Population Characteristics of American Woodcock Wintering in Texas

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Abstract: Despite recent stabilization in measured indices, American woodcock (*Scolopax minor*) populations have demonstrated long-term population declines since 1968 as measured by the Federal Singing-Ground and Wing-Collection surveys. We quantified long-trends in annual sex and age ratios, recruitment index, and changes in body mass of 3,022 woodcock harvested in eastern Texas during winters of 1977–78 through 2002–03. The mean juvenile:adult ratio was 0.58 and none of the annual values exceeded 1.0. This ratio declined significantly over time for females. The male:female ratio for all birds also declined from 1977 to 2002. The calculated recruitment index (number of harvested young/harvested female) of 1.03 for this population was nearly 50% lower than the published (1.9) Federal index for Texas from 1963–2005. There was a negative yearly trend in wintering body mass for adult males and adult females, with both groups experiencing a 3% decline. Within years, mean daily body mass of adult males declined from November through February, while mass for other age and sex classes increased or showed no trend. Adult males exhibited different patterns of within and among year changes in body condition compared to adult females, juvenile females, and juvenile males. The long-term declining trends in female age ratio, recruitment index, and adult body mass provide evidence that American woodcock are declining in eastern Texas. We recommend initiation of a coordinated national effort to identify specific mechanisms for American woodcock declines, and collection of more detailed population data on breeding, migrating, and wintering grounds.

Key words: American woodcock, east Texas, population structure, *Scolopax minor*

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There are two surveys used to detect population trends of American woodcock (*Scolopax minor*) in North America (Kelley and Rau 2005). The Singing-Ground Survey (SGS) documents numbers of displaying male woodcock in northern portions of the breeding range. Data from harvested birds provided to the Wing-Collection Survey (WCS) are used to calculate an annual recruitment index (number of immature/adult female), chronology and distribution of harvest, and evaluate hunting success (e.g., daily and seasonal bag). The SGS data indicate annual average declines of 2.0% and 1.8% in the Eastern and Central regions since 1968; however, this index has stabilized since 1996, suggesting that the population decline has slowed or ceased (Kelley and Rau 2005). The WCS indicates a decline in recruitment since the mid-1980s for the Central Region (Kelley and Rau 2005). It is hypothesized that the range-wide decline of early succession forest habitat is a primary mechanism driving the observed population declines throughout the management units (Kelley et al. 2006). However, other factors, such as low annual or season-specific survival rates, may be influencing populations to a greater degree on a regional or area-specific basis (Krementz et al. 1994*a*, Krementz and Berdeen 1997, Krementz et al. 2003). Thus, evaluation of indices used in the annual regulations process for the Central Management Unit and those reflecting body condition, which influences nesting effort, will allow for determination of the influence of individual wintering areas on the population dynamics of woodcock.

Monitoring population structure of American woodcock at the edge of its range is difficult. The relatively low numbers of woodcock hunters typically results in few wings being submitted to the WCS (Kelley and Rau 2005). Further, limited participation in the Harvest Information Program in these regions results in unreliable harvest data and associated population information (Kelley and Rau 2005). Eastern Texas is at the western edge of woodcock range in the United States (Keppie and Whiting 1994). Although principally a wintering area, breeding activity (including nesting) occurs (Whiting and Boggus 1982, Whiting et al. 1985, Whiting et al. 2005). Straw et al. (1994) highlighted the need for research and habitat management in wintering areas. For example, knowledge of historic population structure would create a baseline for future comparisons when determining the effectiveness of habitat management efforts in wintering areas.

Unfortunately, little is known about the population structure of wintering woodcock in general, and this is especially true in Texas. From 1963–2004, only 987 wings were received from Texas hunters for the WCS, an average of <25 wings/year (Kelley and Rau 2005); in many years <10 wings were received. From 1983–2003, there were only 4 years where >20 wings were received in the WCS and no wings were submitted in 8 of these 23 years. These limited data have not allowed an accurate assessment of population structure for the region. For comparison, during the same time period, nearly 29,500 wings were received from Louisiana (Kelley and Rau 2005). The long-term (1963–2005) recruitment index for birds harvested in Texas is estimated to be 1.9 immature birds/adult female (Kelley and Rau 2005). However, because of low sample size, this index may be unreliable.

