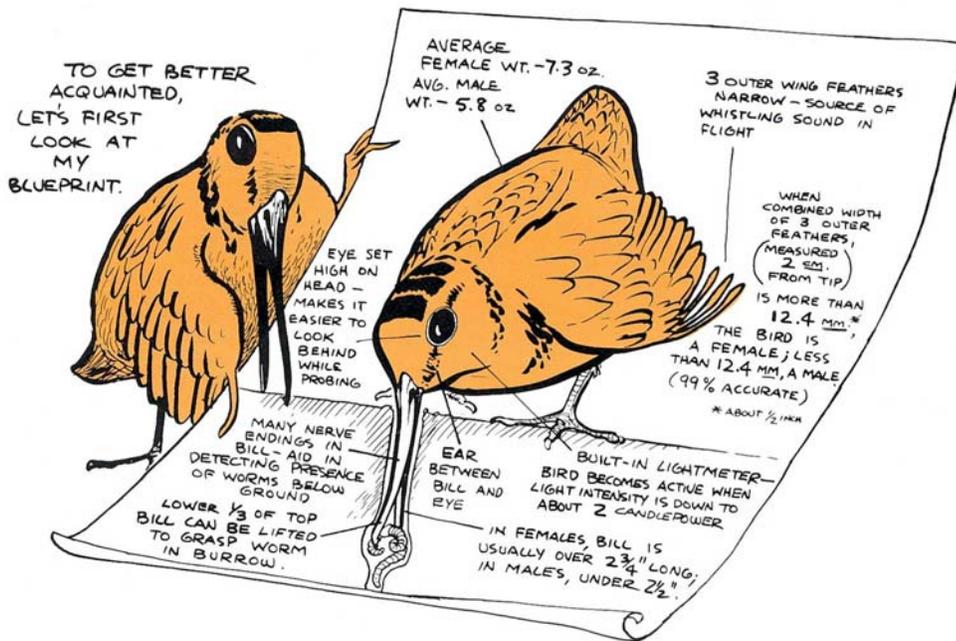# 10th AMERICAN WOODCOCK SYMPOSIUM

Abstracts

**Ralph A. MacMullan Conference Center
Roscommon, Michigan, USA
October 3 – 6, 2006**

Hosted by:
Michigan Department of Natural Resources
United States Fish and Wildlife Service

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Welcome to Michigan and the
10th American Woodcock Symposium

The scientific woodcock community has hosted American woodcock symposia and workshops periodically since 1966. These symposia have provided the opportunity for researchers, land managers, biologists, hunters, and woodcock enthusiasts to discuss and report current information on woodcock ecology and management. Attendees have shared ideas on the future of woodcock research and management efforts, and addressed "hot topics" in the woodcock world. The 10th American Woodcock Symposium is the first symposium held this century. The symposium highlights conservation strategies, habitat management, and population dynamics.

Past Woodcock Symposia		
1st	1966	Minnesota
2nd	1968	Louisiana
3rd	1969	Maine
4th	1971	Michigan
5th	1974	Georgia
6th	1977	New Brunswick
7th	1980	Pennsylvania
8th	1990	Indiana
9th	1997	Louisiana
10th	2006	Michigan

Previous woodcock symposia have effectively fostered communication on woodcock research and have been the foundation for successful woodcock management internationally. With each symposium, the quality of data, sophistication of statistical analysis, and originality of methods have advanced our understanding about this bird. Past symposia have been held across the range of the species. This meeting is designed to stimulate thought, expand ideas, and increase our knowledge about woodcock management and ecology. This binder contains the meeting abstracts. Hard-bound symposium proceedings will be available in the future.

Many people have helped in the planning stages for the 10th American Woodcock Symposium. It is through their dedication and attention to detail that this meeting has come to fruition.

Program Committee Members			
David Andersen	Valerie Frawley	Shari McCarthy	Lou Ann Shaw
John Bruggink	Arnie Karr	Mike Ryan	Al Stewart, chair
Mark Buchinger	Jennifer Kleitch	Jim Kelley, Jr.	Alice Stimpson
Carrie DeVault	David Krementz	John Niewoonder	RAM Center Staff
Dan Dessecker	Scott Lutz	Mike Olinde	
Keith Fisher	Dan McAuley	Joe Robison	

Enjoy your visit to Michigan and take time to deliberate with your peers.

Al Stewart, program chair

IMPROVING WOODCOCK MANAGEMENT BY IMPLEMENTING LESSONS FROM OTHER MIGRATORY GAME BIRDS

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Abstract: Traditionally, American woodcock (*Scolopax minor*) management has involved a mix of population (i.e., harvest) and habitat management. Foresters, wildlife biologists, policy makers, and stakeholder groups have historically embraced a *habitat paradigm* as the primary mechanism affecting woodcock abundance. The *habitat paradigm* is the view that habitat is the key to healthy woodcock populations that, in turn, meet most stakeholder needs. A fundamental assumption of the habitat paradigm is that creation of early successional forest on both public and private forest landscapes will result in increased woodcock abundance as monitored through Singing Ground Survey (SGS) trends and indirectly through harvests. Thus, as abundance appears to decline (as suggested by SGS and harvest trends), the *habitat paradigm* informs stakeholders that more woodcock habitat is needed and habitat management will directly result in greater woodcock abundance, larger harvests, and potentially increased participation in woodcock hunting, eventually leading to more satisfied hunters and reduced stakeholder conflict. Several existing and emerging initiatives involving other migratory birds, however, may provide valuable lessons for developing a new and broader vision for reducing uncertainty in woodcock management through the development of a strategic plan linking current habitat theory, population dynamics, and Joint Venture style partnerships. Recent experiences with mourning doves, waterfowl, and the North American Bird Conservation Initiative (NABCI) may provide concepts leading to a new strategic and heuristic vision. We believe the application of lessons from these initiatives will help garner sufficient financial and human resources to expand and support an integrated system of woodcock population and habitat management that uses effective strategic planning and adaptive resource management that is supported by effective monitoring and evaluation of management efforts. The success of future management is dependent on expanding traditional partnerships to include non-traditional partners who do not have a vested interest in the annual harvestable surplus of woodcock but rather embrace the benefits of early successional forest management to a wide variety of other migratory birds.

