY	50	189	124	173	22	558
BAND W/ RADIO	34	12	8	64	3	121
2006						
BAND ONLY	63	200	41	119	7	430
BAND W/ RADIO	49	29	32	116	10	236
2007						
BAND ONLY	2	92	11	183	141	429
BAND W/ RADIO	5	55	23	116	33	232
TOTAL	203	577	239	771	216	2006

[1]AHY-F = after hatching-year age, gender female
[2]AHY-M = after hatching-year age, gender male
[3]AHY-U = after hatching-year age, gender unknown
[4]HY-U = hatching-year age, gender unknown
[5]U-U = unknown age, unknown gender

Table 2. Reported and actual crippling rates during the September 1–30 portion of the mourning dove hunting season on the James A. Reed Memorial Wildlife Area during 2005–2007.

	DOVES REPORTED KILLED	DOVES REPORTED LOST[1]	% REPORTED LOST	RADIO-MARKED DOVES AVAILABLE[2]	RADIO-MARKED SHOT AND NOT RETRIEVED[3]	% RADIO-MARKED SHOT AND NOT RETRIEVED
2005	7426	1267	17.1	54	4	7.4
2006	7875	1307	16.6	80	7	8.8
2007	*	*	*	22	3	13.6
TOTAL	15,301	2,574	16.8	156	14	9.0

[1]Using a mandatory daily hunting tag, the number of doves reported killed and not retrieved.
[2]The maximum number of radio-marked doves available on opening day of the season.
[3]The number of radio-marked doves that were shot (as verified by necropsy) and not retrieved by hunters; represents an actual crippling rate estimate compared to a reported estimate by hunters.
*Data unavailable at the time of reporting.



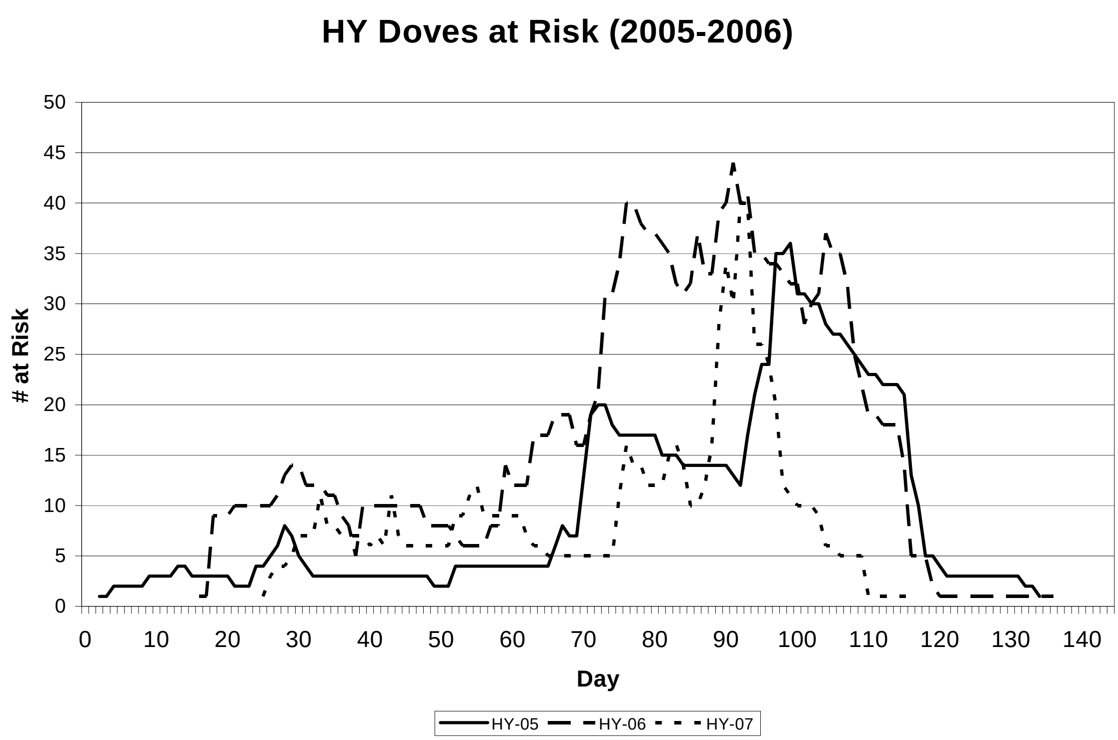


Figure 1. The number of after hatching-year (AHY) and hatching-year (HY) radio-marked mourning doves at risk during the spring, summer, and early fall field season during 2005–2007 on the James A. Reed Memorial Wildlife Area.

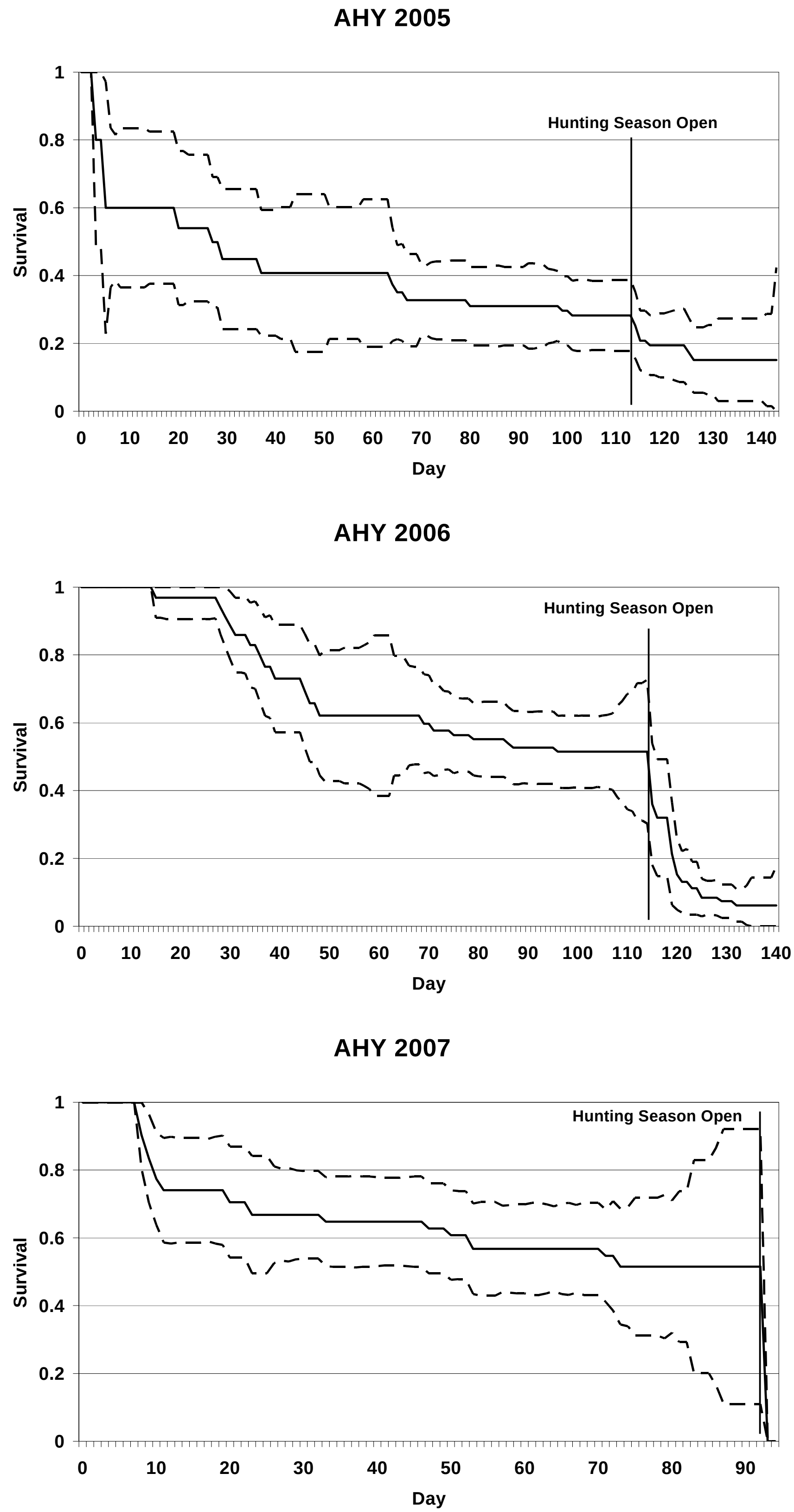


Figure 2. Survival distributions (Kaplan–Meier product limit estimator with staggered entry) for after hatching-year (AHY) mourning doves during 2005–2007 on the James A. Reed Memorial Wildlife Area.