Moreover, data on body mass of wintering woodcock are lacking. Temporal changes in body mass can influence overwinter survival, timing of spring migration, and initiation of reproductive effort (Keppie and Whiting 1994, Whiting et al. 2005). For example, nesting effort on the wintering grounds in Texas is limited to adult females weighing >210 g (Whiting and Boggus 1982, Whiting et al. 2005). Further, expenditure of energy by males displaying for females on the winter grounds may affect their future reproductive efforts if they are unable to maintain body mass during spring migration.

We used a 26-year (1977–78 through 2002–03) database of 3,022 American woodcock harvested in eastern Texas to calculate annual sex and age ratios, variation in recruitment index, and within and among winter seasons changes in body mass. Increasing population numbers would be reflected in rising proportions of total females, juvenile females, and total young per female. Further, changing habitat quality and quantity would be associated with varying body mass values both within and across study years. Identification of changes in population indices across the study period will allow managers to focus their habitat management efforts on certain aspects of wintering woodcock habitat needs.

Study Area

Woodcock used in this study were harvested in the Pineywoods Ecological Region of eastern Texas (Gould 1962). The majority (>95%) were harvested in Angelina, Houston, Nacogdoches, San Augustine, and Trinity counties. Woodcock were harvested in a variety of upland habitats, ranging from 1-year-old pine plantations to mixed pine-hardwood stands, which averaged approximately 80 years old (i.e., sawtimber stand). All seedling (<3 years old) habitats were planted loblolly (*Pinus taeda*) or shortleaf (*P. enchinata*) pine stands. Some sapling and pole stands had been planted; others resulted from seedtree regeneration harvests. All sawtimber stands were from natural regeneration after virgin stands were harvested prior to 1940. Although habitats were dominated by loblolly or shortleaf pine, all had a hardwood component and occurred on soils that were generally classified as sandy loams or loamy sands.

Methods

American woodcock were harvested with shotguns from November through February during the American woodcock hunting seasons, the wintering periods of 1977–78 through 2002–03. During 1977–78, 1978–79, and 1987–88, scientific collection permits allowed for the harvest of birds in a similar fashion through 10 March. One author (RWM) was present during harvest and examination of all birds. We aged and sexed each bird based on wing characteristics (Martin 1964). We weighed 84% of the individuals to nearest 1.0 g; the same balance was used throughout the study and calibrated annually.

We calculated annual and long-term sex ratios (male:female) for adults, juveniles, and all birds. We calculated annual age ratios (juvenile:adult) for males, females, and all birds. The recruitment index (number of juveniles/adult female) was also calculated for each hunting season following Kelley and Rau (2005). We used linear regression to quantify trends in these ratios across the 26-year study duration.

We tested for differences in body mass between sexes and ages using a 2-way ANOVA. Because of interactions between age and sex classes, we separated data by sex and age and used linear regression to quantify trends in wintering body mass among years. We assessed within-year changes in body mass by averaging daily mass data across years (1977–78 through 2002–03) and used linear regression to quantify trends in daily mass variation across winter within each sex and age class. Because juvenile males lag about two weeks behind adults in reaching reproductive maturity (Whiting and Boggus 1982), we further examined variation in body mass of juvenile males starting on 15 January. Statistical significance was established at $\alpha = 0.10$ and all analyses were conducted using SAS (1996).

Results

Population Structure

Of the 3,022 collected birds, we recorded mass data for 2,540 (Fig. 1). The monthly distribution of samples was 2.1% in November, 23.6% in December, 66.1% in January, 7.6% in February, and 0.6% in March. The long-term male:female ratio was 0.72, 0.91, and 0.77 for adults, juveniles, and all birds, respectively. However the male:female ratio for adults ($F_{1,23} = 9.03$, $P = 0.006$, slope = –0.04) and all birds ($F_{1,23} = 7.76$, $P = 0.01$, slope = –0.02) declined (Fig. 2). The yearly male:female ratio did not vary during the 26 winters for juveniles ($F_{1,23} = 0.57$, $P = 0.46$, slope = 0.007; Fig. 2).