IMPLEMENTATION OF THE AMERICAN WOODCOCK CONSERVATION PLAN

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Abstract: The U. S. Fish and Wildlife Service developed national American woodcock (*Scolopax minor*) management plans in 1985 and 1990. Both plans outlined general objectives and strategies for woodcock population and habitat management. Although some specific action items were identified, such as acquisition of habitat in Cape May, New Jersey and Canaan Valley in West Virginia, both plans lacked quantifiable population and habitat goals and objectives to guide woodcock management. In 2002, the International Association of Fish and Wildlife Agencies created a Woodcock Task Force to develop a conservation plan. We examined woodcock densities determined from Singing-ground Survey data from 1970-75 and compared them to current densities to estimate woodcock population deficits for each Bird Conservation Region (BCR) throughout the breeding range. Population and habitat goals for each BCR were determined by estimating the amount of habitat that needs to be created to return woodcock densities to those observed during 1970-75. The conservation plan contains action plans for each BCR, including those BCRs on the wintering grounds, that will be used to guide future "on the ground" woodcock management activities.

THE NORTHERN FOREST WOODCOCK HABITAT INITIATIVE

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Abstract: The most recent compilation of research and management needs for American
Woodcock (Straw et al. 1994) contains the recommendation to create regional habitat
demonstration areas. To address the issue of loss of habitats important for woodcock and
other high priority species, the Wildlife Management Institute has assembled the largest
public/private coalition ever created to proactively address habitat improvement for
woodcock. Twenty-five partners, ranging from private landowners to federal agencies, have
signed on to an initiative designed to link improvements on public lands with widespread
management gains on private lands. Major partners within the initiative include private
forest landowners, the U. S. Fish and Wildlife Service, the U. S. Geological Survey, the
Natural Resource Conservation Service, International Paper Company, state fish and wildlife
agencies, and hunting and conservation NGO's.

The Northern Forest woodcock habitat initiative will provide technical assistance, labor and
funding to create demonstration areas on state and federal lands that exemplify best
management practices (BMPs) for American woodcock; monitor woodcock populations and
habitat use before, during and after implementation of BMPs; and use demonstration areas as
case histories within coordinated outreach efforts to inform and motivate private landowners.
The initiative will also make available to private landowners technical assistance, labor and
machinery to improve American woodcock habitat on their land. The Initiative has begun
implementation in Bird Conservation Region 14, including New England and the
Adirondacks of New York.

ESTIMATING WOODCOCK HUNTER ACTIVITY AND HARVEST IN THE UNITED STATES

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Abstract: From 1964-2001, the U. S. Fish and Wildlife Service (USFWS) conducted annual surveys that estimated American woodcock (*Scolopax minor*) harvest in the United States. However, those surveys were based on samples of federal duck stamp purchasers, therefore the resulting estimates represented only the harvest of woodcock by people who also hunted waterfowl; woodcock hunters who did not purchase a duck stamp were excluded. To remedy this problem, state wildlife agencies and the USFWS established the cooperative state-federal Migratory Bird Harvest Information Program (HIP). HIP requires the state wildlife agencies to collect the name and address of every migratory bird hunter in their state annually. In addition, the state must ask those hunters a series of screening questions about what migratory birds they hunted the previous year and approximately how many they harvested. The states send these hunter data to the USFWS throughout the hunting season, thereby providing the basis for several migratory bird harvest surveys that we have conducted annually since 1999.

We use the hunters' answers to the screening questions to select stratified random samples that direct most of our sampling effort at more avid hunters, thereby maximizing sampling efficiency. For the woodcock harvest survey, about 15,000 hunters are sent diary forms on which they are asked to record the date and county of each woodcock hunt, and how many birds they personally bag. The response rate is typically about 60%. Survey responses are analyzed using standard stratified random sample techniques to estimate active hunters, birds bagged, days afield, the mean seasonal bag per active hunter, and variances for each of these statistics. HIP estimates of both active woodcock hunters and woodcock harvest are about 2 times greater than the same estimates obtained from the old survey system, and HIP harvest estimates at the management unit level have 95% confidence intervals that are about 25% of the point estimates.