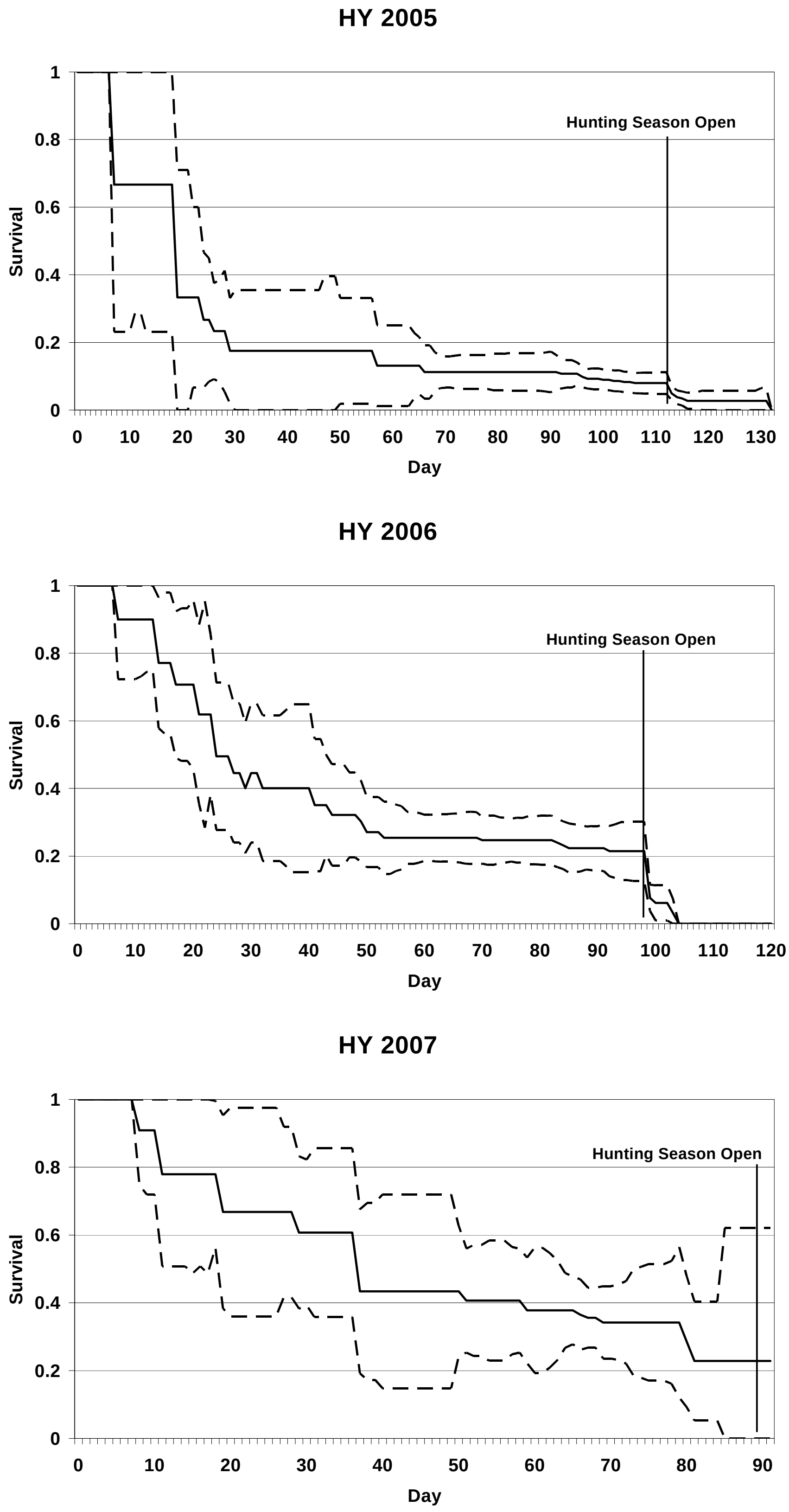


Figure 3. Survival distributions (Kaplan–Meier product limit estimator with staggered entry) for hatching-year (HY) mourning doves during 2005–2007 on the James A. Reed Memorial Wildlife Area.

Mourning Dove Recruitment in Tennessee

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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.

The first year of field work for this 2-year study took place during March-September 2007 on Stonewall Farm, a 162-ha former cattle farm in western Wilson County, Tennessee. 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. Radiomarked doves were monitored daily from date of implant through 30 September 2007. We documented 18 non-harvest-related mortalities among radiomarked doves during the study period. Additionally, 3 radiomarked doves were harvested during a 2-day hunt on the first weekend in September 2007, and 4 radiomarked doves were crippled but not recovered by hunters during those hunts. Among the 5 AHY females radiomarked, 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.

Ongoing analyses will estimate survival of trapped and marked HY and AHY doves from date of radio implant through 1 September 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.

These are results from the first year of a 2-year study. Field work will resume in March 2008, and will include radiomarking and monitoring ~130 doves during the 2008 breeding season. Because very few AHY females were trapped and radiomarked in 2007, emphasis will be placed on marking and tracking adult females in 2008, so meaningful estimates of productivity may be generated. Final data analyses will follow the conclusion of field work in September 2008, and 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.

Radiotransmitter recovered from a mourning dove killed by a predator, Stonewall Farm, Wilson County, Tennessee, August 2007.

Radio-marked mourning dove harvested during hunt at Stonewall Farm, Wilson County, Tennessee, 1 September 2007.

A Pilot Study to Determine if Mourning Doves (*Zenaida macroura*) Ingest Lead Shot in Relation to Shot Availability

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

Lead shot toxicity to migratory birds has been recognized as a serious problem for many decades. Although lead shot was initially seen as a mortality factor in waterfowl, there is evidence that shot also may be problematic for terrestrial birds, especially gamebirds that forage or nest in public hunting areas. Mourning doves (*Zenaida macroura*), in particular, may be at risk from lead shot due to current management practices of planting seed bearing crops on public and hunting areas specifically to attract doves. The objective of this study is to provide an assessment on whether mourning doves ingest lead shot relative to the availability of shot as determined by surface concentration.

The study was to begin from August through October 2007. However, it was unknown to us that the Illinois Department of Natural Resources (IDNR) prohibits baiting of mourning doves just prior to and during the hunting season. (1 September - 31 October and 3-11 November). Hence the study has been deferred for a few months. This may be fortuitous in that the delay allows us ample time to make sure that all of the modified Kniffen traps, housing and field cages are well constructed prior to the collection of birds.

Consequently, we have no data to present at this time. Rather, we have hired a master's graduate student, Stephanie Plautz, to conduct the study under our supervision. Stephanie has nearly completed the construction of 50 modified Kniffen traps. She also has developed plans and purchased material for the temporary cages that will hold doves prior and post field exposure, and has plans for 50–60 field enclosures. After the publication of a very relevant paper (Schulz JH et al. 2007 Am Midl. Natural. 158:177-190) we obtained verbal approval to modify the original study design in a couple of ways. First, instead of exposing doves in sets of three to the field trial, we will construct enclosures that house individual birds. Thus, each bird will serve as an experimental unit instead of each cage of three birds.

Second, trapping will commence in late winter, early spring 2008. As stated in the original study plan, we will conduct a pilot study at that time. The main study will be moved to late spring or summer to avoid the IDNR ban on baiting stations in the autumn.

White-winged Doves

Gender Identification of White-winged Doves

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Expected completion: 2008

Introduction and Objectives

White-winged doves (*Zenaida asiatica*) are migratory game birds with an expanding distribution. The reasons for the range expansion are largely unknown as are the characteristics of populations in newly occupied areas. This species is avidly sought in states having large white-wing 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 liberalizing 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; these rates should be gender specific to examine possible rates of hunting loss on population composition, which could affect breeding population size. Harvest by gender can also be measured through use of hunter bag checks and collections of specific parts through parts collection surveys.

Gender of white-winged doves based on examination of live birds is difficult although some indicate that separation of gender can be done using plumage coloration or body mass. However, others believe the only useful method to correctly assign gender to white-winged doves is through cloacal examination. Cloacal examination takes time and, especially in warm climates, can be stressful to the birds. Additionally, 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 preliminary work suggests a method is available to accurately classify captured white-winged doves by gender.

Our objective is to test use of length of 1 of the 2 central brown tail feathers of white-winged doves to learn if this method can be used to correctly assign gender to live birds that will have their gender verified using molecular techniques. Preliminary work in Arizona (1,000+ bandings, 60+ recaptures) during 2000-07 indicates there is a difference in tail feather length between males and females of all age classes (AHY, SY, HY) although sample sizes for SY's and HY's are small. These differences have also been verified on small samples (~ 20 birds) of gonadally checked hunter- harvested white-winged doves in Arizona. The hypothesis is that central tail feather length (mm) is correlated with gender and can be used to reliably assign gender to live or dead white-winged doves.

A central brown tail feather was plucked from a sample of 200 white-winged doves captured in normal banding operations. Feathers were labeled by band number, measured (mm) fresh, and stored dry. These feathers were then sent to the Rocky Mountain Center for Conservation Genetics and Systematics to ascertain gender using molecular methods. Once in the lab, feathers were again measured to learn whether shrinkage occurred due to drying. DNA was extracted from feathers using the Promega Wizard DNA Purification Kit following the manufacturer's instructions (Promega Corporation). Standard PCRs were performed using the sexing primers developed in our lab. Amplified products were run on the CEQ 8000 Genetic Analysis System (Beckman Coulter). Males were identified by a single peak and females by 2 peaks.

In the adult 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 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 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.

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. 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. These results are from a 1-year study funded by the Webless Migratory Game Bird Research Program (U.S. Fish and Wildlife Service).

A Genetic and Isotopic Characterization of Eastern and Western White-winged Dove Breeding Populations to Determine Wintering Ground Distribution and Population Genetic Structure

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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 wintering 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 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.

Progress to date

Stable isotope and genetic marker analysis

With the help of Texas Parks and Wildlife and Arizona Game and Fish biologists we began collecting wings from hunters in the fall of 2004, 2005, and 2006. 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 revealed clear differentiation between the two populations (Figure 2). Discriminant analysis correctly placed 1080 of the 1200 feathers collected in the correct population. 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 currently collecting doves in the southern states of Mexico. The results of this data will help determine the location and distribution of eastern and western populations in Southern Mexico during the winter.

We completed collections in 3 desert sites in July, 2007 and in both agricultural and desert sites in September, 2007. Gerardo Herrera and Jose Juan Flores, collaborators in Colima and Mexico City, Mexico respectively, have been collecting wings from hunters at hunt clubs throughout southern Mexico in December and January, 2008. Stable isotope and AFLP genetic analysis will be complete by the end of March, 2008. Final collections in both desert and agricultural sites are planned for July, 2008 and September, 2008.

