

AMERICAN WOODCOCK ASSESSMENT

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Maine Department of Inland Fisheries and Wildlife
Wildlife Division
Wildlife Resource Assessment Section
650 State Street
Bangor, Maine 04401-5654

1985 Version by
R. Bradford Allen

2001 Update by
Andrew P. Weik

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INTRODUCTION

Since 1968, the Maine Department of Inland Fisheries and Wildlife (MDIFW) has aggressively pursued development and refinement of wildlife species assessments and implementation of cost-effective comprehensive programs that support selected goals and objectives for the next 15 years. Assessments are based upon available information and the judgments of professional wildlife biologists responsible for individual species or groups of species. Precise data may not always be available or are too limited for meaningful statistical analysis; however, many trends and indications are sometimes clear and deserve management consideration.

The assessment has been organized to group information in a user-meaningful way. The Natural History section discusses biological characteristics of the species that are important to its management. The Management section contains history of regulations and regulatory authority, past management, past goals and objectives, and current management. The Habitat and Population sections address historical, current, and projected conditions for the species. The Use and Demand section addresses past, current, and projected use and demand of the species and its habitat. A Summary and Conclusions section summarizes the major points of the assessment.

This document is an update of the original 1985 Woodcock Assessment written by R. Bradford Allen. For a thorough review of American Woodcock natural history and conservation throughout its North American range, the reader is referred to “American Woodcock (*Scolopax minor*)” (Keppie and Whiting 1994), No. 100 in The Birds of North America.

NATURAL HISTORY

Description

American Woodcock (*Scolopax minor*) is a shorebird (Order *Charadriiformes*, Family *Scolopacidae*) of upland habitats. Five other species of *Scolopax* inhabit Europe and Asia, the best known and mostly widely distributed of which is the Eurasian Woodcock, (*S. rusticola*), a large, migratory woodcock that has been recorded as a vagrant to North America, from Quebec and Newfoundland to Ohio and Alabama (Hayman et al. 1986).

Although classified as a shorebird, American Woodcock are physically and behaviorally adapted to forested habitats (Owen 1977, Keppie and Whiting 1994). Woodcock have a long bill, specialized for feeding on soil invertebrates, particularly earthworms (Oligochaeta); and short, rounded wings for flight through dense forest. Large eyes are set far back on the head to enable binocular vision to both front and rear. The plumage is cryptically patterned in shades of brown and black, blending with the forest floor. Woodcock are polygynous (one male mating with one or more females); sexes look alike, but females are nearly 1/3 larger than males (151-279g F; 116-219g M; Keppie and Whiting 1994). Courtship activity occurs at dawn and dusk, presumably to reduce risk of predation.

Distribution

American Woodcock occur throughout the forests of eastern North America, from southern Newfoundland, the Maritimes, and Atlantic coast states, west to a line that

runs generally from south-central Manitoba in the North, south through Minnesota to central Texas in the South. Their northern limit is generally considered to be southern Manitoba and Ontario east to southern Newfoundland. The southern range of woodcock extends from southern Texas, east along all the Gulf states to Florida.

Woodcock are migratory birds, annually flying between northern breeding and southern wintering ranges. During the breeding season, they are most abundant north of Virginia, Kentucky, and Missouri; during winter, most woodcock probably reside to the south of the aforementioned states. The winter range is limited in the north by snow cover and ground frost.

Two woodcock populations (management regions) are recognized by the United States Fish and Wildlife Service (USFWS). These management regions are referred to as Eastern and Central regions (Martin et al. 1970, Coon et al. 1977, Krohn and Clark 1977), which are nearly identical to the Atlantic and Mississippi Flyways, respectively, used to administer waterfowl management. The two populations are separated generally by the Appalachian Mountains (USFWS 1985, 1990). Birds breeding in, or migrating through, Maine make up a portion of the Eastern region population. Most of the woodcock that nest or are hatched in Maine winter east of the Appalachian Mountains, primarily from southern New Jersey through Georgia (Krohn and Clark 1977).

Habitat and Diet

Woodcock use young to middle-aged hardwoods in Maine, often associated with old fields or forest openings (Mendall and Aldous 1943, Krohn 1970, Dunford and Owen

1973, Reynolds et al. 1977). Alder (*Alnus spp.*), aspen (*Populus spp.*), and birch (*Betula spp.*) are important tree genera characteristic of woodcock habitat in Maine. According to Reynolds et al. (1977), woodcock use of forested habitats was related to the abundance of earthworms, a primary food item. Earthworm abundance was correlated with leaf detritus in second growth hardwood stands. The supply of earthworms available to woodcock is also affected by such soil properties as texture, moisture, and temperature (Reynolds et al. 1977). Maine soils that have been farmed tend to have an adequate abundance of earthworms for woodcock (Galbraith 1984). However, woodcock also require suitable overhead cover, ground cover, and favorable soil conditions to effectively prey upon earthworms. According to Owen (1977), abandoned farmland in the early stages of forest succession probably provides the best diurnal habitat for woodcock in the Northeast. In addition, woodcock require open areas for courtship and night roosting.

Breeding Biology

Woodcock begin their northward migration in late January and February (Roberts 1993, Krementz et al. 1994), and arrive on their singing grounds in March and April (Dwyer et al. 1988). Males typically commence courtship activity within days of arriving on the breeding range. Courtship displays, performed by the male at dawn and dusk, consist of spectacular spiraling flights with a bubbly, chirping song, and a high pitched sound produced in flight by the three narrow, outermost flight feathers of each wing. Low, nasally “peent” calls, given by the male while on the ground between flights, are

part of the courtship activity. Singing grounds typically are forest openings, such as logging roads, old fields, and agricultural edges.

Woodcock are sexually mature, and typically breed, as yearlings (first spring following hatch). Woodcock are believed to be polygynous (one male mating with one or more females). Females may visit more than one singing ground before nesting (McAuley et al. 1993). In the Northeast, woodcock begin to nest in April, often within 100 yards (90 m) of a singing ground (Sepik et al. 1981).

A woodcock nest consists of a simple cup of leaves and grass on the ground, within close proximity to a tree or shrub (Bourgeois 1977). Typical of shorebirds, woodcock usually lay 4 eggs, and incubation lasts 21 days. Because of this small number of eggs, the woodcock's reproductive potential is limited. However, nesting success (i.e. nests that hatch one or more chicks) is generally high (50%), renesting is common (McAuley et al. 1990), and chick survival, although variable, can be quite high.

Peak of hatch for woodcock in Maine is May (Mendall and Aldous 1943). The female alone provides parental care. Within a few hours of hatch, she leads her precocial, highly mobile young to feeding cover, which consists of alder swales or young hardwoods on fertile, moist soils with numerous earthworms (Dwyer et al. 1982). The young require help in procuring food during the first week, taking food items from the hen's bill; however, chicks begin probing for food at 3-4 days old. During the first two weeks, the hen broods her young during night, and periods of cold or wet weather.

Woodcock chicks develop rapidly. By 14 days old they are capable of short flights, and of sustained flights by 18-19 days. Broods break up at about 34 days old, and immatures in Maine disperse from brood range several weeks later, typically during

August (Sepik and Derleth 1993). Immatures are adult size by late summer. Maine woodcock generally begin their southward migration in late October (Owen and Krohn 1973), with most woodcock departing during the first three weeks of November (McAuley et al. 2001).

Survival and Longevity

The survival rate of chicks to flying age (15 days) has been estimated at 0.95 in Alabama (Wiley and Causey 1987), and 0.59 in Maine (Dwyer et al. 1988). Survival from flying age to brood breakup in Alabama (Wiley and Causey 1987) and Maine (Derleth and Sepik 1990) averaged 0.90. Survival during June to October in Maine was 0.66 for immatures and 0.92 for adults (Derleth and Sepik 1990); survival on wintering grounds in southeastern U.S. was 0.65 (Krementz et al. 1994), and 0.79 during spring in Maine (Longcore et al. 1996). Annual survival of Eastern region woodcock during 1967-74, based on band returns, was 0.354 (Dwyer and Nichols 1982). Annual survival rates of females are greater than that of males, and annual survival of adults is greater than that of immatures (Derleth and Sepik 1990). The longest known life span of an American Woodcock is 11 years and 4 months for a female that was banded as a fledgling in the summer of 1971 in Wisconsin, and shot by a hunter during autumn 1982, also in Wisconsin (Klimkiewicz and Futcher 1989).

MANAGEMENT

Regulatory Authority

The USFWS maintains regulatory authority over management of migratory birds, including American Woodcock. The goal of the USFWS's "American Woodcock Management Plan" (USFWS 1990) is to stabilize population declines and increase population levels above current (1990) levels. Region 5 of the USFWS established a goal to increase the Eastern region woodcock population, as indexed by the Singing-ground Survey, to 1985 levels by 2005 (USFWS 1996).

Past Goals and Objectives

The latest MDIFW American Woodcock Assessment was written in 1985 and updated in 1996. The following goals and objectives were established as a result of this plan and through the efforts of a public working group. Appendix A contains tables from the 1985 assessment.

GOAL (1985):

Increase woodcock populations levels.

OBJECTIVES:

Abundance Objective: Increase spring woodcock numbers in all Wildlife Management Units (WMU) by 25% by 1990.

Harvest Objective: Maintain harvest and hunter numbers at or near current (1985) levels.