MONITORING OF THE EUROPEAN WOODCOCK POPULATIONS, WITH SPECIAL REFERENCE TO FRANCE

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Abstract: The Woodcock (*Scolopax rusticola*) is present in all European countries (Western Palearctic) during the breeding, migratory and/or wintering periods. The monitoring of its populations implies the collection of data on breeding and wintering numbers to estimate their trends. At the present time, only four countries [(France (since 1992), Switzerland (since 1993), Russia (since 1999) and Great-Britain (in 2003)] have been collecting data during the breeding period. Only two countries [France (since 1992) and Great-Britain (1994 and 1996)] have been collecting data during the wintering period. The analysis of abundance indices shows a relative stability for breeding and wintering numbers. A more detailed interpretation of trends requires additional information on demographic parameters. The ringing of woodcocks has been greatly developed in France (since the 80s) and in Russia (since the 90s). Consequently, estimations of survival rates are available for the huntable wintering population in France and for the Russian Woodcock population. An estimation of the proportion of young in hunting bags is available for four countries thanks to a wing collection. This allows us to detect springs with low breeding success. Finally, information on harvest is provided by annual or periodical surveys in some European countries. The actions developed to monitor the European Woodcock populations in the Western Palearctic may appear to be incomplete and heterogeneous from one country to another. Obviously, this is due to various situations at different levels: culture, economy and hunting practices. In the future, the objectives should be to complete the panel of monitoring actions and get more information on the evolution of habitats.

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FALL MIGRATION RATES, ROUTES, AND HABITAT USE OF AMERICAN WOODCOCK IN THE CENTRAL REGION[1]

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Abstract: American woodcock (*Scolopax minor*) ecology has been extensively studied on the breeding grounds and to a lesser extent on the wintering grounds, but little research has been conducted on the migration ecology of this declining species. In Fall 2001 we began a 3-year study to document woodcock fall migration routes, rates, and habitat use in the Central Region of the U.S. From 2001-2003, 582 radio-marked woodcock initiated migration from 3 study sites in Minnesota, Wisconsin, and Michigan. Aerial searches were conducted from fixed-wing aircraft during each fall migration period in the Central Region. During 224 hours of aerial telemetry, we located 42 radio-marked woodcock in 6 states. Radio-marked birds were located in upland habitats more frequently than bottomland habitats (66.6% vs. 33.3%, respectively). Migrating woodcock used a higher proportion of mature forest than expected. Stopover duration often exceeded 4 days, with some birds stopping longer than a week. Using locations of radio-marked birds, we speculated woodcock migration routes in the central U.S. GIS was used to map potential woodcock habitat in the Central Region. Based on our results, we identified priority areas for future woodcock management in the Central Region.

DETECTING PASSAGE OF MIGRANT RADIO-TAGGED WOODCOCK USING SEMI-AUTOMATED RECEIVER RECORDING EQUIPMENT FROM FIRE TOWERS

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Abstract: We devised a semi-automated receiver recording system to detect the passage of migrant woodcock at Cape May, New Jersey. Woodcock were originally instrumented with conventional VHF radio transmitters at 2 sites in Maine (Moosehorn National Wildlife Refuge, near Calais, and commercial timberland near Milford) and 1 site in Vermont (Ethan Allen firing Range in Underhill). Commercially available video cassette recorders (VCR) and long-play tapes were used to record both video of the receiver scanner, as well as the receiver audio. Tandem recorders with built-in daily program facilitated full night time (16 hr max) recording. Detection of passing woodcock was maximized by mounting the receiving system in fire towers that provided line-of-site view to the horizon above the forest canopy. Preliminary findings from 1999 recordings indicated a detection range of between 20 and 25 miles. Twenty-one woodcock were detected in two distinct waves of migration: 5 birds over two nights, 6-7 November, and 16 birds over 4 nights, 27-30 November. Woodcock were recorded on 25 instances with detection durations ranging from 7 to 73 min. Most woodcock (20 of 25) were detected in the late night segment from 8 PM to 4 AM. Woodcock took between 8 and 18 days to travel the ca. 600 miles from Moosehorn Refuge to Cape May.

GIS-BASED ASSESSMENT OF AMERICAN WOODCOCK HABITAT AT TWO SPATIAL SCALES IN NEW BRUNSWICK

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Abstract: Numbers of singing male American Woodcock (*Scolopax minor*) recorded during the annual singing-ground survey, an index of the breeding woodcock population, have declined range-wide, including in New Brunswick since 1968. Changes in land-use/land-cover patterns and decreases in available habitat are believed to play an important role in this apparent decline in the population. Characteristics of breeding habitat and historic changes (1982-2000) were quantified at 2 scales using 43 singing-ground survey (SGS) routes in New Brunswick. These results were compared to a provincial scale analysis with the use of two GIS forest inventories (1982-1986 and 19932000). SGS routes are currently (1993-2000) representative of the proportion of available woodcock habitat found in the province. The temporal analysis revealed the area of singing-grounds and nesting/feeding cover is increasing across the province (+17%, and +31%, respectively), whereas the area of available singing grounds and nesting/feeding cover in regions surveyed by the SGS routes is decreasing (-7%, -3%, respectively). Trends of the SGS routes in New Brunswick coincide with habitat changes along routes but neither corresponds to changes in habitat at the provincial scale. Interpretation of declines in woodcock population trends should not be made independent of changes in habitat over the same period.

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DIURNAL MICROHABITAT USE BY AMERICAN WOODCOCK WINTERING IN EAST TEXAS

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Abstract: This study characterized diurnal habitat cover used by radio-marked adult American woodcock (*Scolopax minor*) wintering in east Texas during 2001-2002 and 2002-2003. Habitat cover types evaluated were ground, understory, tree canopy (0.0 – 0.1 m, 0.1 – 6.0 m, and > 6.0 m above the ground, respectively), horizontal (0.0 – 1.5 m above the ground), and overhead vegetation (measured using a spherical densiometer held at ground level). Ground cover categories were water, rock, bare soil, leaf litter, woody debris, grass, and herbaceous, deciduous, vine, and evergreen plant; the only category in each of the remaining cover types was vegetation. Due to differing moisture regimes, 10 of 24 habitat parameters varied between years ($P \leq 0.05$). On mostly floodplain sites in 2001-2002, grass ground cover and understory, horizontal, and overhead covers were lower at used than random locations, but habitats were similar between male and female locations. On mostly upland habitats in 2002-2003, grass ground cover and overhead cover were lower and leaf litter, understory, and horizontal covers were higher at used than random locations. Tree canopy cover was lower, and overhead cover higher at male than female locations. Vegetative structure important to woodcock was sparse ground cover with enough overhead cover to provide protection. In east Texas, early successional forests on upland and floodplain sites provide such habitat. If regularly burned, thinned pine sawtimber plantations and mixed pine-hardwood sawtimber stands will provide diurnal habitat for woodcock.