Additional Research Direction

It has long been believed that desert dwelling white-winged doves move into agricultural areas prior to migration. Preliminary results from our migration study

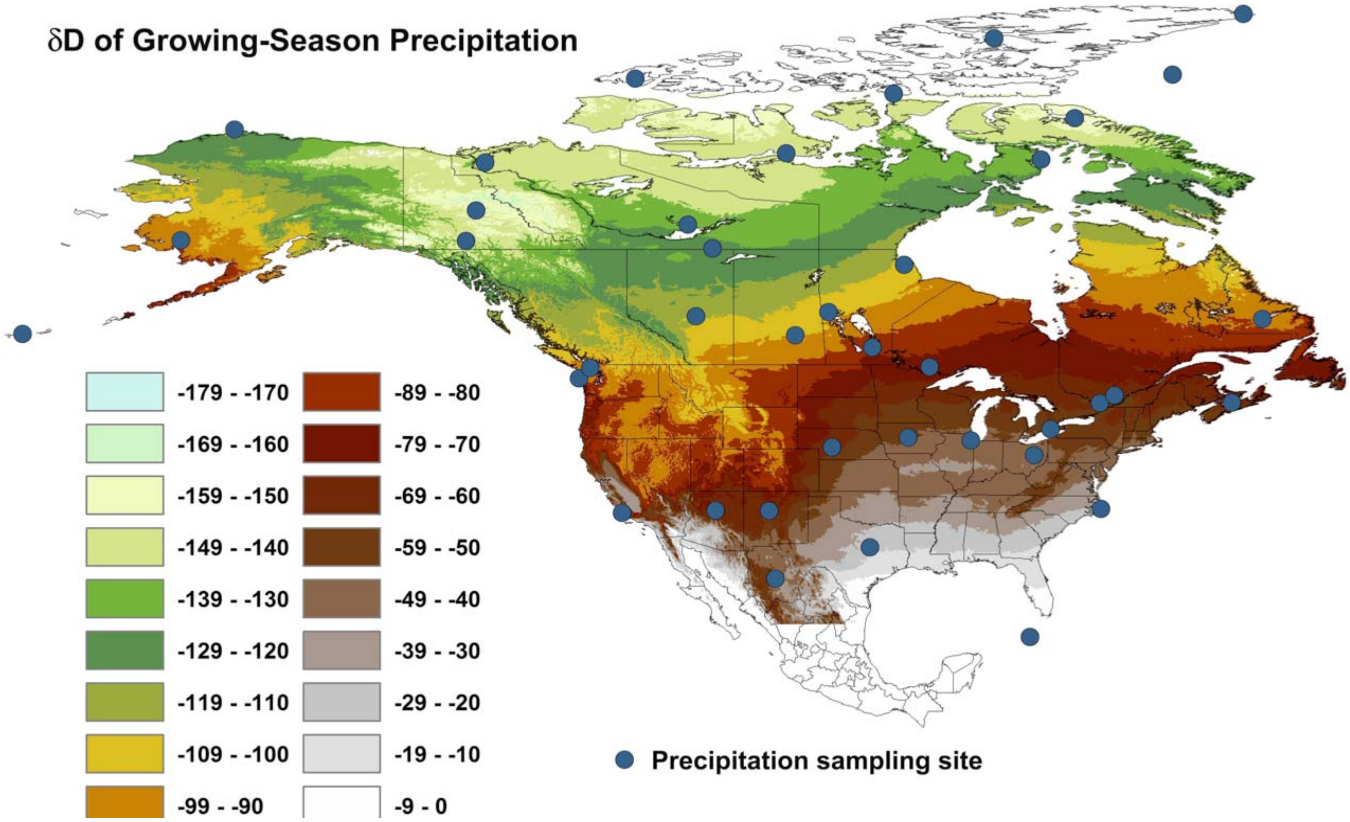


Figure 1. Hydrogen isotope precipitation values across North America show a clear north to south gradient useful for tracking migratory animals (from Meehan et al. 2003).

reveal that breeding season habitat use can be differentiated between doves in the Sonoran desert and doves in agricultural areas as well as post-breeding dispersal patterns using stable isotopes (Figure 3B).

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. During peak flower and fruit production the δD isotopic composition of white-winged dove body water was equilibrated with water derived from 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

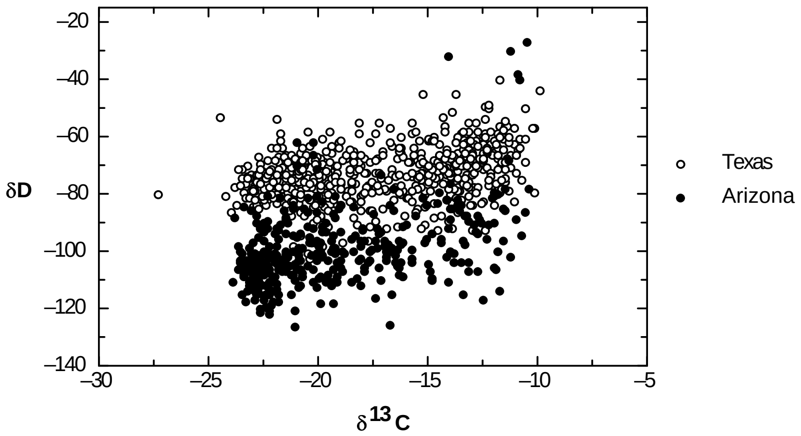


Figure 2. Feather isotope values from birds collected in Texas (○) and Arizona (●) following the breeding season show a clear differentiation between the two populations.

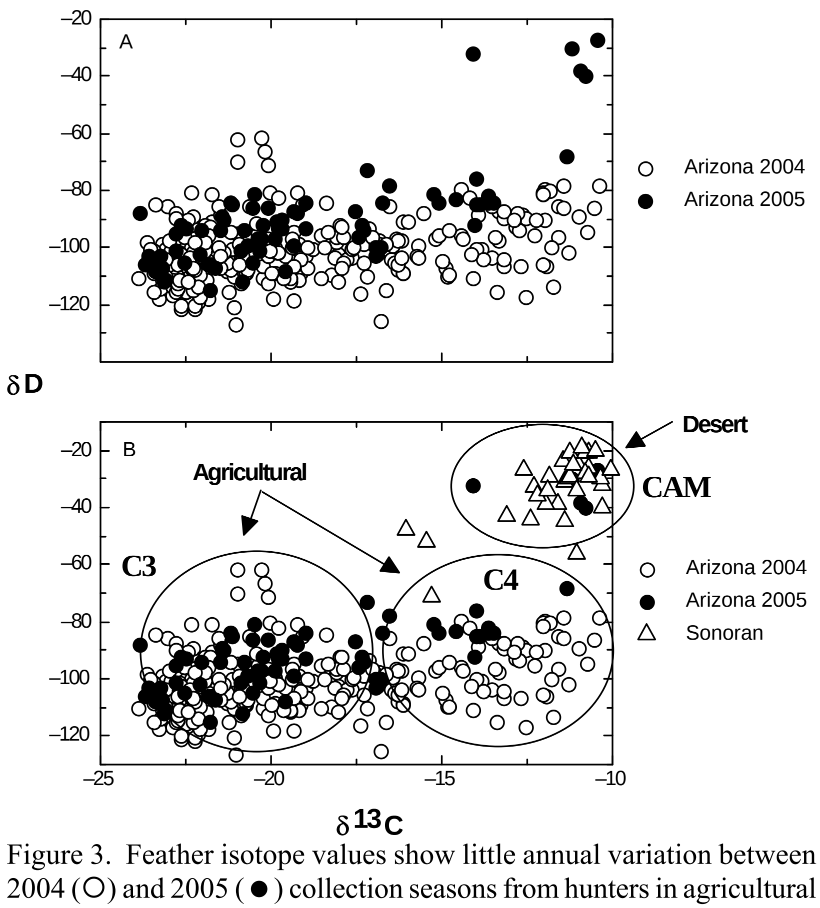
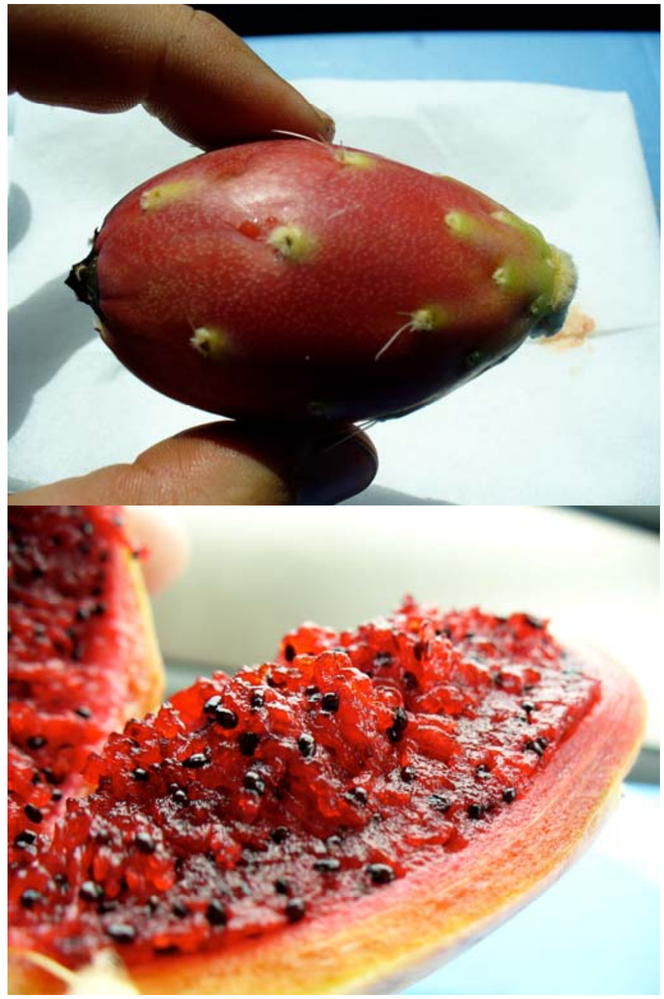


Figure 3. Feather isotope values show little annual variation between 2004 (○) and 2005 (●) collection seasons from hunters in agricultural areas (A). In 2005, five samples fall well outside the range of previously recorded values (A). When you overlay this data with doves collected in the Sonora desert (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).