The long-term juvenile:adult ratio was 0.67, 0.53, and 0.58 for males, females, and all birds, respectively. The yearly juvenile:adult ratio did not vary across wintering periods for males ($F_{1,23} = 0.22$, $P = 0.65$, slope = 0.004) or for all birds ($F_{1,24} = 3.68$, $P = 0.07$,

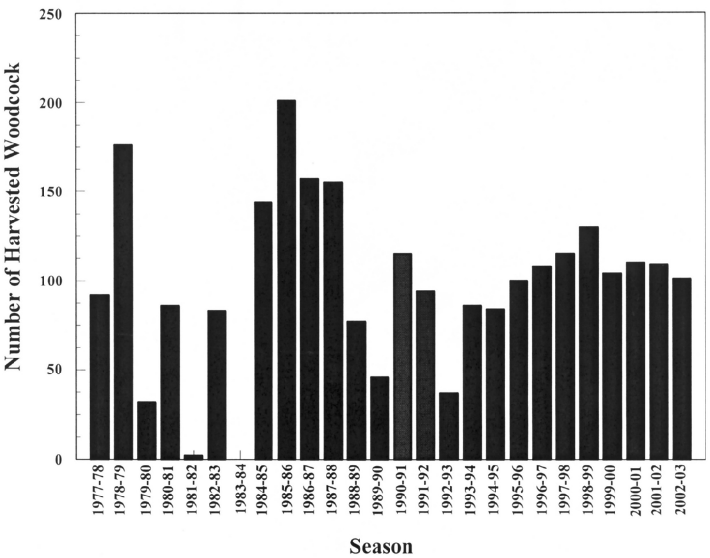

Figure 1. Seasonal sample size of harvested American woodcock (*Scolopax minor*) weighed in eastern Texas from 1977–78 through 2002–03.

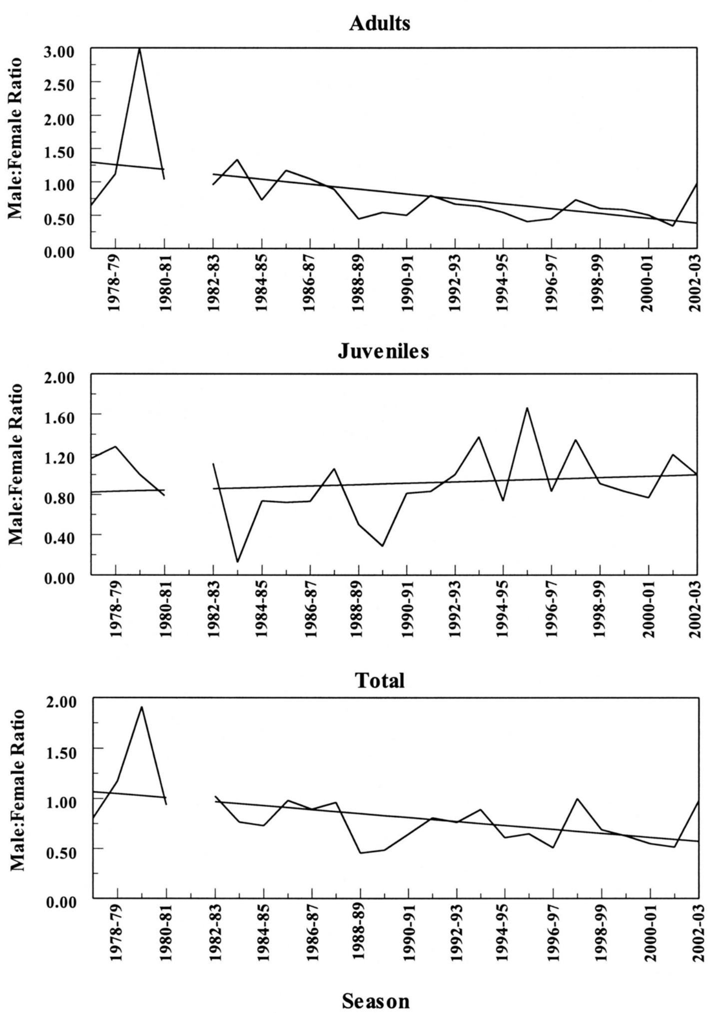

Figure 2. Male:female ratios of American woodcock (*Scolopax minor*) for adults, juveniles, and all birds harvested in eastern Texas from 1977–78 through 2002–03.