AMERICAN WOODCOCK POPULATIONS ASSOCIATED WITH AN ELECTRIC TRANSMISSION RIGHT-OF-WAY

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Abstract: I monitored traditional courtship (spring singing) sites of American woodcock (*Scolopax minor*) populations on the State Game Lands 33 Research and Demonstration Area, which is located along a 230-kV transmission line right-of-way (ROW) of FirstEnergy (Penelec) in the Allegheny Mountain Province, Centre County, Pennsylvania, for 7 years (2000-06). The objective of my study was to determine the relative abundance of male woodcock at courtship sites in relation to treatment units and wire versus border zones on the ROW. Highway construction has been ongoing over the last few years in the Bald Eagle Valley immediately south of the ROW with the expansion of the I-99 Interstate. The number of courting (singing) male woodcock ranged from 1 in spring 2000 to > 7 in springs 2004-06. Early successional habitat created on the ROW by the wire-border zone method of vegetation maintenance on the State Game Lands 33 Research and Demonstration Area presumably will have increasing importance to the long-term conservation of woodcock in the local vicinity.

FALL DIURNAL HABITAT USE BY ADULT FEMALE AMERICAN WOODCOCK IN THE WESTERN GREAT LAKES REGION

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Abstract: We assessed how habitat structure and food availability influenced use of cover types at the habitat patch and home-range scales by adult female (after hatch year) American woodcock in Michigan, Minnesota, and Wisconsin from 2002 through 2004. We also investigated use of alder (*Alnus* spp.) as a staging cover prior to fall migration. We selected this cover to investigate seasonally changing use of cover types based on past observations. Seasonal changes in cover type use could have important ramifications for woodcock management intended to provide or improve woodcock habitat. We measured edge proximity, stem density and earthworm abundance at woodcock locations and paired these locations to random locations at the micro-habitat scale (2002 data): 20 m from use locations within the same stand. We also compared edge proximity with paired use and random locations at the home range scale (2003 and 2004 data): > 35 < 200 m from use locations across cover types and investigated habitat selection at this scale. Adult female woodcock (*n* = 139) used a variety of cover types and the percent of total use changed among years and states. We found the greatest frequency of alder use across all states in 2003, a drought year. We found no difference between alder use during the entire fall period and early fall (*P* = 0.9) or late fall (*P* = 0.7) indicating that alder was not used as staging cover prior to migration. We found that structural habitat features were more important than food resources to habitat selection at both the micro-habitat and home-range spatial scales. Cover types most heavily used by woodcock often had the lowest earthworm abundances. We did find evidence that woodcock selected for edge proximity at both home-range and micro-habitat scales, especially in mature cover types. Woodcock also selected habitats with higher shrub densities and fewer mature stems in young cover types than we found at random.

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FALL SURVIVAL OF AMERICAN WOODCOCK IN THE WESTERN GREAT LAKES REGION[1]

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Abstract: Concern about the status of woodcock populations has highlighted the need for information on the role of hunting mortality in woodcock population dynamics. We radio-marked 1,171 woodcock during a 4-year study in Minnesota (2001-2004), Michigan and Wisconsin (2002-2004) to assess the magnitude and causes of woodcock mortality during fall. In all three states, woodcock were radio-marked in paired study areas, one of which was open to woodcock hunting and one of which was closed to woodcock hunting or had limited access for woodcock hunting. We used program MARK to estimate fall survival rates and hunting mortality rates, and to construct a set of candidate models to examine the effects of hunting and the effects of covariates (year, state, sex, age, size) on survival. Survival rates of woodcock were 11.6% (95% CI 4.5-18.7) higher in non-hunted areas than in hunted areas. Hunting accounted for 71 of the 147 (48%) woodcock deaths in the hunted areas; 47 (32%) were killed by predators and 29 (20%) died from various other causes. In the non-hunted and lightly-hunted areas, 38 of the 66 deaths (58%) were caused by predators; 16 birds (24%) died of various other causes (24%) and 12 birds (18%) were shot. Akaike's Information Criterion model selection indicated that fall survival varied by treatment (i.e., hunted versus non-hunted) and year. Fall survival did not vary by age, sex or size. The overall hunting mortality rate estimate in hunted areas was 14.5%. We found weak evidence that hunting mortality was higher for female woodcock than for males. Our results should be useful to biologists and administrators involved with making decisions about woodcock harvest management.

CHALLENGES TO WOODCOCK CONSERVATION IN THE GREAT LAKES REGION

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Abstract: Long-term declines in American woodcock (*Scolopax minor*) populations in the Great Lakes Region have been associated with degradation and loss of suitable habitat. Recent management planning decisions by public land managers, particularly on National Forests, continue to negatively impact woodcock habitat. Projected declines in aspen/birch forests on all ownerships in the Region are expected to result in continuing population reductions of woodcock and associated wildlife species. The increasing fragmentation of forested tracts as industrial forest lands are sold to private landowners, or land trusts that place limitations on forest management, is also reducing opportunities to enhance woodcock populations. The incorporation of broad-brush riparian management standards effectively eliminates early successional forest management in important riparian corridors. This seriously limits management opportunities that could positively influence woodcock populations.