Past and Current Management

Historically, the woodcock in Maine has advanced from a species pursued by market hunters to a specialty game bird that is highly regarded by hunters with pointing or flushing dogs. Today, the woodcock provides an even broader-based source of recreation because of its conspicuous, aerial courtship display. The history of Maine's American Woodcock regulations reflects this change in status.

In the days of market hunting, tremendous numbers of woodcock were killed. Pettingill (1939) quoted a Field and Stream editorial of 1874: "Woodcock in the market, fairly plenty. Of course New York draws all of the birds of the United States into the market. From a pretty close calculation, we suppose about 1,800 single birds come into New York weekly.....price \$1.50 a pair."

The first law to protect woodcock in Maine was enacted in 1863, making it illegal from 1 March to 4 July to kill, possess, buy, or sell "any of the birds called woodcock..." (Maine State Law, Chapter 166). In 1880, laws governing market hunting began to appear. The closed season on American Woodcock (and Ruffed Grouse) was expanded to 1 December through 1 September; and the use of traps, nets, snares, or any "... device or contrivance, other than the usual method of sporting with firearms ..." was prohibited for hunting upland game birds and waterfowl (Chapter 50, Sections 12, 13, and 16); prior to 1880, it was legal to shoot woodcock during July and August in addition to during the fall season. It is of interest to note that "... Since Maine abolished summer shooting, other states have done likewise, and with good results..." (Commissioner's Report 1880).

In the past, uncontrolled hunting apparently had an adverse influence on woodcock numbers. Declines in woodcock numbers concerned observers as early as 1880 (Commissioner's Report 1880, Fisher 1902). "It is true that ten years ago (1870) one could show more birds as the result of a days shooting in Maine; but there are now ten or twenty times as many persons hunting woodcock as then, and all the best covers are hunted through almost daily during the whole season" (Commissioner's Report 1880). Reasons for this decline in woodcock numbers can only be speculative. Whether market hunting alone, or in conjunction with intensive land clearing for crops and pasture, was the cause of this decline is undetermined. Nonetheless, declines in numbers of woodcock and other migratory birds led to the Weeks-McLean Act, which passed authority for protection of migratory birds to the federal government in 1916. The Migratory Bird Treaty Act of 1918 further strengthened the federal role in migratory bird conservation.

Declining numbers of woodcock prompted managers to reduce bag limits, which were first proposed in the Commissioner's report of 1920. "Woodcock were reported in good numbers in some of the southern counties and quite a number of sportsmen from out of the state availed themselves of the opportunity to engage in the fascinating sport of woodcock shooting. It may be well, however, to reduce the bag limit to five if we hope to see this bird increase, spreading more generally over the southern counties of the state. Five birds is the bag limit in New Hampshire and sportsmen seem well satisfied with that number."

During the late 1930s, it was not uncommon for hunters to record high seasonal harvests, even though a 4 bird daily bag limit was in effect. In 1938, a Washington

County guide and his parties killed 172 birds in 21 days. Three Androscoggin County hunters had a combined total of 210 woodcock during the 1937 season (Mendall and Aldous 1943).

In cooperation with state wildlife agencies, USFWS sets hunting season frameworks (season dates and bag limits; Table 1). Rangewide population surveys were standardized between 1964-1970. With refinement of these surveys came the knowledge that woodcock were more widespread and abundant than previously thought. In the 1960s, regulations were gradually liberalized to allow greater opportunity for harvest. During this time, and continuing through the 1970s, woodcock became an increasingly popular game bird over its entire range. The greatest growth of interest in hunting woodcock was in the southern states. Interest in woodcock grew; and harvests increased, largely through increased participation in woodcock hunting rather than increased success rates. In the Northeast, this increase in hunting pressure came at a time when woodcock habitat was being lost to development and succession of young forests on previously abandoned farmland.

Woodcock regulations became relatively stable in 1965, and remained so until 1978, when a joint woodcock and grouse opening date of 2 October was established. Continued liberal federal season frameworks and public input resulted in a reestablishment of September woodcock hunting in Maine through 1981. In 1982, the USFWS delayed the season until 5 October in certain northeastern states where populations were adversely affected by a severe spring blizzard. In 1983 and 1984, a 1 October opening date was established to provide additional protection to woodcock populations in the Eastern region.

Table 1. History of American Woodcock harvest management in Maine, 1928-2000.

Year	Estimated Harvest *	Estimated Effort *	Statutes and Regulations		Bag Limit
			Season Dates	Season Length (Federal max.)**	
1928-39	37,000	-	1 Oct - 31 Oct	30 (30)	4
1940-47	-	-	1 Oct - 30 Oct	15 (15)	4
1948-52	20,800	4,200	1 Oct - 31 Oct	30 (30)	4
1953-60	33,300	9,100	1 Oct - 9 Nov	40 (40)	4
1961	32,100	8,300	2 Oct - 10 Nov	40 (40)	4
1962	38,100	9,200	1 Oct - 9 Nov	40 (40)	4
1963	31,000	8,900	1 Oct - 19 Nov	50 (50)	5
1964	43,800	10,500	28 Sept - 10 Nov	45 (50)	5
1965	46,700	10,500	27 Sept - 15 Nov	50 (50)	5
1966	74,900	19,100	26 Sept - 15 Nov	50 (50)	5
1967	65,300	13,600	25 Sept - 15 Nov	52 (65)	5
1968	91,900	15,600	24 Sept - 15 Nov	53 (65)	5
1969	68,600	17,700	24 Sept - 15 Nov	53 (65)	5
1970	81,500	19,300	1 Oct - 30 Nov	60 (65)	5
1971	94,300	25,300	24 Sept - 15 Nov	53 (65)	5
1972	174,900	28,900	25 Sept - 15 Nov/ 2 Oct - 15 Nov	52 (65) 45 (65)	5
1973	210,700	37,300	24 Sept - 15 Nov/ 1 Oct - 15 Nov	53 (65) 45 (65)	5
1974	164,000	30,300	23 Sept - 15 Nov	54 (65)	5
1975	110,300	28,300	24 Sept - 15 Nov/ 1 Oct - 15 Nov	53 (65) 45 (65)	5
1976	151,300	28,200	24 Sept - 27 Nov/ 1 Oct - 27 Nov	65 (65) 59 (65)	5 4
1977	133,700	27,000	24 Sept - 15 Nov	53 (65)	5
1978	99,200	23,000	2 Oct - 15 Nov	45 (65)	5
1979	142,700	27,400	24 Sept - 15 Nov	53 (65)	5
1980	172,800	27,000	24 Sept - 28 Nov	65 (65)	5
1981	164,200	31,600	25 Sept - 28 Nov	65 (65)	5
1982	109,800	25,400	5 Oct - 8 Dec	65 (65)	5
1983	107,600	24,200	1 Oct - 30 Nov	60 (65)	5
1984	-	-	1 Oct - 30 Nov	60 (65)	5
1985-87	-	-	1 Oct - 14 Nov	45 (45)	3
1988	75,609	17,546	1 Oct - 14 Nov	45 (45)	3
1989-95	-	-	1 Oct - 14 Nov	45 (45)	3
1996	26,100	8,300	1 Oct - 14 Nov	45 (45)	3
1997	-	-	6 Oct - 4 Nov	30 (30)	3
1998	35,600	9,200	6 Oct - 4 Nov	30 (30)	3
1999-	-	-	6 Oct - 4 Nov	30 (30)	3
2000	-	-	6 Oct - 4 Nov	30 (30)	3

* Estimates of harvest and effort are provided by: MDIFW Game Kill Questionnaire for 1929-1983; Teisl et al. (1992) for 1988; USFWS Harvest Information Program for 1996 and 1998.

** Maximum season length (days) allowed by federal framework is shown in parentheses.

In 1985, the USFWS believed further adjustments of hunting regulations were necessary in the East. For the 1985-86 hunting season, the USFWS proposed and adopted regulations shortening the season from a maximum of 65 days to no more than 45. Again, September hunting was not allowed, and February hunting was prohibited as well. For the first time, the bag limit was reduced from 5 to 3 birds per day. In 1997, the hunting season framework for the Eastern region again was shortened to a maximum of 30 days, beginning no earlier than 6 October, and having a 3-bird daily bag limit; since 1997, states in the Central region have been allowed 45-day seasons, beginning as early as the Saturday nearest 22 September, and a 3-bird daily bag limit.

In cooperation with state wildlife agencies (via the Atlantic Flyway Council and Technical Section), USFWS coordinates annual population monitoring (Singing-ground Survey routes), and hunter and harvest monitoring via the Harvest Information Program (HIP), and conducts the annual Wing-collection Survey (wings submitted by cooperating woodcock hunters). Results of the Singing-ground and Wing-collection Surveys are discussed in the Population Assessment section of this plan; results of the HIP survey are discussed in the Use and Demand Assessment - Harvest section of this plan.

The Department monitored hunter and harvest numbers (Table 1) via the annual Personal Hunting Report (Game Kill Questionnaire) from the early 1970s through 1983. Since 1983, information on statewide woodcock hunter and harvest numbers has been sporadic. A survey of upland bird hunters (Teisl et al. 1992) provided these data for the 1988 hunting season; HIP surveys provided estimates of woodcock hunter and harvest numbers in more recent years.