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 (δ^1H) preferentially evaporate leaving a greater proportion of water molecules containing the heavier hydrogen isotope (δD). This causes the hydrogen isotope ratio (δ^1H/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).

To validate the source of hydrogen to feather keratin we are additionally looking at the hydrogen isotope values of pulp and water from saguaro cacti fruit in the Sonoran desert and irrigation water and crop fruits in agricultural areas. These values will then be compared to feather hydrogen isotope values from birds collected in the same habitats.

Scott Carleton collects ripe fruits from Saguaro Cacti in the Sonoran desert to validate the source of hydrogen isotopes in feathers.



When opened, ripe saguaro fruits reveal their water and carbohydrate rich pulp. This pulp is an important food and water resource to Sonoran desert white-winged doves.

Typical Sonoran desert habitat south of Gila Bend, Arizona

Ripe fruits, in red, open to expose pulp for desert wildlife.

Band-tailed Pigeons

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

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Expected completion: September 2009

Pacific Coast band-tailed pigeon (*Patagioenas fasciata monilis*) populations are currently surveyed using a breeding population index derived from pigeon counts conducted at mineral sites distributed throughout their breeding range (Casazza et al. 2005). This range-wide survey became operational in 2004; realizing a management need identified more than 30 years ago and reiterated in the 1994 Pacific Coast band-tailed pigeon management plan (Keppie et al. 1971, West. Migr. Upland Gamebird Tech. Comm. 1994). One of the critical issues in implementing this method is appropriate representation of band-tailed pigeon breeding range and mineral site use (Casazza et al. 2003).

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.

In January 2007, we marked two band-tailed pigeons north of Sacramento, CA with the 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). The manufacturer programmed transmitters received for the expansion project with a shorter duty cycle; 48 hours off and 10 hours on. In August 2007, we marked fourteen band-tailed pigeons at six locations in California, Oregon, Washington, and Nevada (near CA border at Lake Tahoe). Unsuccessful efforts were made to trap pigeons in British Columbia and a second site in California.

Argos satellites obtained multiple locations of varying quality during each duty cycle (Table 1). Each location was analyzed using an algorithm developed by David Douglas at the USGS Alaska Science Center. This algorithm parse the locations into those of poor quality (filtered), unfiltered, and a single highest quality (selected) for each duty cycle. Criteria for selection and filtering include movement distance, angle of successive location, and location redundancy (i.e. overpassing of locations).

We deployed 14 transmitters at 6 sites within Pacific Coast band-tailed pigeon breeding range in August 2007 (Figure 1). Three birds were marked in both Sequim and near Belfair, Washington. One bird was marked at the Dutch Canyon mineral site northwest of Portland, Oregon and four birds were marked outside McMinnville, Oregon. Two birds were marked on the Smith River near Hiouchi, CA. One bird was marked in Carson City, Nevada. Together with the two transmitters deployed near Sacramento, CA in January 2007, we deployed 16 of 22 available transmitters. 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. As of December 9th, 2007 we have received locations for over 750 duty cycles representing 21 birds (Figure 2).

Spring Migration

Both birds marked near Sacramento migrated northward in the spring. One individual began migration in the last half of March, the other began at the end of May. Total duration of migration was 39 and 34 days, respectively. One individual spent the breeding season near Gray's Harbor, WA. The other migrated to northwestern Oregon. Both birds appeared to initiate nesting related movement patterns (highly localized) within a week of relocating in breeding season territories. The initial route of migration was similar for both individuals. Both birds migrated north from the Sierra Nevada foothills to the Trinity Mountains west of Redding, CA. From there one bird migrated up the western slope of the Cascades, across the Willamette Valley to settle in northwestern Oregon. The other moved northward along the Coast Range to Washington.

Breeding season and nesting

We identified nesting behavior for three birds in 2007. The pigeon marked east of Sacramento which migrated to northwestern Oregon, showed two periods of highly localized movements. The first lasted 39 days, the second lasted 43 days. The length of time required to successfully produce offspring for band-tailed pigeons is approximately 45 days (20 days of incubation and 25 days of nestling care; Keppie and Braun 2000). Both periods are suggestive that nests were successful. The second bird marked east of Sacramento that migrated to Gray's Harbor, Washington exhibited highly localized movements throughout it's time in the breeding season (81 days). This is not sufficient for 2 successful nesting attempts, but suggests at least one nest may have been successful. Lastly, one bird marked in Sequim, Washington exhibited localized movements following marking for 26 days. This was the only newly marked bird to show nesting behavior and we suggest it may have been captured and marked while feeding between nest attendance schedules.

One bird marked in Sequim, Washington on August 2, 2007 left the area approximately 18 days following capture. It did not complete a migration but stopped approximately 200 Km from its capture site for one month east of Kelso, Washington.

Fall migration

Fifteen birds began southerly migrations. Due to intermittent transmitter signals only nine can be confirmed as having arrived at winter territories. Departure dates from breeding territories varied widely from September 21 to October 26 with an average departure date of October 10, 2007. The average duration of migration was 29 days (range 20-46 days) determined from seven birds that completed migration. One additional bird (from Dutch Canyon mineral site) migrated, but the data received from its intermittent transmitter precluded calculation of migration time or routes. The single bird marked in Carson City, Nevada remained relatively nomadic throughout the breeding season and has survived, without migrating, into the winter.

Total distance traveled from breeding territory to winter territory averaged 608 Km for the nine birds with available data. The longest migration path recorded this season is the 915 Km from Sequim, WA to northern Mendocino County, CA. The shortest migrating bird moved 294 Km from Crescent City, CA to southern Mendocino County, CA.

Fall migration routes for most birds terminated along the northern California coast. Two birds from Belfair, WA migrated along the Oregon Coast Range. Two from Sequim, followed the Oregon Cascades south. Two birds from McMinnville migrated along the Oregon Coast Range, at the Klamath/Siskyou Mountains one bird continued along the California Coast Range, the other crossed to the Sierra Nevada foothills. Two additional birds (one from McMinnville, the other from Dutch Canyon mineral site) migrated to the California Coast range and presumably followed the Oregon Coast Range. The bird marked near Sacramento, which bred in northwestern Oregon, stopped at the same location visited during spring migration in the Oregon Cascades near the California/Oregon border (Figure 3).

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. The distribution of known mineral sites in California does not include these areas, suggesting unknown mineral sites may be present.

Hunting Season

No bird had left the original state in which it was trapped by the end of the 2007 September hunting season (September 15-23; Figure 4). 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 2007 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 2008, we will deploy remaining transmitters in California and British Columbia during the breeding season. 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.

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Table 1. Location quality for each deployed PTT transmitter and proportion of duty cycles obtaining at least one high quality location (SD = <1 Km error).

Location class	2006 transmitters	2007 transmitters	Total
LZ	4%	3%	3%
LB	13%	8%	9%
LA	16%	9%	11%
L0	15%	33%	28%
L1	16%	23%	21%
L2	14%	12%	13%
L3	23%	11%	14%
Proportion of duty cycles w/high quality locations (LC 1-3)	94%	73%	79%

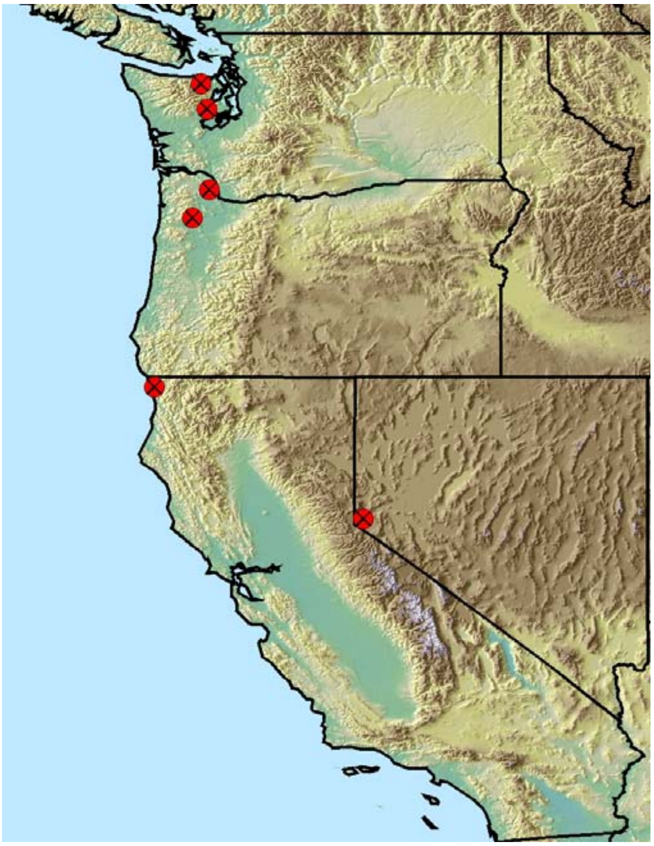

Figure 1. Pacific Coast band-tailed pigeons were captured and fitted with 12 gram back-pack mounted satellite transmitters at six locations in August 2007.