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AN EXAMINATION OF AMERICAN WOODCOCK POPULATION UNITS

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Abstract: Since 1977, American woodcock (*Scolopax minor*) have been managed on the
basis of 2 populations, or regions, as recommended by an examination of banding data which
indicated little interchange of birds between the Atlantic and Mississippi Flyways. Past
examination of woodcock populations used state or province of banding as the smallest level
of geographic unit. I examined the spatial distribution of 3,431 direct recoveries of
woodcock grouped by 44 banding degree block using mult-response permutation procedures
(MRPP). Cluster analysis of MRPP statistics was used to group degree blocks with similar
recovery patterns. Results of clustering indicated general support for division of woodcock
populations by flyway boundaries, but also provided information on locations of potential
sub-populations of birds that may serve as reference areas for future banding studies.

POPULATION DYNAMICS OF AMERICAN WOODCOCK IN THE CENTRAL REGION

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Abstract: We investigated the population dynamics of American woodcock (*Scolopax minor*) frequenting the Central Region. We used vital rate estimates from band-recovery analyses and reproductive information from the Great Lakes region to assess demographic performance. We constructed a matrix population model for females and conducted perturbation analyses (i.e., analytic sensitivities and elasticities) to predict response of λ, the finite rate of population growth, to changes in vital rates. Perturbation analyses indicated that λ was highly sensitive to changes in juvenile survival (0.2595) and first year adult survival (0.1925). Surprisingly, λ was little sensitive to reproductive parameters. Based on our model, recruitment does not appear sufficient to maintain populations in the region. We also simulated the impact of harvest on λ assuming additivity. Depending on the survival rate estimates used, we found that harvest would have to be reduced by ~6 – 10% just to maintain the population at a steady state. The high sensitivity of λ to survival suggests that management strategies geared at increasing survival rates would be an appropriate approach to stabilizing or increasing woodcock populations in the Central Region.

INFERENCES ABOUT THE MATING SYSTEM OF AMERICAN WOODCOCK (*SCOLOPAX MINOR*) BASED ON PATERNITY ANALYSIS

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Abstract: The mating system of American Woodcock (*Scolopax minor*) has been variously described as monogamous or promiscuous, with a dispersed lek or resource based polygyny social structure. If the mating system is a dispersed lek, we would predict little or no correlation between male display sites and nest sites of broods they have fathered. If it is resource defense polygyny, then females should nest close to the displaying male with whom they have mated. We extracted DNA from blood samples from 90 males and 21 females and their broods. Analysis of microsatellite loci indicated that there was no evidence for multiple paternity within broods. Possible fathers were only identified for 10 of 21 broods. Three of these were found at the singing site of the probable father, five were found near the singing site of a neighboring male to the probable father, and two broods were found far from the singing site of the possible father. These data suggest that females are monogamous but resources in the territory of the father are not critical to their decision to mate with him, providing some evidence that the social structure is better described as a dispersed lek. If woodcock are mating in a 1:1 ratio, then singing ground surveys which count only males could provide information about population trends of both males and females.

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INCUBATION BEHAVIOR OF THE AMERICAN WOODCOCK (*SCOLOPAX MINOR*) IN MAINE

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Abstract: From April - June, 1987 and 1988, 12 radio-equipped female woodcock (*Scolopax minor*) were remotely monitored at their nest sites on Moosehorn National wildlife Refuge to determine patterns and constancy of incubation behavior. Females spent 92% of their time on the nest, leaving for only 108.42 ± 3.77 (SE) min / day. The total time spent off the nest each day did not vary by year ($P = 0.39$), by daily high temperature ($P = 0.71$), or by precipitation ($P = 0.48$). There was some indication that renesting birds spent more time off of the nest/day than first nesters and that the amount of time woodcock hens spent off the nest at night was related to the phase of the moon.

Nesting woodcock hens consistently left their nests during crepuscular periods, remaining on the nest for only 1 of 131 morning crepuscular periods and 3 of 131 evening crepuscular periods. Crepuscular movements of nesting hens accounted for 39% of the total time spent off the nest (258 episodes), 55% of time spent off the nest occurred during the daylight hours (294 episodes), and only 6% occurred at night (38 episodes). Nesting females spent 41% of all their time off the nest, active in the immediate vicinity of the nest.

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GENETIC SEX DETERMINATION IN WOODCOCK CHICKS

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Abstract: Knowledge of the sex of adults and young birds in natural populations can enhance our understanding of behavior and survival and can have a variety of wildlife management applications. The need for a genetic method of sex determination is based on the findings that adults in an estimated 50% of all bird species are morphologically identical and the percentage is even greater in chicks. This is particularly true for the American woodcock *(Scolopax minor)*. A recently developed genetic technique utilizes the polymerase chain reaction (PCR) for the determination of bird gender from feather pulp samples. This DNA-based system uses two conserved CHD1 (chromo-helicase-binding) genes that are located on the avian sex chromosomes in all birds, with the possible exception of the ratites (*Struthioniformes*). Although this technique is often successful and is claimed to be applicable to nearly every avian species, it had yet to be tested on woodcock. In addition, this study attempts to determine the feasibility of using this noninvasive approach when collecting chick feathers in the field. Chicks are banded from age one hour to age 12 days at which time they are beginning to fly, with age determined by bill length (Ammann 1994) or actually observation. Michigan woodcock banders collected feathers from May 6 through June 8, 2005. Samples were also received from the Minnesota Department of Natural Resources. Feathers from known-sex woodcock carcasses collected during the fall hunting season were also processed as control samples. DNA analysis was run on 126 of the chick samples and on feathers of 20 individuals from carcass submission during the winter and summer of 2005. Of the 126 chick samples processed, 94 samples provided distinguishable results. Of the 33 known sex samples processed, 26 had expected results and there were no results for 7 samples. Comments from woodcock banders were generally favorable with some difficulties mentioned.