The Department manages habitat for woodcock on portions of several Wildlife Management Areas (WMAs) by mowing and brush-hogging to promote night roost fields and openings for courtship, and timber harvesting to stimulate early successional forest for feeding and brood cover. In addition to serving as habitat for woodcock and other early successional species, these sites serve as demonstration areas for citizens interested in managing for woodcock on their own woodlots. Sepik et al.'s (1981) booklet, *A landowner's guide to woodcock management in the Northeast*, continues to be a valuable resource for landowners and land managers interested in managing habitat for woodcock.

HABITAT ASSESSMENT

Past Habitat

Woodcock habitat is closely associated with early stages of forest succession. According to historical records, large areas of potential woodcock habitat were created in the mid to late 1800s, when land was cleared for numerous small farms in Maine. The total amount of farmland in Maine peaked at over 6.5 million acres in 1880 and has declined to 1.2 million acres in 1997 (Benson and Frederic 1982, Bureau of Census 1999). Between 1880 and 1925, total cropland area changed little. However, during this same period the amount of pasture land decreased by over one million acres. Since 1925, agricultural land has declined steadily as well.

The natural succession of abandoned farmland to young forestland produced a great deal of woodcock habitat in Maine. However, as plant succession progressed beyond optimum conditions for woodcock, habitat area decreased.

Since the 1960s, the area of forestland in Maine has stabilized at approximately 17.7 million acres (Griffith and Alerich 1996), of which 95% (16.9 million acres) is classified as commercial timberland. Increases in timberland due to abandoned farmland reverting to forest have slowed, and are offset by losses of habitat to residential or commercial development (Gadzick et al. 1998). Commercial forestry on large land holdings, and the manipulation of small woodlots for stand improvements and firewood by private landowners, continue to influence woodcock habitat across a broad range of the State. Recent increases in harvests of hardwood pulp likely have improved habitat conditions for woodcock in industrial forests.

Dwyer et al. (1983) used aerial photography to study habitat changes along Singing-ground Survey routes in 9 northeastern states, including Maine. They found that the largest single change in any habitat type along survey routes was an increase in urban/industrial development. Urban/industrial development often replaced the abandoned fields and shrublands that had been good woodcock habitat; declines in singing male counts were correlated with these habitat changes.

Some land use activities can have beneficial effects on woodcock habitat. Openings for singing grounds can be created by cutting small blocks of forest (Sepik et al. 1981). Nicholson (1977) reported that commercially harvested woodlands produced openings suitable for singing grounds and nocturnal roosts, but unless these clearings occurred adjacent to adequate diurnal habitat, woodcock use was low. Galbraith (1984) found that the agricultural history of an area was the best predictor of earthworm biomass of any characteristic examined, even though some old agricultural sites were heavily forested. In short, earthworms occurred more often, and their biomass was markedly greater, at previously farmed sites than at sites that had never been farmed.

Current Habitat

Woodcock require the following: (1) openings (e.g., fields, clearcuts, roads, beaver-impacted habitat) used for courting and nocturnal roosting, (2) fertile, generally poorly drained loamy soils containing abundant earthworm populations, and (3) the proper life forms of vegetation, which provide adequate feeding and hiding cover for protection and feeding during both diurnal and nocturnal use.

Woodcock habitat in Maine generally is associated with early stages of forest succession. Areas that receive high use by woodcock are dominated by shrubs or young (<20 years old) deciduous trees, particularly alder, aspen, or birch (Dunford and Owen 1973, Sepik et al. 1981). These types of areas generally are associated with abandoned farmland, recently burned and logged areas, or moist riparian zones.

Woodcock habitat, although fairly easy to identify, is relatively short-lived and is of little commercial value. Consequently, it is not well represented in standard forest inventories. Nor is woodcock habitat sufficiently well identified in the Department's Wetland Inventory. A Habitat Suitability Index (HSI) Model was used to estimate the relative quality of Maine's woodcock habitat for the 1985 Woodcock Assessment (Appendix A, Table 4); this model could not be used for the current assessment because a key component, ground cover, was dropped from the State's 1995 forest inventory. Given these limitations, in 2000 the Department contracted the University of Maine's Cooperative Fish and Wildlife Research Unit to develop a model to aid in assessing the quantity and quality of woodcock habitat in Maine; unfortunately, this model was not satisfactory. Therefore, for the current assessment, forest survey data were used to index the amount of woodcock habitat in Maine. The habitat index underestimates the amount of woodcock habitat in the state; however, it may be useful for assessing trends in woodcock habitat over time. The habitat index used in the current assessment is similar to those used in previous assessments, the major difference being no wetland inventory data were included in the current index.

For the purpose of the current habitat assessment, Wildlife Management Districts (WMDs) were grouped into two regions, based on natural forest regions and land use

categories (MDIFW 1996). Wildlife Management Districts 1-2, 4, 5, 7-10, 14, 18, and 19 and Baxter State Park comprise the “Industrial Forest” region; WMDs 3, 6, 11-13, 15-17, and 20-30 constitute the “Forest-Agriculture-Residential” region (Figure 1). The Industrial Forest region is 96% forested, with large proportions of Spruce-Fir and Northern Hardwood cover types. The Forest-Agriculture-Residential region is 84% forested, with a more even distribution of forest types. Based on 1995 forest inventory statistics (Griffith and Alerich 1996, USFS 1997), approximately 4,180 square miles, or 13.5% of the State of Maine, is in cover types considered woodcock habitat (i.e., habitat index) (Table 2).

American Woodcock habitat data from 1995 were analyzed by Wildlife Management Unit (WMU; Figure 2) for comparison with 1982 data (Table 3; Appendices B and C). Forest cover type data from 1982 were adjusted for comparison to 1995 data by applying the percent area of each cover type in each WMU, to the standardized estimate of the area for each WMU.

The area of woodcock habitat estimated for Maine declined 18% during the decade prior to the 1985 woodcock assessment. Based on the woodcock habitat index (Table 3), the area of woodcock habitat increased approximately 40% from 1982 to 1995. All WMUs showed increases in woodcock habitat except WMU 8 (southern Maine), which declined in habitat area. Changes in habitat quality and carrying capacity, however, are less clear. Since 1982, there have been changes in species composition and age structure of the forest, and area of idle farmland (Figure 3; Appendices B and C) from which changes in habitat quality can be inferred. The increase in area of early successional hardwoods, particularly in the younger age

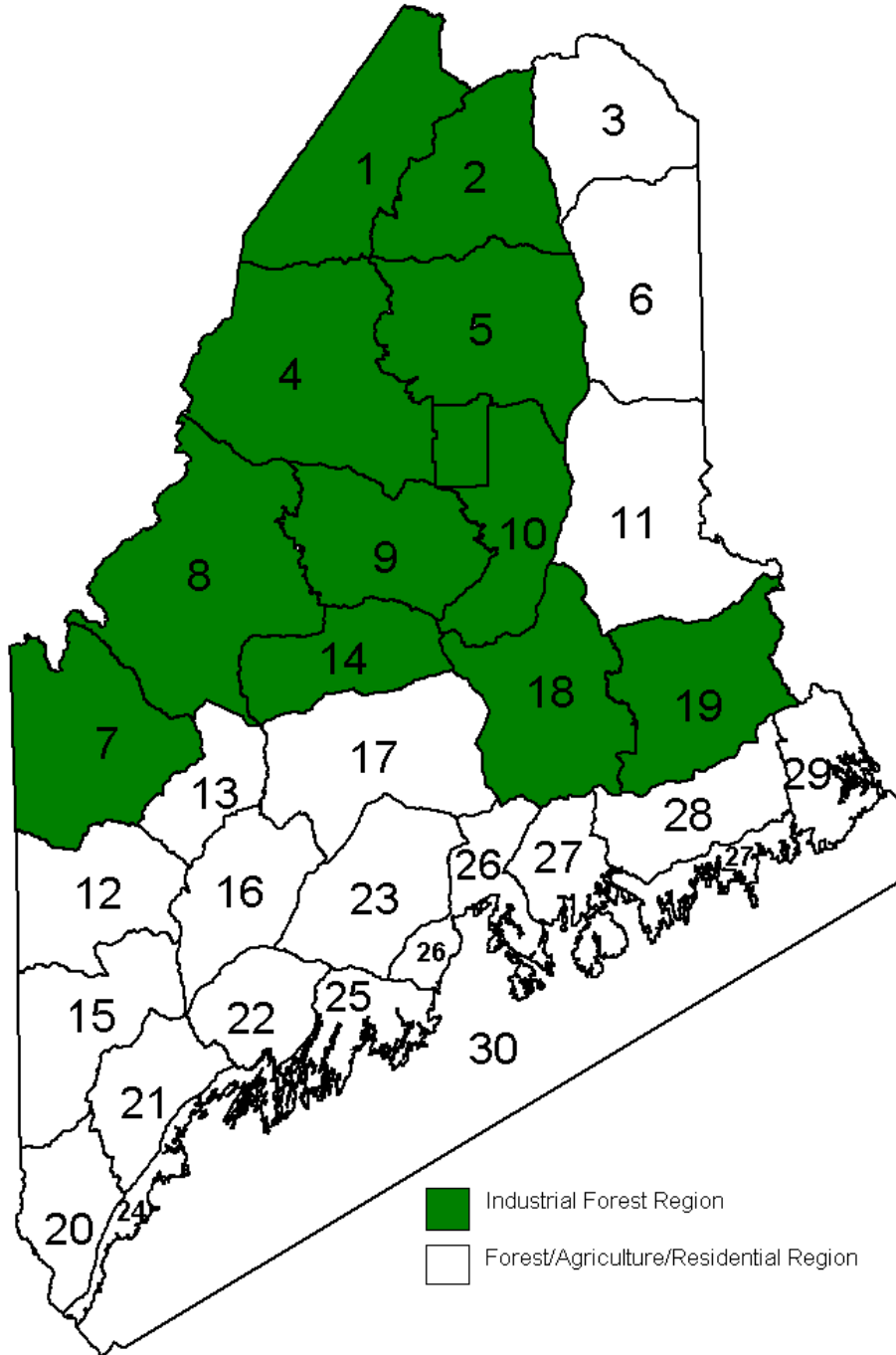


Figure 1. Maine Department of Inland Fisheries and Wildlife's Wildlife Management District (WMD) System.