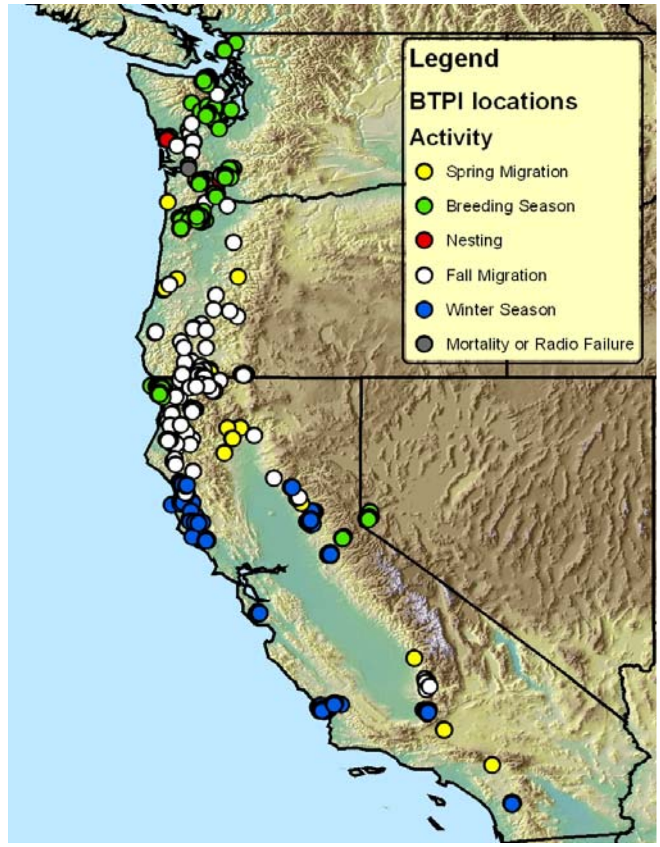

Figure 2. Satellite telemetry locations from band-tailed pigeons are providing new information on migratory patterns and winter use areas.

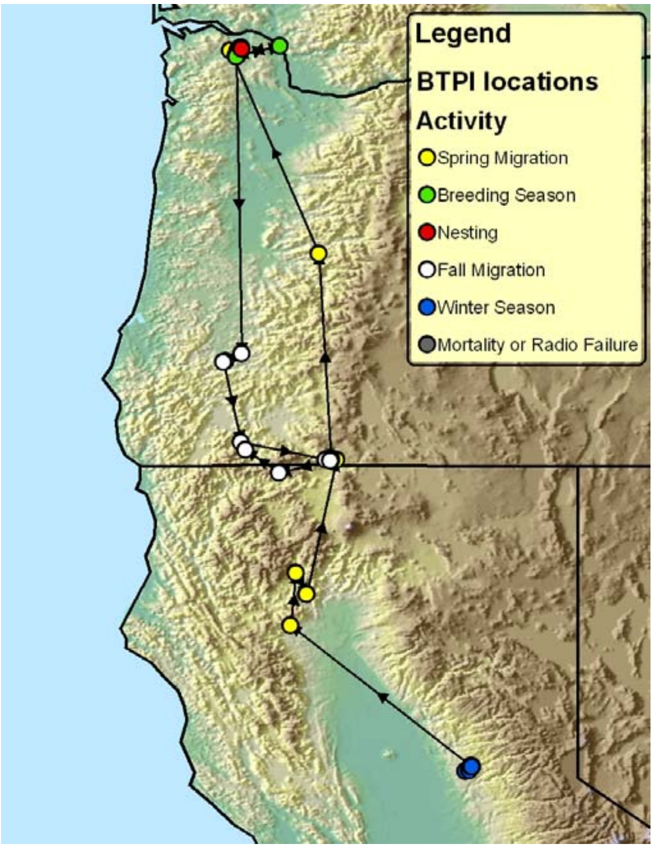

Figure 3. Movement path for PTT# 64236 January to November 2007.

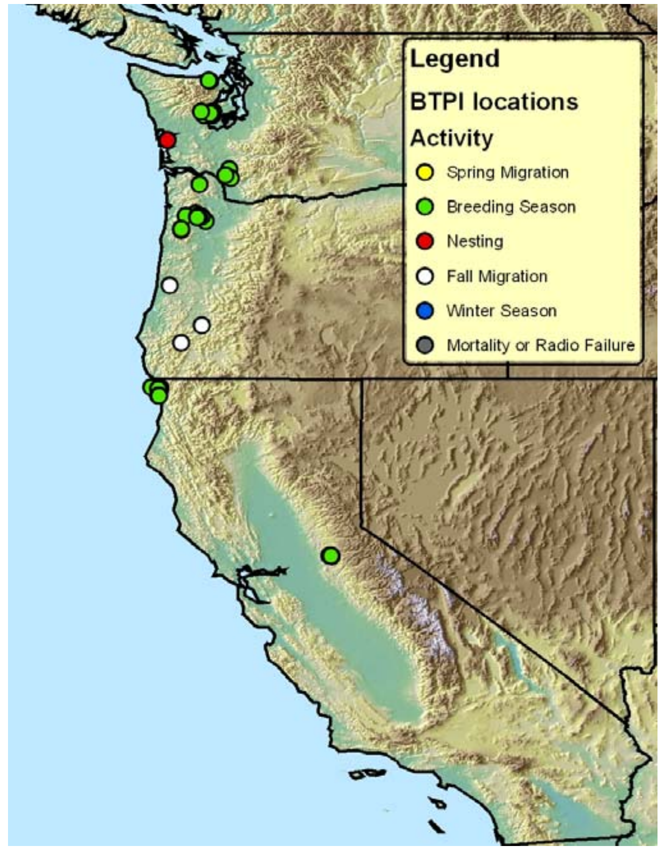

Figure 4. Band-tailed pigeon locations during the September 2007 hunting seasons. All birds remaining within the state in which they were marked, though two had begun southward migrations.

Biologists Cory Overton and Eric Kolada capture band-tailed pigeons in Belfair, Washington. Photo by: Mary Hrudkaj.

A solar powered satellite transmitter is attached to an adult band-tailed pigeon. Photo by: Mary Hrudkaj.

Two radio-marked band-tailed pigeons are released where captured in Belfair, Washington. Photo by: Mary Hrudkaj.

Sandhill Cranes

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

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Graduate students: Tandi Perkins, PhD; Diana Iriarte, MS; Bret Beasley, MS; **Expected completion:** December 2008.

Reporting period: November 2006 through November 2007.

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. 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. 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 have been continuous until mid-September 2007. M.S. students initiated field studies in 2006 and completed these investigations during September 2007. Scan sampling identified sites of high crane use across the study area from Idaho to 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 (soon after arrival on the wintering grounds, immediately before departure from the wintering grounds, on migration sites, and on the breeding grounds during breeding, brood rearing and fall staging in Idaho, Colorado, and New Mexico.

A total of 5120 hours of scan sampling was conducted during two years of intensive investigations that accounted for 13,384 crane observations. These observations were distributed across the study area as follows: 6406 in the Middle Rio Grande Valley, New Mexico during winter; 1078 during fall migration and 1241 during spring migration in the San Luis Valley, Colorado; and 4659 within the Grays Lake Basin, Idaho during breeding, brood rearing, and fall staging. A total of 549 m^2 quadrats were sampled for above and below ground food resources at use (286) and non-use (263) sites. The quadrats were distributed across the study area as follows: Bosque del Apache National Wildlife Refuge (NWR) arrival 90, Bosque del Apache NWR departure 90, San Luis Valley during spring migration 90, and at Grays Lake Basin on breeding 99, brood rearing 99, and fall staging 99. Scan sampling indicated that cranes regularly used drier sites not classified as wetlands where ground water discharge influenced plant community composition. These sites are classified as wet uplands/meadows.

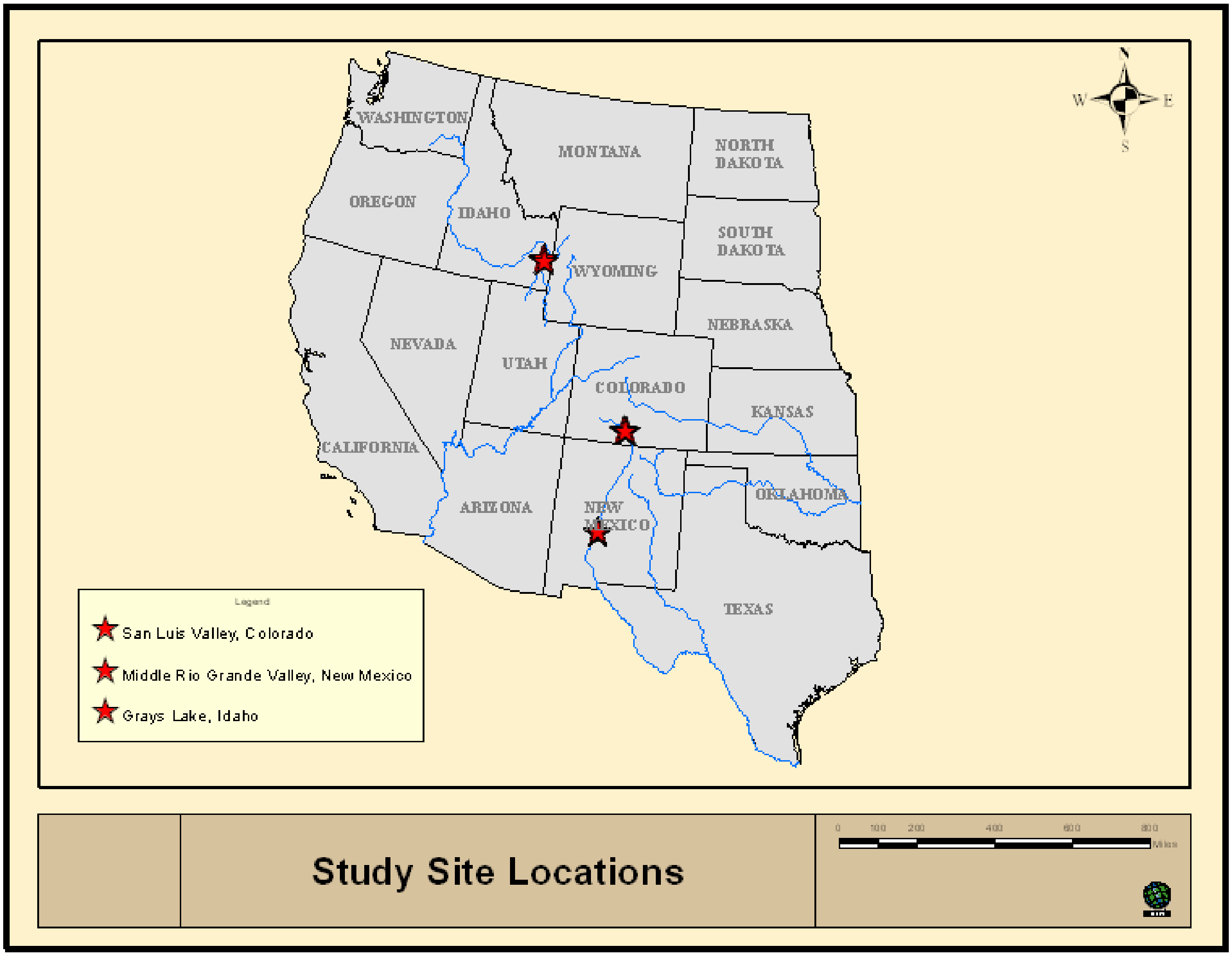

Figure 1. Primary sampling locations associated with sandhill crane use of agricultural , wetland and wet upland/meadow habitats from the breeding grounds to wintering sites within the United States.