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GENETIC VARIATION AMONG GRAVID FEMALE AMERICAN WOODCOCK IN EASTERN TEXAS DURING WINTER

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Abstract: We investigated genetic variability in gravid female American woodcock (*Scolopax minor*) from two eastern Texas counties during late January 1997-1999. We amplified and sequenced a 750 base pair fragment of the mitochondrial cytochrome *b* gene for 20 gravid females collected on winter range. We observed 13 unique haplotypes among the 20 individuals with an average haplotype divergence of 0.63%. The high level of haplotype diversity ($h = 0.009474$) and low nucleotide diversity ($\pi = 0.00509$) are consistent with genetic variation in woodcock collected on the traditional summer nesting range. Our results suggest considerable admixture among woodcock populations on wintering grounds. If winter breeding is common, it may provide a mechanism for preventing genetic differentiation of woodcock populations from different flyways, and this lack of differentiation has implications for the proper designation of management units for woodcock.

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THE CURRENT STATUS OF WOODCOCK AND WOODCOCK SURVEYS IN NORTH AMERICA

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Abstract: Singing-ground Survey data indicate there have been long-term (1968-2005) declines of 2.0% per year in the Eastern Region and 1.8% per year in the Central Region. However, there was no significant trend in either Region during 1995-2005. Annual indices of recruitment have also undergone long-term declines. The evolution of methods for analyzing Singing-ground Survey data has been from base-year, to route-regression, to estimating equations methods, and now involve hierarchical modeling approaches. The method of estimating woodcock harvest and hunter numbers has changed from a survey originally intended to survey waterfowl hunters to one geared specifically to woodcock hunters (Harvest Information Program). The woodcock Wing-collection Survey was incorporated into a national webless migratory gamebird wing-collection survey in 1997. The need/feasibility of developing regional woodcock banding programs is assessed.

BREEDING EURASIAN WOODCOCK SURVEY IN BELARUS

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Abstract: In 2005, Institute of Zoology of the National Academy of Science of Belarus and APB-Birdlife Belarus (NGO Akhova Ptushak Belarusi) undertook a survey of breeding Eurasian Woodcock *Scolopax rusticola* with following aims: (1) to develop the Woodcock monitoring program in Belarus, (2) to produce baseline population index figures for breeding population of Woodcock, and (3) to investigate the distribution and abundance of breeding Woodcock in relation to woodland habitat characteristics. A survey method was based on counts of roding males, as developed in France (Ferrand, 1993). We performed counts at 60 listening points located in 10 squares (12x12 km each). Observers made the counts of roding birds during May and June. Habitat data were collected at squares situated within 50–100 m from the each observation point. The number of contacts varied between 2 and 30 (mean 11.6+6.91 SD). The occupation rates of the high and low abundance sites were 0.867 and 0.133 respectively. We found a significant difference in the Woodcock abundance between habitats ranked based on the tree density and a negative relationship in the variables. This is likely explained by features of the feeding and breeding behavior of Woodcock. Further work is needed to establish population trends and to determine the factors influencing the species abundance in order to establish a sustainable management policy in future. This work was supported by the ONCFS (Office National de la Chasse et de la Faune Sauvage, France).

AMERICAN WOODCOCK SINGING-GROUND SURVEYS: DO THEY REFELCT POPULATION TRENDS?

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Abstract: Standardized singing-ground surveys have been conducted in the northern United States and southern Canada to detect trends in American woodcock (*Scolopax minor*) populations since 1968. Surveys are not conducted in southern and midwestern states in which woodcock are known to breed because: 1) such surveys would be counting migrating males; 2) nesting in those states is considered insignificant; 3) current surveys accurately reflect population trends unless nesting in those states has increased in recent years; and 4) there are no long-term survey data from those states. Examination of numbers of courting males over dates from southern states shows bell-shaped curves similar to those from traditional singing-ground survey areas. This suggests that males recorded during traditional surveys continued on their migratory routes rather than ceased courting. The only curve that showed a right-skewed pattern which would be expected if counts took place after migrants had passed through and before courtship waned was from Quebec. The highest densities of courting males per route are in the northern portions of the survey area, including Quebec. These findings strongly suggest that existing singing-ground surveys are recording migrating males. Nesting in the South and Midwest has been documented by numerous researchers and may have increased in recent years because of wide-spread use of the clearcut forest regeneration method and woody plant invasion, respectively. There also are indications that forest management activities have increased breeding north of the survey area. If these changes have taken place, singing-ground surveys do not reflect continental population trends. Instituting surveys throughout the known woodcock breeding range would provide preliminary data in 5 years. Surveys could be used to determine if breeding activities are increasing in the South or expanding west and north. Woodcock are opportunistic breeders, able to take advantage of appropriate climatic conditions when they occur on the wintering grounds and along the northward migration routes; long-term surveys could be used to help define these conditions, and investigate relationships of courtship intensity on the wintering grounds and during migration to courtship intensity on the northern breeding grounds.