Table 2. American Woodcock habitat^A by Wildlife Management District group, 1995.

Forest Type Group	Industrial Forest (WMDs 1-2, 4,5, 7-10,14, 18,19, and BSP) (mi ²) ^B	Forest/Agriculture /Residential (WMDs 3,6, 11-13, 15-17, 20-30) (mi ²) ^B	Statewide All WMDs (mi ²)
Aspen/birch			
sawtimber	144	109	253
pole timber	856	1,019	1,875
seedling/sapling	698	851	1,549
nonstocked	9	0	9
Elm/ash/red maple seedling/sapling	121	193	314
Idle farmland	58	122	180
Total area of woodcock habitat	1,886	2,294	4,180
Total land area	15,028	16,009	31,037

^AWoodcock habitat figures include aspen/birch (all size classes) and elm/ash (seedling/sapling) forest cover types, and idle farmland.

^BLand area estimated from standard estimate of land area used in MDIFW species assessments (Chilelli 1998a) and % land area by forest type from 1995 Maine forest survey (USFS 1997).

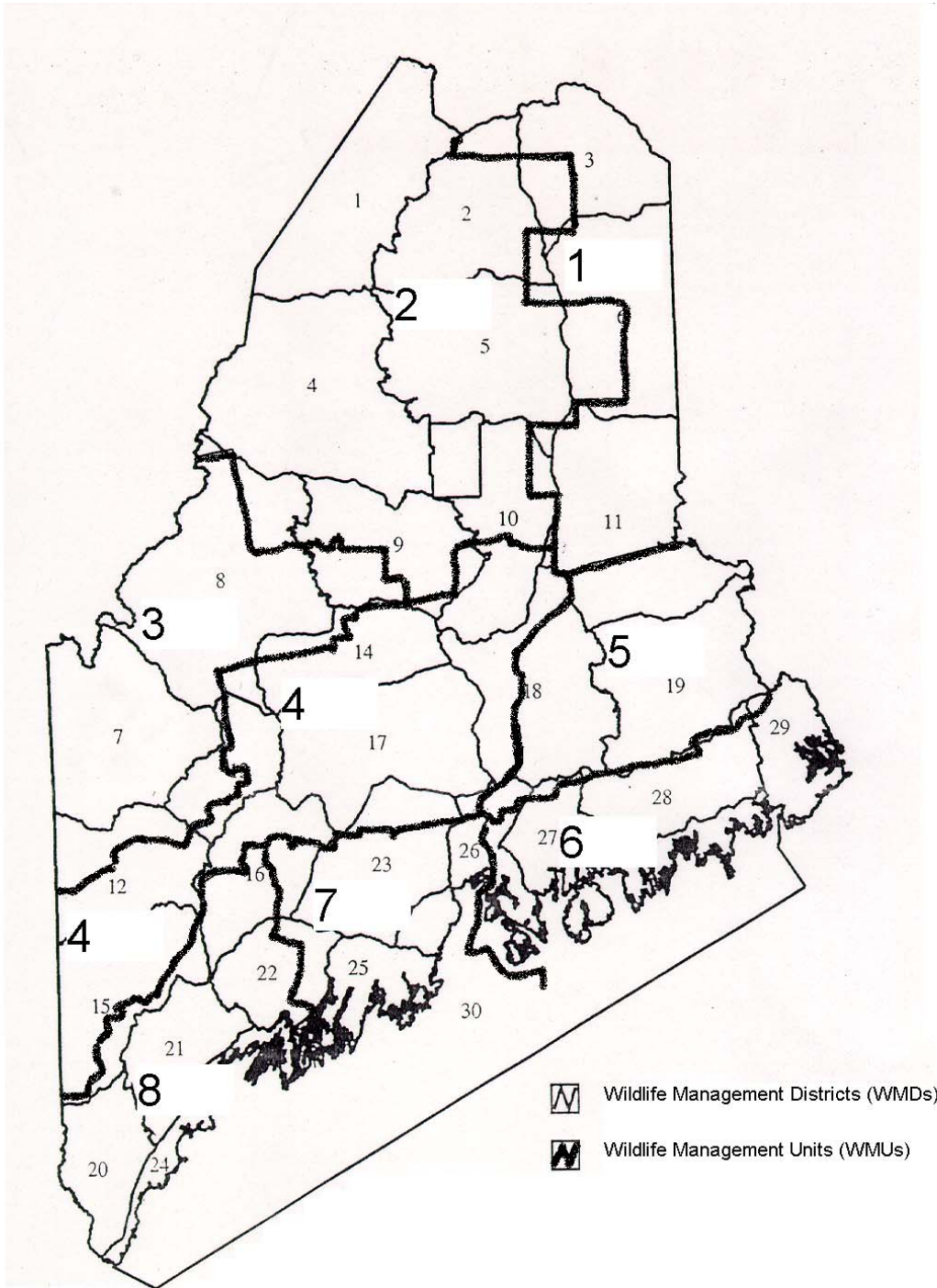


Figure 2. Comparison of Maine Department of Inland Fisheries and Wildlife's Wildlife Management Unit (WMU) and WMD Systems.

Table 3. American Woodcock habitat^A (mi²) by Wildlife Management Unit, 1982 and 1995.

Wildlife Management Unit	Total Area ^B	1982	1995
0	3,437	548	641
2	7,391	421	903
3	3,834	340	555
4	6,372	696	887
5	2,375	164	277
6	2,782	288	392
7	2,094	214	258
8	<u>2,540</u>	<u>248</u>	<u>224</u>
Statewide	30,825	2,919	4,137

^AWoodcock habitat figures include aspen/birch (all size classes) and elm/ash (seedling/sapling) forest cover types, and idle farmland.

^BLand area estimated from standard estimate of land area used in MDIFW species assessments (Chilelli 1998a) and % land area by forest type from 1982 and 1995 Maine forest survey (USFS 1982, 1997).

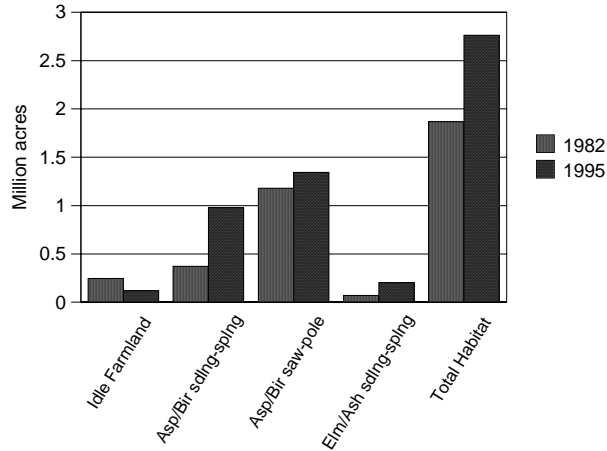


Figure 3. Estimated areas of woodcock habitat types in Maine from 1982 and 1995 forest inventories. Asp/Bir = Aspen/Birch group; Elm/Ash = Elm/Ash/Red Maple group; sdng-splng = seedling-sapling size class; saw-pole = sawtimber and pole timber size classes. Maine Forest Service data, Gadzik et al. 1998.

classes, likely has improved habitat suitability for woodcock since 1982. This positive indicator of habitat quality, however, is confounded by a concurrent decline of 52% in the area of idle farmland (Figure 3).

Area occupied by seedling/sapling stands (of all commercial types) has increased from 18% (3.0 million acres) of Maine's forests in 1982, to 25% (4.2 million acres) in 1995 (Gadzik et al. 1998). Much of this change to a younger forest is within spruce/fir types, but substantial changes in forest composition are a result of hardwood regeneration on sites recently harvested for spruce and fir. Further, recent strengthening of the hardwood pulp market has spurred harvest of older, overstocked, low quality hardwood stands. These stands are being replaced with younger, more vigorous growth that may have higher value as woodcock habitat. Annual harvests of hardwoods in Maine increased 20% from 1990 to 1996 (Gadzik et al. 1998).

Limitations to methods used to assess habitat quantity and quality in this and previous plans include: 1) a general lack of data quantifying the density relationships between American Woodcock and their habitats in Maine; 2) our inability to quantify suitable woodcock habitat at the landscape scale; and 3) the fact that woodcock are migratory, so trends in quantity and quality of habitat required during migration (e.g. in the Atlantic seaboard to the Appalachian Mountains) and in the wintering range may affect populations in Maine more than conditions of breeding habitat in the state.