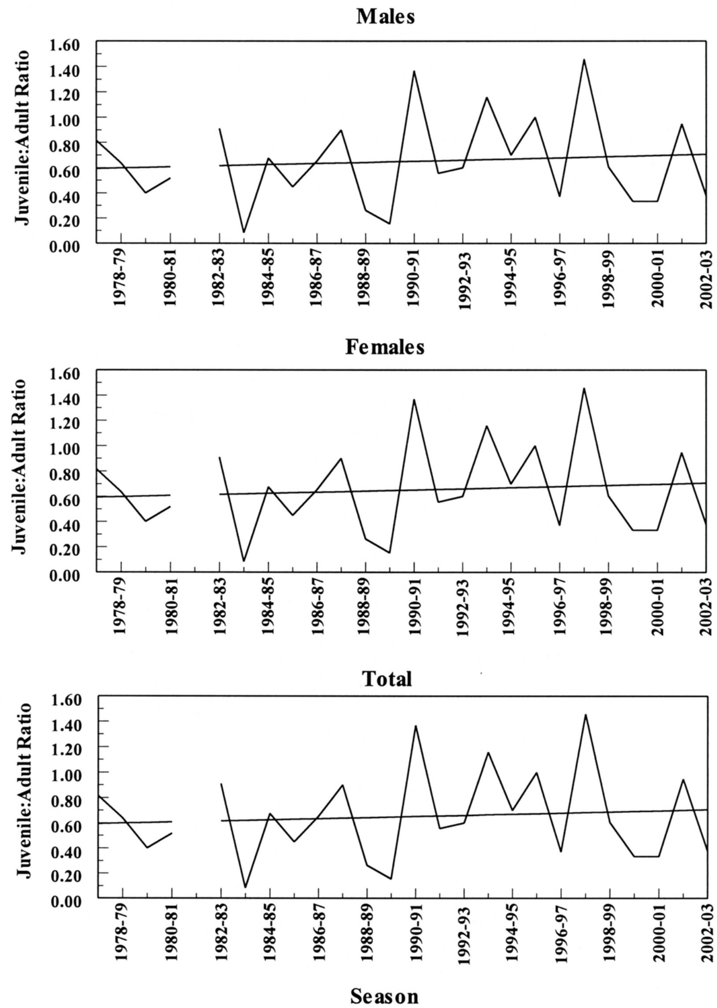

Figure 3. Juvenile:adult ratios of American woodcock (*Scolopax minor*) for males, females, and all birds harvested in eastern Texas from 1977–78 through 2002–03.

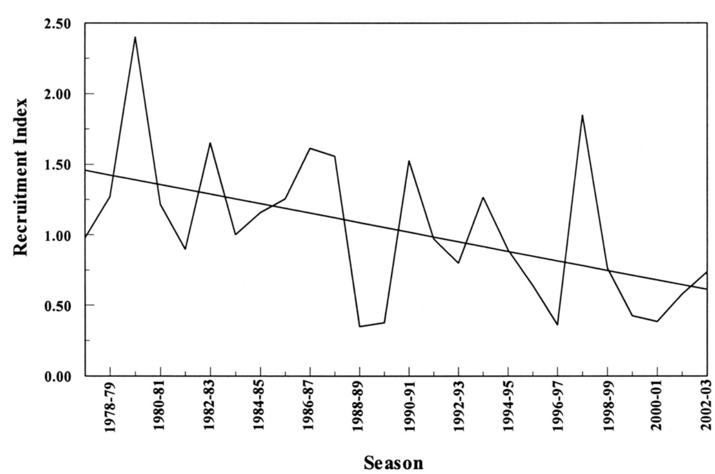

Figure 4. Recruitment index (number of harvested juveniles/harvested female) of American woodcock (*Scolopax minor*) in eastern Texas from 1977–78 through 2002–03.