MICHIGAN WOODCOCK BANDING PROGRAM: A CASE STUDY

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Abstract: Banding of American woodcock (*Scolopax minor*) has been an effective technique to monitor woodcock migration, distribution, and other aspects of woodcock life history. In the 1930s, researchers in the U. S. began using bird dogs to locate woodcock broods for banding. Since the 1960s, the Michigan Department of Natural Resources has conducted a long-term spring woodcock-banding program involving volunteers. This program has been improved in recent years through mandatory bander training sessions. Currently, this program enlists approximately 100 volunteer banders that annually spend 2,000 hours in search of woodcock and band over 1,000 chicks.   Banding programs can be expanded without encumbering government agencies by using trained volunteer banders. This model can be adopted in other regions to increase the scope and distribution of woodcock banding programs.

SURVIVAL AND RECOVERY OF WOODCOCK BANDED IN MICHIGAN, 1981-2004

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Abstract: American woodcock (*Scolopax minor*) population indices suggest long-term declines in the Central Management Unit (CMU). CMU woodcock hunting season frameworks have been restricted in response to these declines because of concern over potential reduction in woodcock harvest potential. Evaluation of relationships among population trends, hunting regulations, and survival require long-term estimates of woodcock survival. Although banding information is unavailable for most CMU breeding areas, Michigan has coordinated a banding program that has provided enough marked birds to evaluate models explaining temporal variation in survival. These data consist of spring banding of adults and locals as well as limited traditional preseason bandings of adults and hatch-year birds. We fit a suite of models to band recovery information collected annually over the period 1981-2004. The data provided a range of support for models varying from the global model with year- and age- dependent survival and recovery rates to several reduced models that constrained age- and year- dependence. We included appropriate models to test for evidence of effects of hunting regulations on adult and juvenile woodcock survival.

SURVIVAL OF AMERICAN WOODCOCK BROODS AND CHICKS IN MAINE

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Abstract: During 1986-1989, 89 female American woodcock (*Scolopax minor*) were radio-marked during the period 1 April – 30 June at Moosehorn National wildlife Refuge in Maine. Forty six broods made up of 190 chicks were followed for a 21 day period to determine survival. Brood survival, the probability of fledging >1 chick, during the 21day period ranged from 0.339 to 1.000. Survival of chicks varied from 0.142 to 0.944. Survival rates differed among years. Preliminary estimates indicate that survival of chicks and broods from after second year (ASY) females differed from second year (SY) females. Differences between original nests and re-nests and effects of weather were investigated.

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MICHIGAN WOODCOCK HUNTER AND HARVEST DYNAMICS IN RELATION TO HUNTING SEASON FRAMEWORKS, 1954-2004

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Abstract: The Michigan Department of Natural Resources has monitored American woodcock (*Scolopax minor*) hunting effort and harvest via post-season mail surveys of randomly selected small game hunters since 1954. We analyzed trends in hunter numbers and harvest over the period 1954-2004 and used these data to examine impacts of changes in woodcock abundance, hunter numbers, and U. S. Central Management Unit (CMU) hunting season frameworks on woodcock harvest in Michigan. Estimates of woodcock hunter numbers ranged from 29,150 during 1954 to 126,270 during 1976; estimates of woodcock harvest ranged from 40,630 during 1956 to 390,370 during 1980. Because of changes in licensing of Michigan small game hunters, we separately examined impacts of changes in hunting season frameworks before 1970 and from 1970 forward. Woodcock harvests were positively and linearly related to numbers of woodcock hunters during both licensing periods ($R^2 > 0.85$). A linear model fit for years after initiation of coordinated woodcock population surveys (after 1967) indicated that woodcock abundance in Michigan was not a good predictor of harvest and that harvest was weakly related to hunting season frameworks when simultaneously accounting for changes in hunter numbers and licensing. Using a similar model fit to the entire time series of harvest and hunter estimates (excluding woodcock abundance), we estimated that the change from a 40 day season (4 bird daily limit) to a 50 day season (5 bird daily limit) in the CMU beginning in 1963 resulted in about a 5% increase in Michigan harvest under average hunter numbers. Changes from a 65 day season (5 bird daily limit) to a 45 day season (3 bird daily limit) in 1997 appeared to reduce harvest by about 11% assuming average hunter numbers. Although hunting season frameworks can be used to manipulate harvest, harvest is more sensitive to changes in hunter numbers. Declining woodcock hunter numbers in Michigan have followed the trend in declining numbers of Michigan small game hunters since the mid-1970s. Future evaluations of woodcock hunting season frameworks should consider potential impacts of changing hunter numbers and woodcock harvest potential.

We found little evidence to suggest woodcock selected habitat on the basis of food procurement needs alone, however our results indicated the importance of habitat structure, particularly edge proximity, well developed shrub layers, and lack of residual large diameter trees in early seral covers. These findings may indicate that predator avoidance, measured by structural characteristics, is more important than food abundance in selection of habitat by woodcock, which makes management objectives intended to provide woodcock habitat a feasible task.