Habitat Projections

Because of the preponderance of forest cover across Maine's landscape, the future carrying capacity of woodcock habitat will be largely affected by forestry practices. During the past 14 years, timber harvesting has occurred on 42% of commercial forest land in Maine (Griffith and Alerich 1996). Recent and future timber harvesting, and other forest management activities, will determine the species-age composition of the forest, and its value as woodcock habitat. However, future timber supplies are difficult to predict. Forecasts must incorporate growth and yield information, but changes in demand for species and size classes, and changes in harvest technology, add uncertainty to predictions; and the occurrence and effects of natural phenomena, such as spruce budworm outbreaks, drought, and wildfires, are even less predictable.

Demand for pulpwood and sawlogs in the Northeast is projected to increase at least through the next 15 years (Haynes et al. 1995). At current growth and harvest rates, harvest is expected to exceed net growth through 2015; however, total forest

acreages are expected to be stable through this period (Gadzick et al. 1998). This will likely result in shorter rotations, creating a younger forest, which generally benefits woodcock. Intensive management of forestland, including mechanical timber stand improvement operations, establishing conifer plantations, and use of herbicides to release softwood regeneration from competition with hardwoods, will likely increase (Gadzick et al. 1998). Although these intensive forest management practices may have a deleterious effect on woodcock habitat (Coulter and Baird 1982), currently only about 4% of timberland in Maine is affected (Gadzick et al. 1998); however, this could increase to 9% over the next 15 years.

Throughout most of the state, Spruce/Fir is likely to maintain a balanced age structure, but continue a relative decline in area as young stands of Northern Hardwoods continue to increase (Chilelli 1998b). The increase in young hardwood stands should result in improved habitat for American Woodcock.

From a commercial forestry perspective, Aspen/Birch stands currently have a well balanced age structure, with good distribution across the landscape. Although Aspen/Birch types constitute only 13% of Maine's forestland, they are one of the most important forest types for woodcock. Aspen/Birch forest types regenerate best after clear cutting, but use of clear cutting in Maine has declined from 23% of area harvested in 1990, to only 8% in 1996 (Maine Forest Service 1997). Therefore, there may be a decrease in young stands of this forest type, and a concomitant decline in quality of woodcock habitat, during the next 15 years if the declining trend in use of clear cutting continues (Chilelli 1998b). The effects of partial harvests on future woodcock habitat

are unclear, and will likely vary with harvest intensity, and composition of the residual stand.

Elm/Ash/Maple forest types, while comprising a small proportion of Maine's forest, is one of the fastest increasing groups. Projected increases in younger age classes of Elm/Ash/Maple should have a positive influence on woodcock habitat.

Commercial and residential development will likely continue to reduce area of woodcock habitat in Hancock and southern Penobscot Counties, the midcoast and Capitol regions, and southern Maine. Further, as many as 34% of small, non-industrial landowners in New England who own less than 50 acres, have no intention of ever harvesting timber (Birch 1996); as these small woodlots mature, they become less diverse in age classes and tend to become poorer habitat for woodcock. Maturing trends, particularly among Northern Hardwoods and Oak/Hickory forest types (Chilelli 1998b), are evident in residential areas of southern and midcoast Maine. Alternatively, increased demand for firewood will improve wildlife (including woodcock) habitat on some small ownerships in the future (Coulter and Baird 1982).

Widespread reversion of agricultural land to forests created large acreages of favorable woodcock habitat, particularly young aspen stands. In southern Maine, this trend has reversed and it is likely that young stands of alder and Aspen/Birch, and so carrying capacity for woodcock, will decline with the decrease in farm abandonment.

Habitat Projections by WMD Group

Carrying capacity of the industrial forest region may decrease slightly in the next 15 years if seedling/sapling stands of Aspen/Birch types decline substantially, despite

improvements in Northern Hardwood types, due to the disproportionate importance of Aspen/Birch as woodcock habitat. Therefore a 3% reduction in carrying capacity by 2015 is assumed for the industrial forest region.

Carrying capacity of the forest/agricultural/residential region will likely decrease in the next 15 years due to declines in young stands of Aspen/Birch types, maturing forests in southern Maine (particularly among Oak/Hickory and Northern Hardwoods types), and loss of habitat quantity and quality to commercial and residential development. For these reasons, a 5% reduction in carrying capacity by 2015 for this region is assumed.

POPULATION ASSESSMENT

Past Populations

Little data are available on the status of woodcock populations prior to the late 1960s. Information on woodcock numbers can be inferred from historical records and journals. This literature suggests that woodcock were abundant during the mid to late 1870s, which probably coincided with the beginning of the most active farming period in the State. Woodcock numbers probably reached an historic low at the beginning of the twentieth century. Uncontrolled hunting seemed to adversely affect woodcock numbers. According to Mendall and Aldous (1943), continuous market hunting during all seasons was an established custom over much of the birds' range. After bag limits were reduced and seasons were drastically shortened, the general declining trend in woodcock numbers was reversed. Interest in sport hunting subsequently increased.

Mendall and Aldous (1943) observed that by the late 1930s, woodcock were an abundant summer resident in eastern Maine. In Hancock and Washington Counties, woodcock populations approached or equaled the high density populations of the Maritime Provinces. Woodcock were also observed to be a common breeding bird throughout other areas of the state except in the extreme northern and western portions.

Efforts to monitor trends in the breeding populations of woodcock were initiated by Gustav A. Swanson and others in Maine in 1937 (Tautin et al. 1983). Rangewide population surveys were standardized between 1964-1970. In Maine, the Singing-ground Survey censuses courting male woodcock along approximately 50 randomly

selected 3.6 mile routes each spring. Cooperators count the number of calling (courting) male woodcock heard at each of 10 stops along each route. Since 1968, data on the average number of males heard per route from Singing-ground Surveys in Maine and elsewhere have been used as annual indices of breeding woodcock populations. Although these surveys do not yield population estimates, annual breeding indices have been useful to monitor trends in relative abundance of woodcock within states and across broader regions.

During 1968-2001, the woodcock breeding population index in the Eastern region declined at an annual rate of 2.3% (Kelley 2001; Figure 4). During the same period, the breeding population index for Maine declined 2.2% annually. In 1996, the breeding population indices of 1.63 for the Eastern region, and 2.33 for Maine, were the lowest since the survey began in 1968. Maine's index rebounded to 3.09 singing males/route in 1999; the breeding population index for Maine has remained relatively stable for the past decade, although the Eastern region population has declined 3.3% per year (Kelley 2001). The long term population decline is thought to be the result of habitat loss and degradation, on both the breeding and wintering grounds, caused by forest maturation and residential/commercial development (Dwyer et al. 1983, Owen 1977, Straw et al. 1994).

Whether Singing-ground Surveys adequately track populations is uncertain (Sauer and Bortner 1991). Singing-ground Surveys are not conducted over the southern breeding range of woodcock, and are incomplete on their northern range; thus they likely are inadequate for monitoring continental abundance of woodcock.

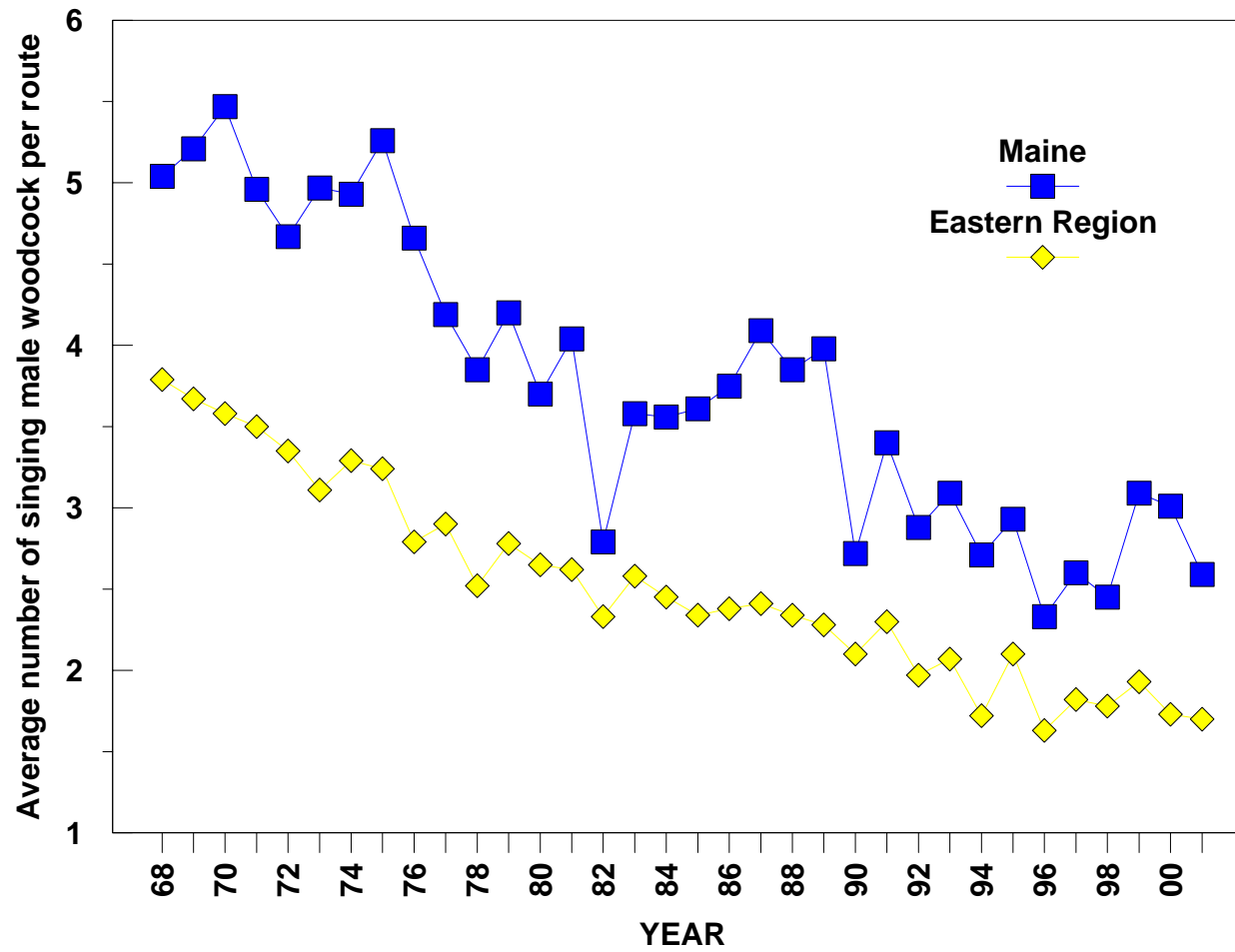


Figure 4. Breeding population index for American Woodcock, 1968-2001. USFWS data.