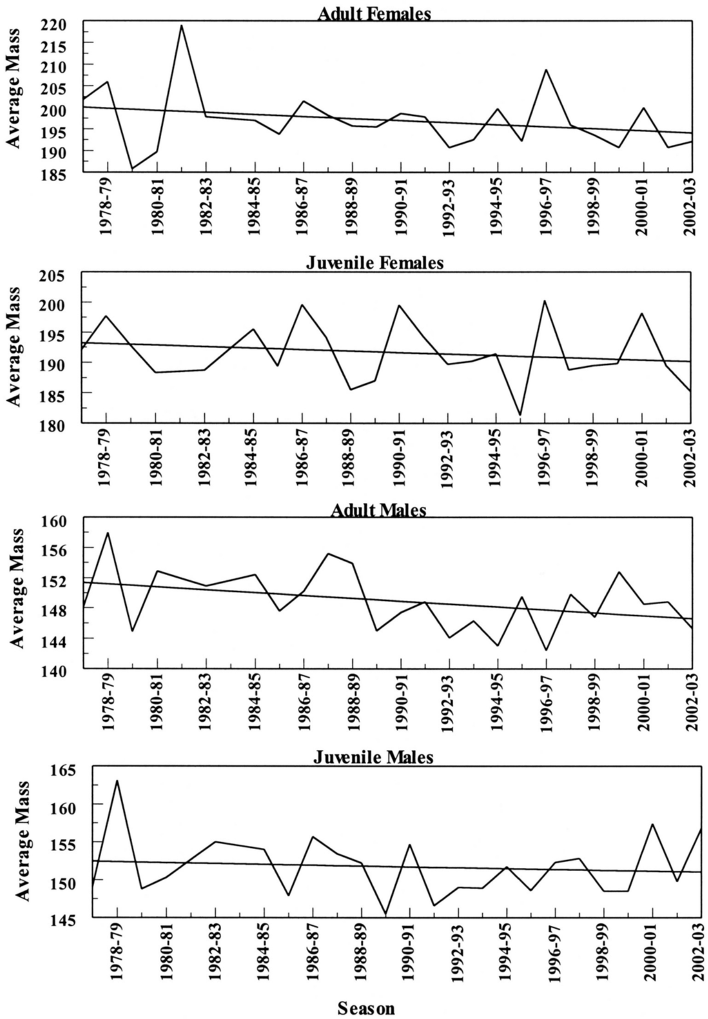

Figure 5. Average winter body mass (g) for American woodcock (*Scolopax minor*) harvested in eastern Texas during wintering periods 1977–78 through 2002–03.

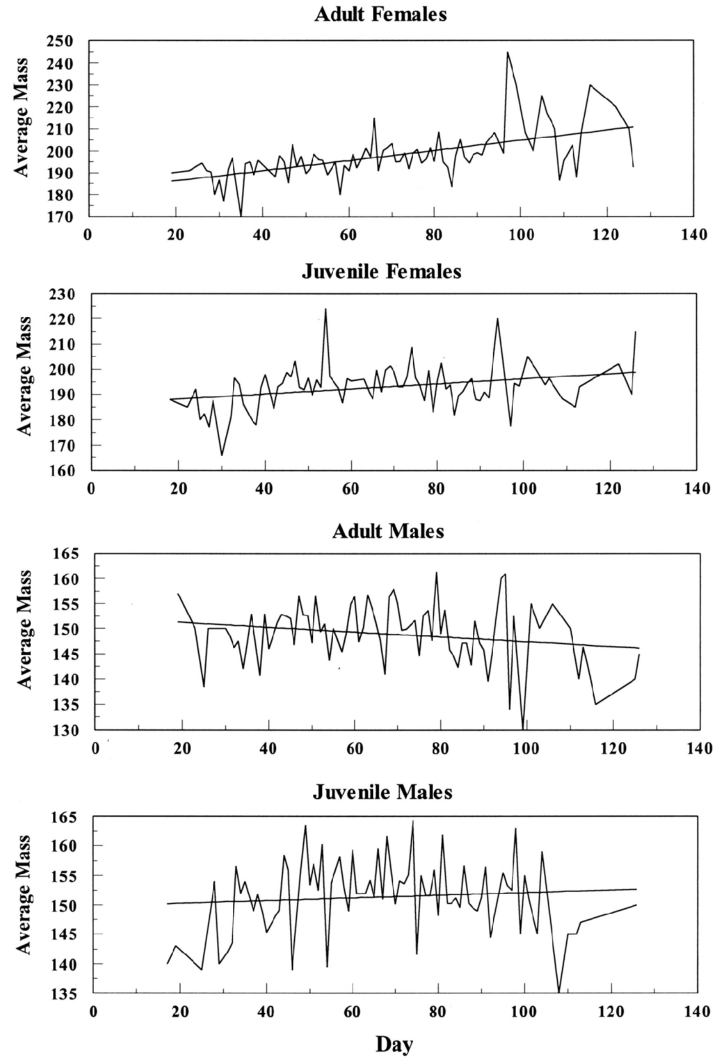

Figure 6. Average daily body mass (g) of age and sex classes of American woodcock (*Scolopax minor*) harvested in eastern Texas from 1977–78 through 2002–03. Days are enumerated starting from 1 November (Day 1).

slope = –0.01; Fig. 3). However, the juvenile:adult ratio for females ($F_{1,2}$ = 15.17, P < 0.001, slope = –0.02; Fig. 3) declined over time.