The 549 above and below ground samples were taken from the following habitats: agriculture, wet uplands/meadows, temporary wetlands, seasonal wetlands, and transitional wetlands. Plant communities on these sites with high use included agriculture (corn, alfalfa, barley), wet uplands/meadows (alkali sacaton, *Sporobolus airoides*; rabbit brush, *Sarcobatus vermiculatus*; and sagebrush, *Artemsia* spp.), temporary wetlands (salt grass, *Distichlis spicata*), seasonal wetlands (managed wetlands, Baltic rush, *Juncus balticus*), and transitional wetlands (timothy, *Phleum pretense* and brome, *Bromus inermis*). The sites classified as wet uplands/meadows have an array of above and below ground food resources that have not been well identified in the literature.

All food samples will be sorted by January 2008 and identification will commence about mid-December 2007.

Anticipated date of completion of the identification process is late spring 2008. Summarization of habitat conditions and results of the identification process will commence immediately. The summarization of crane distribution and use data has been completed for the Middle Rio Grande at Bernardo Wildlife Management Area and is well along for Bosque del Apache NWR.

After spending the summer in the field, the M.S. students continue to take required classes to meet degree requirements. Writing will be a focus for all three students beginning in summer 2008. This progress report is the second of 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 2. Seasonal wetland habitat conditions at Grays Lake National Wildlife Refuge, Idaho before the start of the growing season.

Figure 3. Above ground biomass sampling in a temporary wetland habitat within a 1 m^2 quadrat using a vacuum technique on Grays Lake National Wildlife Refuge, Idaho.

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

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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 a more mature landscape is widely regarded as the reason for apparent 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.

Progress to Date

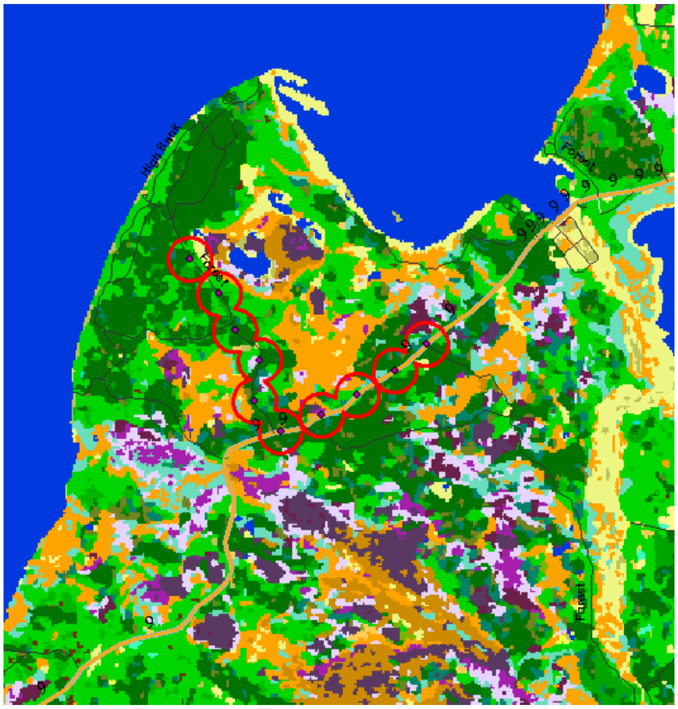
To date, we have established an agreement through the Minnesota Cooperative Fish and Wildlife Research Unit to support this project at the University of Minnesota. A M.S. student (Matt Nelson) has begun compiling existing landcover data and Singing-ground Survey route locations and counts. Route locations have been obtained from the U.S. Fish and Wildlife Service Migratory Bird Management Office, and a subset of route coordinates have been obtained from volunteers who conduct the surveys. Route locations are being verified with volunteers prior to data analayses, and we have compiled current landcover data at the broad scale.

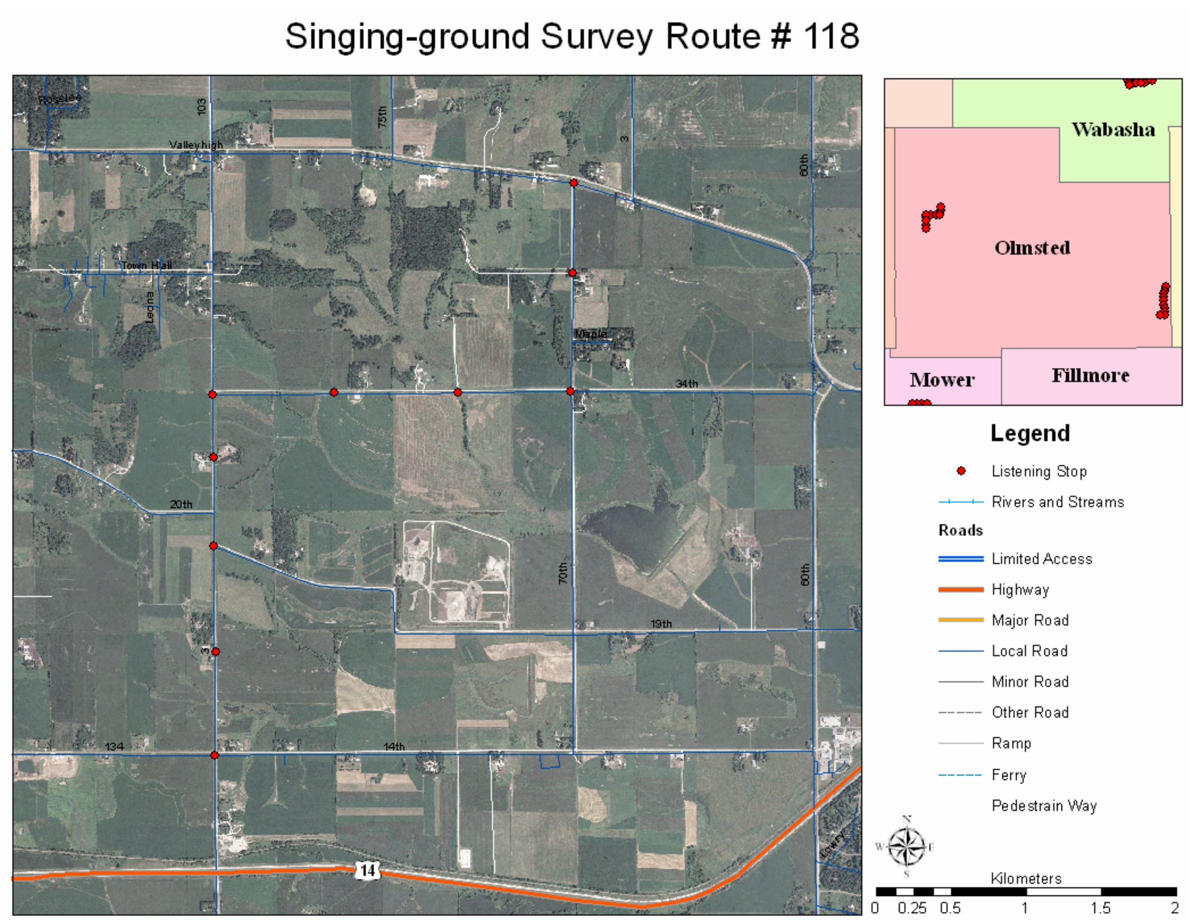
Future Work

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

(1) Complete data compilation of existing landcover data bases necessary to conduct analyses
(2) Complete acquisition of accurate Singing-ground survey route locations and associated woodcock abundance data.
(3) Based on landcover data availability, determine feasible analytical approaches and begin 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).





Digitized land cover and aerial photo of 2 Singing-ground Survey routes in Minnesota.

Survival, Habitat Use and Fall Movements of American Woodcock in the Western Great Lakes Region

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Final report

Introduction

Declines in the number of American woodcock (*Scolopax minor*) heard on the annual Singing-ground Survey (Straw et al. 1994) have resulted in concern about the status of woodcock populations. The number of males heard on the survey declined an average of 1.8% in the Central Region and 2.0% per year in the Eastern Region during 1968-2007 (Kelley et al. 2007). Large-scale habitat changes are generally regarded to be the primary cause of the apparent population declines. However, concern about the status of woodcock populations has highlighted the need for information on the role of hunting mortality in woodcock population dynamics. McAuley et al. (2005) examined the effects of hunting on survival of woodcock in the Eastern Region. However, information on hunting mortality in the Central Region, where hunting seasons begin earlier and are longer, is lacking. Similarly, movements and habitat use prior to fall migration, migration chronology, and cues for migration are poorly understood. Thus, in 2001 (Minnesota) and 2002 (Michigan and Wisconsin) we initiated a study to document fall survival rates of woodcock, assess the magnitude and sources of woodcock mortality, and investigate movements, habitat use, and factors that influence fall migration chronology of woodcock in the western Great Lakes Region.