AMERICAN WOODCOCK FALL MIGRATION USING CENTRAL REGION BAND RECOVERY AND WING-COLLECTION SURVEY DATA[1]

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Abstract: Band recovery and wing-collection survey data have the potential to provide information on American woodcock fall migration ecology in the Central Region, yet these extensive data sets have not been analyzed recently. We analyzed all direct recoveries of woodcock banded in Michigan, Minnesota and Wisconsin, as well as wing-collection survey data, to determine the progression of fall migration, the migration direction and final destination of woodcock migrating from these states. Migration initiation based on band recoveries was not observed until late October and early November, with most migration occurring during November. Wing receipt data showed a similar trend, with most change in mean receipt latitude occurring from 1 November – 5 December. During November, wing receipts were spread through the entire Central Region. By 15-31 December, 92% (n=26) of band recoveries were on the wintering grounds (south of 33º N latitude). Most banded woodcock from Michigan, Minnesota, and Wisconsin wintered in Louisiana. Because woodcock banded in these states remain in these states through November, they will be exposed to harvest for most of the hunting season. Should the population status of local birds be a concern, this migration pattern needs to be considered when setting season dates.

AMERICAN WOODCOCK WINGBEE RELIABILITY

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Abstract: Recruitment indices are estimated annually for the American woodcock using data collected through the Wing-collection Survey. Wings from woodcock harvested by hunters are identified to age and sex by participants at the annual woodcock "wingbee". Steps are taken to insure that wingbee participants are competent at aging and sexing woodcock wings, but the efficiency of these steps have not been evaluated. We collected data on participants over 6 years to address their reliability in aging and sexing wings. About 65% of participants successfully passed a mandatory test in identification skills before scoring wings, and also, about 60% of participants passed the same test on finishing scoring at the end of the wingbee. When wingbee participants misidentified a wing, the mistake was in the direction of calling an immature an adult or calling a male a female. We make a number of suggestions as to how to improve the wingbee operation.

AN EVALUATION OF WOODCOCK HARVEST REGULATIONS

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Abstract: Woodcock harvest regulations in the U. S. have gradually become more restrictive in response to continued population declines. We summarized woodcock hunting season frameworks in the U. S. from 1918-2005. Population trend estimates and seasonal patterns of woodcock wing-receipts under various harvest regulation packages were examined for the Eastern and Central Regions. Similarly, hunter numbers and woodcock harvest from the Annual Questionnaire Survey of U. S. Waterfowl Hunters (1964-2001) and Harvest Information Program (1999-2004) were summarized for periods characterized by similar harvest regulations.

MAGNITUDE AND SPATIAL DISTRIBUTION OF AMERICAN WOODCOCK HUNTING PRESSURE IN A CENTRAL MINNESOTA WILDLIFE MANAGEMENT AREA

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Abstract: Hunting is considered a potential factor influencing American woodcock (*Scolopax minor*) population dynamics, yet little is known about the magnitude or spatial distribution of hunting pressure. In 2004 and 2005 as part of a larger telemetry study of fall movements, habitat use, and mortality of woodcock in central Minnesota, we investigated distribution of hunting pressure and hunters in a wildlife management area recently opened to woodcock hunting. We measured hunter use of the area by recording how many vehicles passed access points (2004 only), interviewed hunters as they prepared to hunt, asked hunters to carry Global Positioning System (GPS) units while hunting, and recorded information in post-hunt interviews about hunting success and methods. Over the 2-year study period, we obtained information from 48 hunts where hunters carried GPS units. On average, individuals hunted approximately 2.3 hours ($n = 41$) and shot and retrieved 0.54 ($n = 48$) woodcock and 0.18 ($n = 38$) ruffed grouse (*Bonasa umbellus*) per hunt. Most hunters (77%, $n = 53$) employed dogs while hunting. Trips averaged just over 4.7 km ($n = 33$) and hunters on average traveled <1 km from their vehicle ($n = 32$), with the majority of hunting pressure close to existing trails. Most woodcock hunters (77%) employed dogs, but there was no association between hunting success and use of dogs. Woodcock hunters exhibited the strongest preference for aspen (*Populus* spp.) forest, even though this cover type had the highest abundance on the study area. Our results suggest that even in an area managed and well known for upland bird hunting opportunities, hunting pressure was not widely distributed and woodcock harvest rate was low.

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THE CONSERVATION ESTATE OF AMERICAN WOODCOCK IN THE MIDWESTERN AND NORTHEASTERN UNITED STATES

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Abstract: Applying efficient conservation measures is desirable in a constrained economic climate. Mapped predictions of a species abundance may allow the spatial targeting of focal areas for conservation increasing the efficiency of conservation application. Mapped predictions from a hierarchical spatial count model of breeding season American Woodcock (*Scolopax minor*, hereafter woodcock) relative abundance provided an opportunity to identify and prioritize focal areas for conservation in the midwestern and northeastern United States. We overlayed the mapped patterns in predicted relative abundance against digital data layers describing Federal- and State-managed lands to identify the relative contribution of governmental agencies in the conservation of woodcock habitat. We found that governmental agencies, in a regional sense, have direct jurisdiction over woodcock habitat equal to that expected by chance. In total, the proportion of predicted woodcock on Federal-administered lands was 7%, whereas the proportion was 13% on State-administered lands. Thus, the vast majority (80%) of the woodcock population occurs on private lands. We identified 10 peaks in woodcock abundance throughout the breeding season range that may be focused on for future conservation action. Some of these peaks in predicted abundance, for instance, near Lake Superior State Forest in Michigan, are currently well within the direct jurisdiction of governmental agencies, whereas other areas, such as peaks occurring in northwestern Pennsylvania, western New York, and northern Maine, largely occur in a private lands context. Thus, conservation of woodcock on their breeding grounds will require an array of management approaches largely dictated by their spatial context relative to current land ownership. The maps of predicted abundance relative to governmentally managed lands that we provided can be used to prioritize and focus management of woodcock on the United States portion of the breeding ground.

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