The long-term recruitment index was 1.03. There was a negative long-term decline in the recruitment index ($F_{1,24}$ = 7.93, P = 0.01, slope = –0.03; Fig. 4). Our data indicated an estimated 58% decline in the index from 1977–78 to 2002–03.

Trends in Body Mass

There was an interaction between sex and age when comparing body mass ($F_{1,2536}$ = 46.95, P < 0.001); therefore, analyses were separated by sex-age classes. Juvenile males were, on average, about 3 g greater ($F_{1,1114}$ = 20.96, P < 0.001) in mass than adults (Table 1). Mass of adult females was about 4 g greater ($F_{1,1426}$ = 39.37, P < 0.001) than juveniles (Table 1).

Overwinter body mass declined 3.1% from 1977–78 to 2002–03 for adult males ($F_{1,22}$ = 3.45, P = 0.08, slope = –0.19; Fig. 5). Although not statistically significant, body mass of adult females declined 3.0% among years with a slightly steeper slope than adult males ($F_{1,23}$ = 1.72, P = 0.19, slope = –0.24; Fig. 5). We did not detect any trends in winter body mass for juvenile males ($F_{1,22}$ = 0.24, P = 0.63, slope = –0.06) nor females ($F_{1,23}$ = 0.80, P = 0.38, slope = –0.12; Fig. 5).

Body mass increased 13.2% and 5.8% through winter for adult females ($F_{1,81}$ = 37.20, P < 0.001, slope = 0.23) and juvenile females ($F_{1,77}$ = 8.13, P = 0.006, slope = 0.10; Fig. 6), respectively. In contrast, adult males declined 3.4% in body mass through winter ($F_{1,78}$ = 3.70, P = 0.06, slope = –0.05), while body mass of juvenile males did not change over winter ($F_{1,75}$ = 0.67, P = 0.42, slope = 0.02; Fig. 6). How-

Table 1. Average body mass (g) for wintering (November–February) adult and juvenile male and female American woodcock (*Scolopax minor*) harvested in eastern Texas from 1977–78 to 2002–2003.

Sex/age	$\bar{X}$	SE	*n*
Male			
Adult	149.67 A[a]	0.43	676
Juvenile	152.60 B	0.49	439
Female			
Adult	196.96 A	0.47	954
Juvenile	192.68 B	0.57	473

a. Age means within each sex that are followed by the same letter do not differ ($P > 0.05$).

ever, after 15 January, juvenile males exhibited a 3.8% decline in body mass ($F_{1,29} = 3.94$, $P = 0.06$, slope = –0.16; Fig. 6).

Discussion

Based on several indices, results indicate that American woodcock wintering in east Texas have experienced decreasing body mass over the past two decades, which may have impacted recruitment of woodcock in the Central Region. Mean adult male:female ratios declined during winters 1977–78 through 2002–03, which indicates a decline in the proportion of harvested males per female. Possible explanations for this include changes in migration timing between sexes, available habitat, habitats used by sexes during winter, recruitment between sexes into the adult population, or vulnerability between sexes to harvest. Krementz et al. (1994*b*) found no evidence of differential migration dates for any sex-age class in the Eastern Region, but this has not been examined in the Central Region. There is some evidence for differential habitat use between males and females on the wintering grounds (Berdeen and Krementz 1998, Berry 2006), which may contribute to differences in harvest vulnerability between sexes. Indeed, preliminary results from our data indicate that adult females increased in proportion of the harvest during the study period (R. M. Whiting Jr., unpub. data).

The average juvenile:adult ratio from 1977–78 to 2002–03 was 0.58 and never exceeded 1.0 for any annual value. Although the long-term trend for males and all harvested birds was steady, the juvenile:adult ratio declined for females. This may indicate that juvenile females are more susceptible to factors affecting the population, including habitat degradation and loss, and may be the primary age and sex class influencing the overall continental population decline. Krementz et al. (2003) found relatively low annual survival of juvenile woodcock (~27%) but was unable to test for any differences in survival between sexes because of limited recovery data. If these trends are present in other wintering areas, it is possible that annual juvenile female survival may be quite low. Alternatively, the types of habitat hunted changed over the course of the study (R. M. Whiting Jr., unpub. data) and juvenile females may not have been as well represented in hunted habitats in latter years.