Methods

In all 3 states we radio-marked woodcock on paired study areas; 1 of which was open to hunting ("hunted areas") and expected to received considerable hunter use, and the other of which was either closed to hunting ("non-hunted areas" in Michigan and Minnesota) or was relatively inaccessible to hunters and expected to attract little or no hunting activity (lightly-hunted area in Wisconsin). We used Program Mark to estimate survival and to evaluate a set of candidate models to examine the effects of hunting and several covariates (sex, age, year, state) on survival. We monitored movements and habitat use of a sub-sample of adult female woodcock intensively to assess whether foraging-habitat-use decisions were related to prior experience and environmental cues, and to assess how habitat structure and food availability influenced use of cover types at the habitat-patch and home-range scales. Finally, we used environmental data and departure dates of radio-marked woodcock to examine the influence of environmental factors on the timing of departure of woodcock during fall.

Summary of Results

During 2001-2004, we captured and radio-marked 1,171woodcock; 595 in hunted areas and 576 in non-hunted or lightly-hunted areas (Table 1). Hunting accounted for 48% of the 147 woodcock deaths in the hunted areas, followed by predation (32%), and various other sources of mortality (20%). The 66 woodcock deaths that occurred in the non-hunted and lightly-hunted areas were caused by predators (58%), various other sources (24%), and hunting (18%). Because more hunting mortality than expected occurred in the lightly-hunted area in Wisconsin, we included data from this area with the hunted areas when pooling data among states for survival analyses. Data from the non-hunted area in Minnesota in 2004 also were included with the hunted areas when pooling among states because that area was opened to woodcock hunting in 2004. Information-theoretic model selection based on Akaike's Information Criterion indicated that fall survival varied by treatment (i.e., hunted versus non-hunted) and year (Table 2) but not by age, sex, or state. Survival ranged from 0.707 (95% CI 0.631-0.770) in the hunted areas in 2003 to 0.961 (95% CI 0.852-0.990) in the 1 non-hunted area in the study in 2001 (Minnesota). Fall (10 September – 8 November) survival estimates based on data pooled among years and states were 0.784 (95% CI 0.746-0.817) in the hunted areas and 0.881 (95% CI 0.824-0.921) in the non-hunted areas. The kill rate due to hunting when data were pooled among states and years was 0.145 (95% CI 0.117-0.180). Our results suggest that hunting mortality was at least partially additive to other sources of mortality in our study areas during the fall, but its contribution to annual mortality remains unclear.

Primary determinants of movements of 58 adult female woodcock during fall (prior to migration) appeared to be low local food availability and the potential for increased food availability elsewhere. Patch quality was an important predictor of future foraging habitat selection and our results support the hypothesis that woodcock movement behavior balances the risks associated with movement with the potential benefits of increased energy intake in new foraging areas. Adult female woodcock primarily moved small distances (47.7% <50 m and >90% <400 m between subsequent locations and 5.82 ha average 95% fixed kernel home range size) prior to fall migration.

Adult female woodcock used a variety of cover types and the percentage of total use varied by type among years and states. The seedling-sapling aspen cover type was the most preferred cover type across states and years but had the lowest earthworm biomass of all used cover types, indicating that on average our radio-marked woodcock selected areas with high stem density over areas with high earthworm biomass. We also found evidence that woodcock selected for edge proximity at both micro-habitat and home-range scales.

We documented 786 fall migration departure dates of radio-marked during 2002-2004. Photoperiod appeared to be the primary cue for timing of departure. Thus, most woodcock migrate from the Great Lakes region at about the same time each year. Earthworm abundance did not appear to influence timing of departure. Woodcock were more likely to depart under a bright moon (illumination >50% of the moon's surface), when barometric pressure was high, with northwest winds, and when visibility was high. Across years and study areas, most woodcock departed in late October or early November, with a mean departure date of 28 October.

Funding for this project was provided by the U.S. Fish and Wildlife Service-Region 3, the Biological Resources Division of the U. S. Geological Survey, the Minnesota Department of Natural Resources (DNR), the Michigan DNR, the Wisconsin DNR, the 2001 Webless Migratory Game Bird Research Program, the University of Minnesota-Twin Cities, Northern Michigan University, the University of Wisconsin-Madison, the Minnesota Cooperative Fish and Wildlife Research Unit, the Ruffed Grouse Society, the Wisconsin Pointing Gun Dog Association and the North Central Wisconsin Chapter of the North American Versatile Hunting Dog Association. Three manuscripts from this project have been accepted for publication, and 3 others are in preparation. We also have presented our results at professional meetings and for sportsman's groups on at least 14 occasions.

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Table 1. Number of radio-marked American woodcock in hunted and non-hunted or lightly-hunted areas in Michigan, Minnesota, and Wisconsin 2001-2004.

	Michigan		Minnesota		Wisconsin	
Year	Hunted	Non-hunted	Hunted	Non-hunted	Hunted	Lightly-hunted
2001	--	--	31	44	--	--
2002	65	56	67	69	71	48
2003	59	16	66	75	70	52
2004	63	52	33	97[a]	70	67
Total	187	124	197	285	211	167

[a]Opened to woodcock hunting in 2004.

Table 2. Fall season survival estimates of radio-marked American woodcock in hunted and non-hunted or lightly-hunted areas, 2001-2004 from the model $S_{treatment,\ year}$. Survival estimates are based on data pooled among states.

	Hunted		Non-hunted[a,b]	
Year	Survival	95% CI	Survival	95% CI
2001[d]	0.930	0.746-0.982	0.961	0.852-0.990
2002	0.797	0.726-0.851	0.883	0.817-0.927
2003	0.707	0.631-0.770	0.828	0.736-0.890
2004	0.820	0.763-0.864	0.897	0.831-938

[a]Data from the lightly-hunted area in Wisconsin were included in the hunted sample.
[b]The non-hunted area in Minnesota opened to woodcock hunting in 2004; data from 2004 were included in the hunted sample.
[c]The number of birds that provided any useable data during the 60-day fall season.
[d]Minnesota study area only.

Marsh Birds

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

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The king rail (*Rallus elegans*) is a large rail found throughout coastal and inland wetlands in southeastern and midwestern North America, with populations also found in the Greater Antilles and central Mexico. Coastal populations are mainly resident year-round, while more northern and interior populations are migratory. The migratory population has declined dramatically in the past 30 years, most likely due to the extensive loss of wetland habitat. Another potential impact on king rail populations is hunting. Although migratory populations are listed as Endangered or Species of Concern in many midwestern states, the king rail is a game bird in 14 Atlantic and Gulf coast states. It is possible that migratory populations winter in coastal areas where they are exposed to harvest.

Due to the secretive nature of the king rail, it is a difficult species to study. Even with the aid of taped calls, it is difficult to detect and thus difficult to monitor. Little is known about specific habitat associations, migration routes, and wintering areas. Refuge owners wanting to manage for king rails need more information about distribution and habitat requirements to develop an effective plan, and determining the winter distribution of endangered migratory king rails may impact hunting regulations in some states. This project will be one in a series of studies meant to build upon one another to address these issues. The project objectives are: 1) to asses the distribution, abundance, and habitat occupancy of apparently migratory king rails along the Mississippi River between St. Louis and Hannibal, Missouri; 2) to gather basic information about reproductive ecology and habitat use; and 3) to assess different trapping methods.

From 2 May to 1 July 2006 and 23 April to 7 July 2007, we surveyed wetlands among 20 refuges and private lands along both sides of the Mississippi River between St. Louis and Hannibal, Missouri, and along the Illinois River up to Beardstown, Illinois. We used the protocol described in the North American Standardized Marsh Bird Survey, and surveyed each point 5-8 times in mornings and evenings. We recorded temperature, cloud cover, wind speed, background noise, and water level conditions at the time of each survey. We collected habitat data ≤ 50 m of each survey point. Measurements recorded included rank of vegetation height and water depth (ranks were: ankle, knee, waist, and chest or higher compared to the observer) and percent of crop field, bare ground, open water, woody, upland grass/forb, and emergent plants by species. We will analyze the response data and habitat covariates using program PRESENCE to estimate the probability of a site being occupied (psi) and the probability of detection (p), as well as to assess the relative importance of habitat or landscape variables.

We detected king rails at BK Leach Conservation Area and Clarence Cannon National Wildlife Refuge (NWR) in both years. In 2007 we detected king rails at a private land adjacent to Clarence Cannon NWR, which did not have any detections in 2006. In 2007 we also detected king rails at Spunky Bottoms, a refuge in Illinois owned by The Nature Conservancy, which we did not survey in 2006. We had a single king rail detection early in the 2007 season at Ted Shanks Conservation Area, and none in 2006.