Further, survey routes were established along roads, but roads are not located randomly; therefore, some land cover types and land uses likely have been sampled disproportionately to their occurrence on the landscape. For example, residential and commercial development (and hence, woodcock population decline) are more prevalent along paved roads than in blocks of forest unfragmented by improved roads; Singing-ground Surveys along such routes may overstate the decline in woodcock abundance of such areas, and reduced detection due to traffic noise would depress counts further. In contrast, northern Maine, an area where breeding population indices have increased during the past decade, is underrepresented in Singing-ground Surveys; 12 of the 16 survey routes that were selected in the 1960s in northern WMDs 1, 2, 4, and 5, have never been run. Consequently, Maine's breeding population index trend may not be truly representative of the state, but likely is skewed by survey counts, and hence population dynamics and habitat trends, in central and southern parts of the state. Nevertheless, these surveys are the best population-level information available, and have produced a great deal of useful trend information on woodcock numbers.

Current Populations

Allen (1985) used estimates of woodcock habitat suitability (derived from 1982 forest inventory data and 1971 wetland inventory data; Powell and Dickson 1984), land area, woodcock density estimates (based on detection distance) from Singing-ground Surveys, and age and sex ratios from Wing-collection Surveys (Table 4, Figure 5), to estimate the statewide resident woodcock population (Appendix A, Table 5).

Table 4. American Woodcock harvest size¹ and composition by sex and age² in Maine, 1979-2000.

Year	Harvest ¹	Federal Wing Survey Samples						
		Adult ³ Males	(%)	Adult Females	(%)	Immatures	(%)	Immatures/ Adult Female
1979	142,700	310	(20)	431	(28)	810	(52)	1.9
1980	172,800	293	(18)	424	(27)	863	(55)	2.0
1981	164,200	299	(24)	299	(24)	619	(52)	2.0
1982	109,800	180	(18)	257	(25)	577	(57)	2.2
1983	107,600	240	(19)	336	(27)	665	(54)	2.0
1984		202	(18)	343	(31)	569	(51)	1.6
1985		159	(20)	261	(33)	368	(47)	1.4
1986		102	(18)	160	(28)	313	(54)	2.0
1987		195	(23)	245	(29)	410	(48)	1.7
1988	⁴ 75,609	142	(18)	231	(28)	436	(54)	1.9
1989		191	(26)	210	(29)	329	(45)	1.6
1990		121	(22)	148	(26)	290	(52)	2.0
1991		264	(23)	265	(23)	627	(54)	2.4
1992		185	(16)	366	(32)	588	(52)	1.6
1993		68	(20)	105	(31)	165	(49)	1.6
1994		151	(18)	259	(31)	428	(51)	1.7
1995		143	(17)	307	(36)	395	(47)	1.3
1996	⁵ 26,100	136	(19)	244	(34)	344	(47)	1.4
1997		160	(20)	227	(28)	414	(52)	1.8
1998	⁵ 35,600	⁶ 26	(19)	36	(26)	75	(55)	2.1
1999		189	(23)	276	(33)	365	(44)	1.3
2000		225	(24)	254	(27)	473	(50)	1.9
Total		3,730	20	5,430	29	9,650	51	1.7

¹Data source: MDIFW Game Kill Questionnaire (1979-83).

²Data source: federal wing-collection survey.

³Adult male to adult female ratio during 1979-99 = 0.7/1.0.

⁴Data source: Teisl et al. 1992.

⁵Data source: USFWS Harvest Information Program.

⁶Small sample size because wing envelopes were not delivered to Maine hunters in 1998

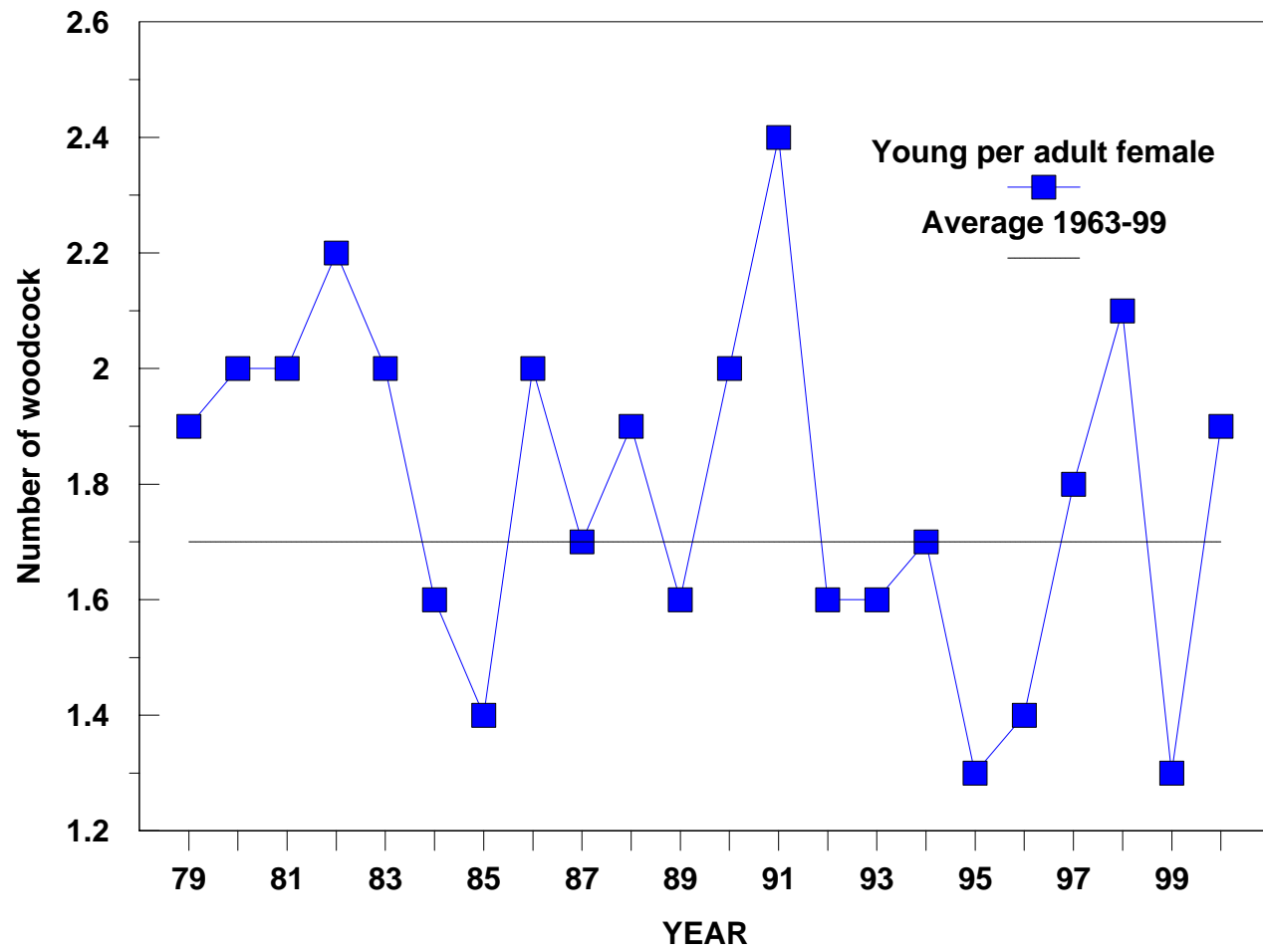


Figure 5. Recruitment index for American Woodcock in Maine, 1979-2000. USFWS data.

Table 5. Woodcock population estimates by Wildlife Management Unit, 1985 and 1995.

Wildlife Management Unit	1985 Estimated population*		1995 Estimated population**	
	Spring	Fall	Spring	Fall
1	72,500 - 97,700	154,500 - 211,200	114,436 - 154,213	243,868 - 333,365
2	42,700 - 56,500	91,500 - 123,600	31,179 - 41,256	66,812 - 90,251
3	11,400 - 16,700	25,100 - 36,500	4,054 - 5,939	8,926 - 12,980
4	104,900 - 132,500	226,300 - 287,000	115,855 - 146,337	249,933 - 316,972
5	13,700 - 20,200	30,200 - 44,000	16,755 - 24,705	36,935 - 53,813
6	94,700 - 129,600	204,300 - 284,100	81,402 - 111,401	175,611 - 244,205
7	46,500 - 62,700	99,100 - 135,500	24,809 - 33,452	52,872 - 72,292
8	40,300 - 59,000	88,600 - 128,800	25,664 - 37,573	56,423 - 82,024
Statewide	426,700 - 574,900	919,600 - 1,250,700	414,154 - 554,875	891,380 - 1,205,901

* 1985 estimates from 1985 Woodcock Assessment. Assumes 0.5-1.0 subdominant males per singing male; 0.7 males per female; and 1.0-2.0 immatures per adult female in fall population.