The recruitment index from hunter-provided wings is commonly used in the annual process of setting harvest regulations for woodcock for each management region (Kelley and Rau 2005). Wings provided by Texas hunters do not have much influence on the regional indices or on the annual regulations-setting process; however, annual state-specific recruitment index values are also reported. The reported 1963–2005 index for Texas is 1.9 (Kelley and Rau 2005). However, for Texas and potentially other low harvest states, the WCS may produce an unreliable state-specific assessment. Our calculated recruitment index, with a much larger sample size representing Texas than previously available, was nearly 50% lower than the reported 1.9 from the WCS for Texas for all but two years.

Declining body mass for both sexes may represent physiological responses to changes in habitat conditions on wintering sites. The relationships among wintering habitat conditions and body mass for each age and sex class need to be determined. Early in our study, all woodcock were harvested on private lands. However, there was a shift, such that by the later winters, >90% of woodcock were harvested on U.S. Forest Service lands. Such lands were managed differently from private lands; thus, investigation into the effects of different forest management techniques on woodcock body mass is needed on the wintering grounds.

If body mass declines continue, the breeding mass threshold of 210 g for adult females (Whiting and Boggus 1982) will be achieved by fewer individuals, reducing the potential contribution to the population by American woodcock breeding in Texas and perhaps other southern states. For example, 18% of the females measured during our study exceeded 210 g and could potentially initiate breeding on the wintering grounds, but a conservative 2.5% decline in body mass would reduce the potential breeding females to 8.3% of the adult female population. Not only would such a decline in body mass decrease the breeding effort in Texas, it would likely impact subsequent efforts further north. Further, these declines in body mass may be occurring over a larger geographic scale on wintering grounds. They appear to be associated with similar continental population declines over the same period (Kelley and Rau 2005) and may affect subsequent migration survival, breeding propensity, and future recruitment. Krementz et al. (2003), using banding data from 1978–1998 in Michigan, did not find a temporal trend in annual survival. However, these data were collected prior to the most recent wintering time periods of our study and a reanalyses of banding data through 2003 may be necessary to detect any potential effects of declining body mass on woodcock survival.

We believe that seasonal mass declines in adult and juvenile males, respectively, were the result of courtship activity. In eastern Texas, regular courtship activity begins in early January and numbers of courting males and courtship flights peak in mid-February (Whiting and Boggus 1982, Tappe et al. 1989). During this period, males are expending energy and restricting foraging time, thus loss of mass is not surprising. Our findings are contrary to those from south-central Louisiana, where male mass increased slightly throughout winter (Pace et al. 2000). However, breeding activity is very limited in that area (Olinde and Prickett 1991, Olinde 2000). In Maine, neither adult nor juvenile males lost mass during the April–May breeding season (Dwyer et al. 1988), but mass in that study averaged 5–10 g less than ours. Adult females had a greater percent increase in body mass than juveniles because some adults nest in eastern Texas, whereas there is no evidence of nesting by juveniles (Whiting and Boggus 1982, Whiting et al. 2005). Interestingly, the median date of harvested birds became later (31 December 1977–1993 to 7 January 1994–2002) during the study; thus, the within season gain in body mass by females did not offset the long-term decline in body mass of wintering adult females.

We encourage examination of body mass data-sets and collection of such data in other wintering areas to determine if trends such as ours are widespread. Future research should also concentrate on identifying habitat conditions along fall migration routes and on wintering grounds that may influence body mass on wintering areas and determine its potential influence on reproduction.

Management Implications

The apparent long-term declining trends in female age ratio data, recruitment index, sex ratio, and body mass of American woodcock in eastern Texas should be cause for concern in migratory bird managers. Continued investigation into woodcock ecology on the wintering grounds examining such topics as relationships among available habitats, habitat use, and survival are needed throughout much of the wintering grounds to guide future management activities. Few funds are available for American woodcock research even though national and regional trends for many population attributes are negative. We suggest a coordinated national effort be initiated to examine causes of these trends over the entire woodcock range, as outlined in the previous paragraph, with efforts beyond the northern breeding grounds. To accomplish this, significant resources will need to be dedicated by agencies responsible for American woodcock. Declaration of American woodcock as a focal species by the U.S. Fish and Wildlife Service should ensure that they retain a priority status into the future.

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Literature Cited

Berry, C.B. 2006. Characteristics of diurnal microhabitat used by adult male and female American woodcock in East Texas. Master's thesis. Stephen F. Austin State University, Nacogdoches, Texas.