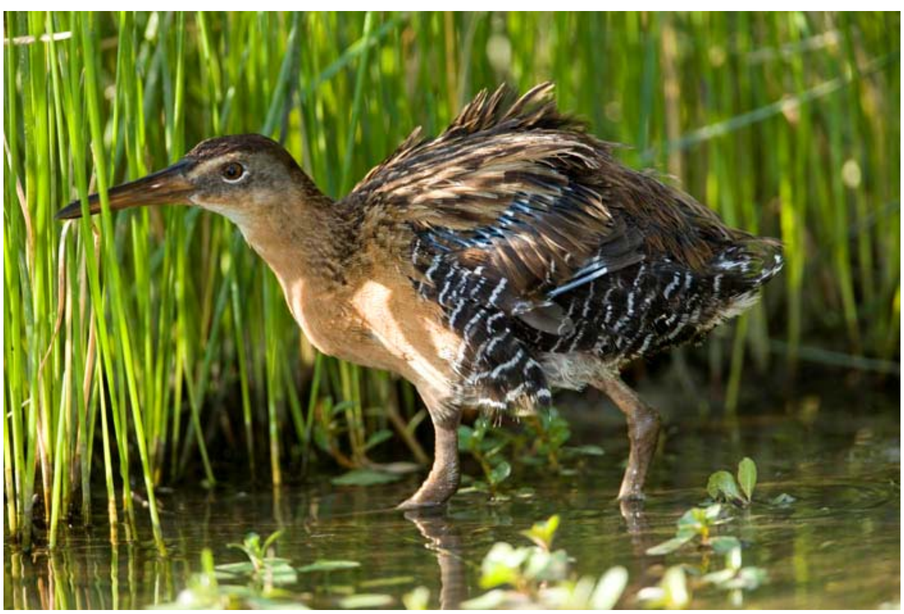
We observed king rail broods throughout the 2006 and 2007 seasons at Clarence Cannon NWR and BK Leach. We recorded information about movement patterns, prey taken, foraging methods, and other behaviors. We measured the following habitat parameters within a 5 m radius of each brood location: vegetation cover, vegetation density, water level, distance to nearest levee, and first and second dominant plant species. At BK Leach, broods were generally found in shallow pools surrounded by patchy emergent vegetation such as cattails, river bulrush, and spikerush. At Clarence

Cannon NWR and the adjacent private land, the broods were generally found near drainage ditches lined with perennial emergent vegetation such as water smartweed and spikerush. The chicks would forage in small pools and ditch edges or hide in the vegetation while an adult brought them food.

We tried to capture king rails throughout the season using a variety of methods including mist nets, ground traps, and spotlighting from foot and ATV. We caught and banded 3 adult and 2 juvenile king rails, and attached radio transmitters using a three-loop thigh harness for adults and superglue for juveniles. We used a 3.8 g radio transmitter (PD-2, Holohil Systems, Inc.) for 2 adults and a 2.95 g radio transmitter (BD-2, Holohil Systems, Inc.) on 1 adult and the 2 juveniles. We caught one adult at night using a spotlight, dip net, and a call playback, to which the rail called and approached. We caught another adult by using a call playback to attract the rail, then flushing it into a 36 mm mist net and securing it with a dip net. We caught one chick by flushing it into a 36 mm mist net; the chick, at 3-4 weeks old, was small enough to become tangled in the net. We caught the other chick by slowly walking toward a ramp trap with 25 m leads made from chicken wire. We caught the final adult at night from an ATV using spotlights and a dip net. Both chicks and the first adult lost their transmitters within 2 days.

We tracked one king rail at Clarence Cannon NWR from 6 June through 11 July 2007, when we found the transmitter without the harness on the ground. The marked bird remained near the capture location with another adult and 2 chicks until 18 June 2007. The marked bird then moved south about 500 m to an adjacent unit where it remained until 25 June 2007. The bird then moved to a third unit, about 600 m west of the first location. On 27 June, we briefly observed one 3-4 week old chick near the radioed bird. We observed a chick several times afterward following the radioed bird, and the adult would often make soft grunting or purring sounds and carry food to where the chick was hidden. On 6 July, we saw 2 chicks, both 4-5 weeks old, following the radioed bird and making begging calls. There are two possible situations that may explain the appearance of these chicks with the radioed bird: one is that these are the same chicks that were present with the radioed bird at its initial location, and they were able to relocate the radioed bird when it arrived at this unit. A second possibility is that these chicks originally belonged to another set of adults. Three to four weeks prior to these observations, there had been an adult king rail with 4 chicks, all several days old, in this same area.

We banded the last king rail at BK Leach CA on 15 August 2007. The refuge manager Brian Loges tracked this rail several times a week for us. It remained within 100 m of the capture location until 28 September, after which it could no longer be located. It was not found anywhere else in the refuge and is presumed to have migrated out of the area.



Adult king rail at Clarence Cannon National Wildlife Refuge. Photo by Noppadol Paothong, Missouri Department of Conservation.

Dr. David Krementz and Abby Darrah tracking a king rail on a Wetland Reserve Program land. Photo by Jessica Shaw.

A king rail being held by Jessica Shaw and banded by Abby Darrah. Photo by Jean Favara of Clarence Cannon National Wildlife Refuge.

Juvenile king rail captured at a Wetland Reserve Program land. Photo by Abby Darrah.

Abby Darrah holding a king rail before banding. Photo by Candy Chambers of Clarence Cannon National Wildlife Refuge.

Other Webless Research Projects

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

Studies of Native Columbiformes in Tucson, Arizona, 2007

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Banding of mourning (*Zenaida macroura*) and white-winged doves (*Z. asiatica*) continued in 2007. Five hundred mourning doves and 106 white-winged doves were banded. No Inca doves (*Columbina inca*) were seen at the trap location (Catalina Foothills, northeast Tucson) in 2007. All bandings were between 4 April and 19 September although mourning doves were present at the trap site in substantial numbers every day. Breeding activities of mourning doves began between 10 and 15 January and calling continued until 15 September. 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.

Trichomoniasis (caused by *Trichomonas gallinae*) in mourning doves was not observed in 2007. Trichomoniasis has not been observed in white-winged doves during 2000-2007.

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

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Biologists speculate that the Eurasian collared-dove (*Streptopelia decaocto*) (ECDO) has the potential to become a competitor of the native mourning dove (*Zenaida macroura*) (MODO) (Romagosa 2002). Resource and habitat requirements such as food selection, nest sites, and nesting materials are analogous between these two species (Romagosa et al. 1999, Romagosa et 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. There are aspects of the ECDO life history in the USA that 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 trends in population densities of MODO and ECDO in suburban areas, 2) identify ECDO and MODO home-range size and daily movement patterns in suburban environments during the breeding season, 3) assess ECDO productivity in suburban environments, and 4) determine recovery rates of marked populations of ECDO and MODO from suburban environments.

Research was conducted in the towns of Herrin, Marion, and Carterville in Williamson County and West Frankfort of Franklin County. Line transect surveys were conducted at each town in March, July, and September to estimate trends in population densities of ECDO and MODO. Kniffin modified funnel traps were used at each study site to capture doves. All captured doves MODO (n = 150) and ECDO (n = 2) were aged and sexed according to Cannell (1983) and fitted with a federal band and a unique color band combination. Morphological measurements were taken for each dove. MODO (n = 6) and ECDO (n = 2) were surgically implanted with radiotransmitters to determine home-range size and daily movement patterns. One ECDO nest was found on top of a utility pole and both hatchlings fledged.

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

Figure 1. Tiffany L York Osborne surgically implanting a subcutaneous radiotransmitter inside a Eurasian collared-dove. Photo by Douglas C. Osborne.

Figure 2. Tiffany L. York Osborne holding Eurasian collared-doves upon release after surgery. Photo by Douglas C. Osborne.

Figure 3. Tiffany L. York Osborne and field technician Kathy Brautigam taking morphological measurements of a mourning dove. Photo by Douglas C. Osborne.

Effects of Urbanization on Harvest and Recruitment of Mourning Doves

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Mourning doves *(Zenaida macroura)* are one of the most abundant bird species in North America. This species has adapted well to a wide variety of habitat types, including highly developed urban areas. However, population declines have been observed in some regions of the United States, perhaps due to anthropogenic factors including changing farming practices and increasing development. This study will focus on ecological parameters of mourning doves to discover population trends within an urban to rural cline in southern Illinois. The objectives of this study are to: 1) Estimate mourning dove nesting success, relative abundance, survival, home range size, and contribution to the dove harvest along an urban- to-rural cline. 2) Determine relative abundance and nest success in various habitats in southern Illinois.

Spring of 2007 marked the beginning of field research and observation. Kniffin funnel traps were placed at several sites throughout Illinois in areas ranging from urban to rural. Captured mourning doves were assigned sex and age, and fitted with United States Geological Service (USGS) harvest bands. Several morphological measurements including body mass, wing length, total body length, etc. were taken. Nine doves were fitted with subcutaneous radio transmitters, although only three doves provided enough information to develop home range estimates. Call-counts for estimating relative abundance were completed in late May and early June in Williamson and Franklin counties in Illinois. Nest searching provided very minimal results, with only three nests found. The adults quickly abandoned these nests after subsequent visits by observers found no young or eggs. Field-work was completed in the middle of October when the last radio-marked individuals could not be found, due to battery death or migration. These data represent field-work conducted during the spring, summer, and fall of 2007. The second and final field season for this study, funded by the Illinois Department of Natural Resources Federal Aid Project W-106-R, will take place during the same time of year in 2008.

Figure 1. Mourning dove during surgical implantation of subcutaneous radio transmitter. The body of the transmitters is inserted near the shoulder area while the antenna protrudes from the hip.

Figure 2. An example of a morphological measurement on a banded mourning dove from Zeigler, IL. All captured dove are categorized by sex and age, banded, and measured prior to release.

Figure 3. Juvenile mourning dove captured in a Kniffin funnel trap in southern Illinois. Proso millet, milo, and corn make effective baits for mourning doves, but may attract other bird species as well.

Figure 4. Radiotelemetry was conducted several times weekly to monitor radio-marked doves. Many of these birds were consistently found close to homes and other developed areas.

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

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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 on fields managed for public dove hunting by the Tennessee Wildlife Resources Agency (TWRA) in central Tennessee on 1 September 2007. These fields included wildlife management area fields and fields leased from landowners by TWRA to provide public hunting opportunity. 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 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.

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 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.

These are results from the first year of a 2-year study. Experimental hunts will be conducted on these and possibly other dove fields in the region during September 2008. Final data analyses will follow the conclusion of these second-year hunts, and the final report and manuscript for this project will be completed by December 2008. 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.

Doves perched in tree near spinning-wing decoy during an experimental mourning dove hunt in Wilson County, Tennessee, 1 September 2007.

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April 2008