** 1995 estimates derived by applying proportional change in breeding population index between 1977-85 and 1993-97 within each WMU to the 1985 population estimate for each WMU.

Wing-collection Survey data show that more adult females than males are shot each year, because they are more abundant and/or more vulnerable to shooting. The adult male to adult female ratio typically is 0.7/1.0. The ratio of immatures to adult females in the harvest provides a retrospective index of the reproductive success of the previous nesting season. In Maine, the average annual production index is 1.7 immatures per adult female.

For purposes of comparing 1995 and 1982 populations, current (1995) statewide population estimates were derived by applying the proportional change in statewide breeding population index between 1977-85 and 1993-97 in each WMU to the 1985 population estimate for each WMU (Table 5; Appendix E). Mean index values of a number of years (1977-85 and 1993-97) were used to dampen the effects that an unusually high or low annual index would have on the population estimate.

The current estimates of total woodcock are 3% less than the 1985 estimates. Woodcock numbers in southern, coastal, and western mountain areas (WMUs 3, 7, and 8) showed the most decline, while woodcock increased in WMUs 1, 4, and 5. However, the woodcock habitat quantity index (Table 3) has increased during 1982-1995, indicating one or more of the following: 1) the estimates of population and habitat are too imprecise to indicate any differences that may actually exist; 2) the habitat index inadequately measures woodcock habitat quantity and quality; 3) declines (unmeasured) in habitat quality were more important than any increases in habitat quantity; 4) the method used to estimate population is inaccurate; 5) the woodcock population varies, across the state, in relation to habitat carrying capacity (i.e., suitable habitat along some survey routes is unoccupied by woodcock).

The imprecision of the spring population estimate, as well as the imprecision of the 1996-2001 population objective, make it unclear whether the objective of increasing spring woodcock numbers has been met. Recent breeding population indices (Figure 4) indicate that Maine's spring woodcock population during 1996-2001 has at least stabilized, if not increased.

The proportion of the statewide population within each WMD group was estimated from habitat area and Singing-ground Survey data within each WMD group (Table 6). Fifty-seven percent of the estimated 1995 spring woodcock population (414,154 - 554,875 birds) occurred in the Forest/Agriculture/Residential WMD group, which has the greater woodcock habitat index (Table 2), as well as a greater breeding population index (3.22 singing males per route), than the Industrial Forest WMD group (population index = 3.00). The resident fall (pre-hunting season) population was estimated to range between 891,380 - 1,205,901 birds.

Population Projections

Projections of habitat conditions (a 3% reduction in habitat quality in the Industrial Forest WMD group, and a 5% reduction in habitat quality in the Forest/Agriculture/Residential WMD group) were used to calculate spring and fall populations in 2015 (Table 7). Maine's 2015 spring woodcock population is projected to

Table 6. Estimated current (1995) spring and fall woodcock populations by WMD Group.

Wildlife Management District Group	Estimate of 1995 Woodcock Population ¹			
	Spring ² Range		Fall ³ Range	
Industrial Forest (WMDs 0-2, 4,5,7-10,14, 18,19)	178,086	238,596	383,293	518,537
Forest/Agriculture /Residential (WMDs 3,6, 11-13,15-17, 20-30)	236,068	316,279	508,087	687,364
Statewide	414,154	554,875	891,380	1,205,901

¹1995 statewide estimates were derived by applying proportional change in statewide breeding population index between 1977-85 and 1993-97 to the 1985 population estimate (Allen 1985). Proportion of statewide population within each WMD group was estimated from habitat area and Singing Ground Survey data within each WMD group.

² Assumes 0.5-1.0 subdominant males per singing male; and 0.7 males per female.

³ Assumes 1.0-2.0 immatures per adult female in fall population.

Table 7. Projected (2015) spring and fall woodcock populations by WMD Group.

Wildlife Management District Group	Estimate of 2015 Woodcock Population ¹			
	Spring ² Range		Fall ³ Range	
Industrial Forest (WMDs 0-2, 4,5,7-10,14, 18,19)	172,743	231,438	371,794	502,981
Forest/Agriculture /Residential (WMDs 3,6, 11-13,15-17, 20-30)	224,265	300,465	482,683	652,996
Statewide	397,008	531,903	854,477	1,155,977

¹2015 population projections assume reductions in carrying capacity from 1995 of 3% in the Industrial Forest WMD group, and 5% in the Forest/Agriculture/Residential WMD group.

² Assumes 0.5-1.0 subdominant males per singing male; and 0.7 males per female.

³ Assumes 1.0-2.0 immatures per adult female in fall population.

range between 397,000 - 531,900, and the estimated fall woodcock population for 2015 is projected to range between 854,477 - 1,155,977 birds.

Differing land uses over the next 15 years will result in changes in habitat conditions for woodcock between, as well as within, WMD groups. Although woodcock seem fairly tolerant of human activity, woodcock habitat and population will continue to be lost to residential and industrial development, and the downward trend in reverting agricultural land; this trend will continue to be most evident in the rapidly developing southern, coastal, and Capitol portions of the Forest/Agriculture/Residential WMD group.

Intensive forest management (clear-cutting, heavy partial harvests, and fuel wood harvesting), and the increasing harvest of early successional hardwoods may create favorable habitat for woodcock in some areas of the state. These land uses may offset deteriorating habitat conditions on previously abandoned farmland. Conditions for breeding woodcock may be improving in northern portions of both WMD groups (WMDs 1-6, 9-11, 19), as the number of singing male woodcock censused in recent years in these areas has increased. As Keppie et al. (1984) pointed out, woodcock densities may be low, but, because of the extent of the boreal forest across the northern edge of the woodcock's breeding range, significant numbers of woodcock may be produced.

Our population projections are based on projections of woodcock habitat conditions. However, the effects of habitat trends on population size are difficult to quantify, as we do not know the level of the current population relative to carrying capacity of the habitat. Habitat trends on migration stopover sites and on the wintering range further complicate woodcock population projections. Trends in woodcock

numbers will likely be downward in certain areas of the state and be stable or improve slightly in others. Periodic fluctuations will occur annually, depending on weather and habitat conditions.

Limiting Factors

Limiting factors for American Woodcock may include quantity and quality of habitat; egg and chick mortality caused by influences of weather and predation; and adult mortality due to influences of weather and predation, including hunter harvest.

Habitat quality and quantity can limit woodcock on the breeding range, migration stopovers, and wintering range. Hence, Maine's woodcock population could be limited not only by sprawling residential development in Maine, but also by degradation or loss of habitat needed, for example, during migration in New Jersey or Virginia, or by loss of wintering habitat in Georgia. Temporary adverse effects on habitat quantity and quality may result from maturation of forest, managing for softwoods at the expense of early successional hardwoods, and conversion of forest habitat to other uses (e.g., Christmas tree plantations, agricultural development). Losses of forest habitat converted to residential or commercial uses (e.g., shopping malls, urban sprawl) can be considered permanent.

Adverse weather conditions can cause mortality of adult as well as juvenile woodcock, via exposure, starvation, or increased susceptibility to predation, or can impair adults' reproductive success. Late season snow storms can cause mortality of, or can delay breeding by, early-arriving adults in northern latitudes. Protracted periods of cold, wet weather during May and June can cause increased mortality among eggs

and chicks. Summer drought can slow growth rates or cause starvation among immature woodcock.

Predation accounts for the majority of deaths of immature (Wiley and Causey 1987) and adult woodcock (Derleth and Sepik 1990, McAuley et al. 2001), and was the greatest single cause of nest failure in Maine (Mendall and Aldous 1943). While the effects of market gunning during the late 1800s were grave for woodcock and other wildlife species, the role of modern sport hunting in regulating American Woodcock populations seems less important, undoubtedly varying with local hunting pressure. A recent 3-year study on the effects of hunting on survival of woodcock on breeding and migration areas in Maine, New Hampshire, Vermont, and Pennsylvania, by MDIFW and collaborators (McAuley et al. 2001), found that radio-marked woodcock (n=428) on 4 study areas open to hunting experienced similar survival rates as radio-marked woodcock (n=343) on 3 study sites where hunting was not permitted; predation caused the majority of deaths on all study areas. MDIFW and collaborators plan to study the cumulative effects of hunting on survival during migration, beginning September 2001.

USE AND DEMAND

Past and Current Use and Demand

Mendall and Aldous (1943) reported the earliest annual estimates of harvest for Maine as 37,000 during the period 1935 - 1939. Through the 1950s, an average of 4,200 hunters killed roughly 20,000 birds annually. In the 1960s, 12,500 hunters annually killed over 52,000 woodcock (Table 1).