Berdeen, J.B. and D.G. Krementz. 1998. The use of fields by wintering American woodcock. Journal of Wildlife Management 62:939–947.

Dwyer, T.J., G.F. Sepik, E.L. Derleth, and D.G. McAuley. 1988. Demographic characteristics of a Maine woodcock population and effects of habitat management. U.S. Fish and Wildlife Service Research Report 4, Washington, D.C.

Gould, F.W. 1962. Texas plants—a checklist and ecological summary. Texas Agricultural Experiment Station, College Station, Texas.

Kelley, J.R. Jr., M. Banker, D. Dessecker, D. Haukos, D. Krementz, D. McAuley, N. Myatt, W. Palmer, T. Post, and S. Williamson. 2006. American woodcock conservation plan. Woodcock Task Force, Migratory Shore and Upland Game Bird Working Group, Association of Fish and Wildlife Agencies, Washington, D.C.

——— and R.D. Rau. 2005. American woodcock population status, 2005. U. S. Fish and Wildlife Service, Laurel, Maryland.

Keppie, D.M. and R.M. Whiting Jr. 1994. American woodcock (*Scolopax minor*). Account 100 *in* A. Poole, and F. Gill, editors. The birds of North America, The Academy of Natural Sciences, Philadelphia, Pennsylvania.

Krementz, D.G. and J.B. Berdeen. 1997. Survival rates of American woodcock wintering in the Georgia Piedmont. Journal of Wildlife Management 61:1328–1332.

———, J.T. Seginak, D.R. Smith, and G.W. Pendleton. 1994*a*. Survival rates of American woodcock wintering along the Atlantic Coast. Journal of Wildlife Management 58:147–155.

———, ———, and G.W. Pendleton. 1994*b*. Winter movements and spring migration of American woodcock along the Atlantic Coast. Wilson Bulletin 106:482–493.

———, J.E. Hines, and D.R. Luukkonen. 2003. Survival and recovery rates of American woodcock banded in Michigan. Journal of Wildlife Management 67:398–407.

Martin, F.W. 1964. Woodcock age and sex-determination from wings. Journal of Wildlife Management 28:287–293.

Olinde, M.W. 2000. Gonadal condition of American woodcock harvested in Louisiana during the 1986–1988 hunting seasons. Pages 84–89 *in* D.G. McAuley, J.G. Bruggink, and G F. Sepik, editors. Proceedings in the ninth American woodcock symposium. U.S. Geological Survey, Biological Resources Division Information and Technology Report 2000-0009, Washington, D.C.

——— and T.E. Prickett. 1991. Gonadal characteristics of February-harvested woodcock in Louisiana. Wildlife Society Bulletin 19:465–469.

Pace, R.M. III, M.W. Olinde, and F G. Kimmel. 2000. Weight variation among American woodcock wintering in south-central Louisiana. Pages 90–95 *in* D.G. McAuley, J.G. Bruggink, and G.F. Sepik, editors. Proceedings in the ninth American woodcock symposium. U.S.Geological Survey, Biological Resources Division Information and Technology Report 2000-0009, Washington, D.C.

SAS. 1996. SAS users guide: statistics. SAS Institute, Inc. Cary, North Carolina.

Straw, J.A., D.G. Krementz, M.W. Olinde, and G.F. Sepik. 1994. American woodcock. Pages 97–114 *in* T.C. Tacha and C.E. Braun, editors. Migratory shore and upland game bird management in North America. International Association of Fish and Wildlife Agencies, Washington, D.C.

Tappe, P.A., R.M. Whiting Jr., and R.R. George. 1989. Singing ground surveys for woodcock in East Texas. Wildlife Society Bulletin 17:36–40.

Whiting, R.M. Jr. and T.G. Boggus. 1982. Breeding biology of American woodcock in east Texas. Pages 132–138 *in* T.J. Dwyer and G.L. Storm, editors. Woodcock ecology and management. U.S. Fish and Wildlife Service, Research Report 14, Washington, D.C.

———, R.R. George, M.K. Causey, and T.H. Roberts. 1985. February hunting of American woodcock: breeding implications. Pages 309–317 *in* S.L.Beason and S.F. Roberson, editors. Game harvest management symposium. Caesar Kleberg Wildlife Research Institute, Kingsville, Texas.

———, D.A. Haukos, and L.M. Smith. 2005. Factors influencing American woodcock reproduction in Texas during January. Southeastern Naturalist 4:639–646.