Maine's woodcock harvest peaked in 1973, when an estimated 37,000 hunters killed over 210,000 birds (Table 1). The increase in woodcock harvest is believed to have been largely due to increased participation in woodcock hunting, not increased success rate. Soon after this record kill, the first Department Woodcock Species Management Plan was completed. This plan concluded that local breeding stocks in southern WMUs were sustaining maximum harvests. Krohn and Clark (1977) conservatively estimated that over 60% of the harvest of local woodcock occurred within Maine. In actuality, this percentage is likely higher, as band reporting rates generally are lower near areas of extensive banding. Regulations proposed by the Department since 1975 were aimed at reducing the early season hunting pressure on these local breeding populations. Since that time, the annual woodcock harvest has declined, probably because of a decrease in woodcock numbers, hunting effort, and hunting opportunity.

Between 1979 and 1981, Maine woodcock hunters enjoyed liberal hunting seasons that included the last week of September through the middle or end of November (Table 1). Harvests during this 3-year period averaged over 159,000 birds.

In 1982, the USFWS imposed restrictions on the season in Maine and other northeastern states where woodcock populations were adversely affected by a severe spring blizzard; the season in Maine did not open until 5 October.

During 1980 to 1983, 24,000 hunters killed 138,500 birds per year (Table 1). From 1983 through 1985, a 1 October opening date was established in an effort to stem declines of woodcock populations in the East. Nonresident hunters consistently comprised slightly less than 20% of the estimated total number of woodcock hunters in Maine.

A 1988 survey of upland bird hunters (Teisl et al. 1992), and the USFWS's HIP surveys from 1996 and 1998, are the only sources of information on statewide woodcock hunter participation and harvest since 1983. In 1988, 17,546 (8%) of the 222,322 individuals who held Maine hunting licenses hunted woodcock; only 8% of this total were nonresidents. An estimated 75,609 woodcock were killed (Teisl et al. 1992). In 1996, USFWS (via HIP surveys) estimated that 8,300 ($\pm 46\%$) hunters killed 26,100 ($\pm 78\%$) woodcock; in 1998, 9,200 ($\pm 42\%$) hunters killed 35,600 ($\pm 72\%$) woodcock. Woodcock harvests and hunter numbers may have declined in recent years; however Teisl et al. (1992) and USFWS HIP data are not comparable, as their methods differed.

Woodcock hunter harvest success, population sex and age structure, and recruitment data of woodcock harvested in Maine are collected through the USFWS's Wing-collection Survey. A sample of hunters are asked to send the USFWS one wing from each woodcock they kill. The USFWS coordinates an annual "wing bee", a gathering of state, federal, and nongovernmental organization biologists who determine

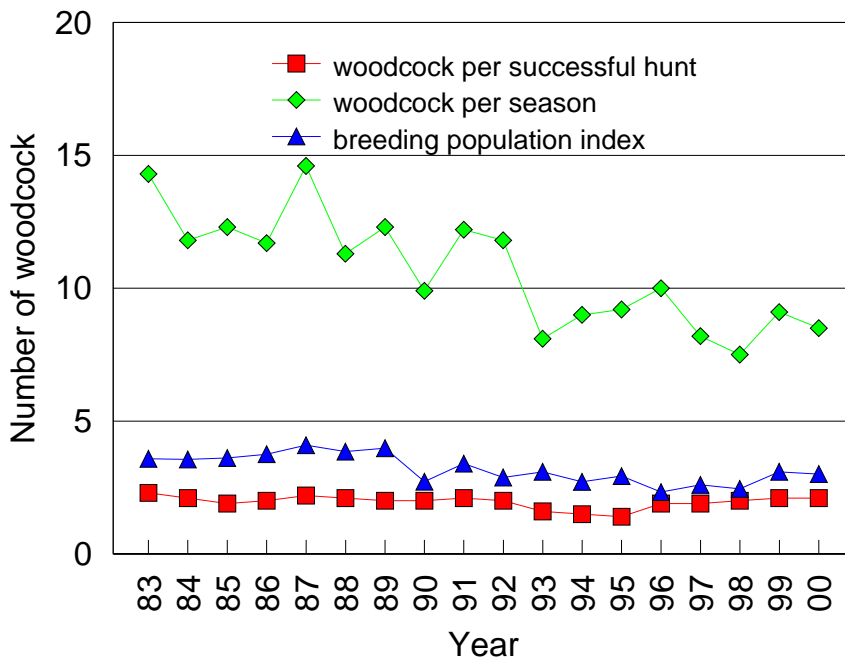


Figure 6. American Woodcock hunter harvest success and American Woodcock breeding population index, Maine, 1983-2000. USFWS data.

the age and sex of this sample of hunter-killed woodcock wings. These data are derived from a yearly sample of roughly 1,300 wings.

Data from the Wing-collection Survey show an erosion of seasonal woodcock hunting success during the past decade, from about 12 to 7.5 birds per season (Figure 6). During the same period, the daily success index has remained stable at approximately 2 birds per successful hunt. Maine woodcock hunters either are having more unsuccessful hunts, or are hunting fewer days per season.

A 1988 survey of upland bird hunters provided information on hunting activity, success, hunting methods, satisfaction levels, and opinions associated with hunting woodcock in Maine (Teisl et al. 1992; Tables 8, 9, and 10). During the 1988 woodcock season, 17,546 hunters spent 103,801 days in pursuit of American Woodcock;

residents averaged 6 days of hunting compared to 5 days for nonresidents, but nonresidents hunted an average of 1 hour longer per day (Table 8).

Woodcock hunters in Maine can generally be subdivided into 2 groups: hunters who use dogs, and hunters who walk to flush birds. Both groups generally hunt woodcock and Ruffed Grouse simultaneously. Residents were equally likely to hunt with a dog as without one; only one-third of nonresidents hunted woodcock without dogs, and over half of nonresident woodcock hunters brought their own gun dogs to use (Table 9). Nonresidents hunted more successfully, bagging 7 birds per season to the residents' average of four (Table 8); nonresidents averaged 3.6 hours of hunting per woodcock killed, whereas residents hunted 6.0 hours for each bird in the bag. In 1988, 53% of residents rated the woodcock hunt as "fair" or "poor", while 68% of nonresidents expressed higher satisfaction with the hunt, generally evaluating their experiences as "good" to "perfect".

The majority of hunters (65% of residents and 69% of nonresidents) felt the length of the 1988 woodcock season (1 October to 15 November) was okay (Table 10); there was also general agreement that the bag limit of 3 woodcock per day was adequate. More than one-third of hunters felt hunting pressure had increased since 3 years earlier. Opinion was split on the subject of a special permit for woodcock hunting: over half of residents opposed the idea, while nonresidents were nearly equally divided.

American Woodcock have substantial nongame value. Birders, including bird hunters, enjoy watching woodcock during spring courtship displays, and many nature watchers listen on spring evenings for the distinctive "peent" and the whistling sound of woodcock wings in flight.

Table 8. Hunter effort, success, and evaluation of the 1988 Maine woodcock hunt.

	Residents	Nonresidents	Total
Number of Hunters	16,071	1,475	17,546
Average Number of Days Hunting Per Hunter	6	5	
Average Hours Hunting Per Day Per Hunter	4	5	
Total Number of Days Hunting	96,426	7,375	103,801
Hours Hunting	385,704	36,875	422,579
Average Number of Birds Bagged Per Hunter	4	7	4.3
Hours Hunted Per Bird Bagged	6	3.6	5.6
Total Number of Birds Bagged	64,284	10,325	75,609
Hunters' Evaluation of the Hunt			
Poor	13%	16%	
Fair	40%	16%	
Good	27%	37%	
Very Good	20%	16%	
Excellent	0	5%	
Perfect	0	11%	
Average Response	Good	Good	

Data from: Teisl et al. 1992.

Table 9. Hunting methods used during the 1988 Maine upland bird hunting season.

Methods Used to Hunt Grouse	Resident	Nonresident
Walked Through Woods	84%	77%
Drove Slowly Down Gravel Roads	61%	33%
Walked Gravel Roads	59%	60%
Walked Through Fields	42%	26%
Hunted with My Dog	14%	29%
Hunted with Someone Else's Dog	8%	23%
Other	9%	2%
Methods Used to Hunt Woodcock		
Hunted with My Dog	21%	53%
Hunted with Someone Else's Dog	36%	37%
Did Not Hunt with a Dog	50%	32%

Data from: Teisl et al. 1992.

Table 10. Woodcock hunters opinions regarding select woodcock management issues related to the 1988 Maine upland bird hunting season.

	Resident	Nonresident
Length of 1988 Woodcock Season		
Too Short	22%	8%
Okay	65%	69%
Too Long	5%	13%
No Opinion	8%	10%
Daily Bag Limit		
Too Low	14%	23%
Okay	70%	56%
Too High	8%	10%
No Opinion	8%	10%
Hunting Pressure on Woodcock Since 1985		
Increased	38%	33%
No Change	19%	31%
Decreased	5%	3%
Do Not Know	38%	33%
Support for a Woodcock Hunting Permit		
Favor	35%	45%
Undecided	11%	13%
Opposed	54%	42%

Data from: Teisl et al. 1992.

Use and Demand Projections

The number of woodcock hunters will likely remain stable or decline slightly through the next planning period. The nonconsumptive use of woodcock may increase with the growth of bird watching.

Opportunity for both hunting and watching of woodcock will likely decline in areas of the state experiencing more commercial and residential development, due to habitat loss, fragmentation, and degradation associated with development, and posting of land against trespass. Opportunity for seeking woodcock throughout the industrial forest region will likely remain unchanged through 2015.

SUMMARY AND CONCLUSIONS

The American Woodcock has long been a popular game bird in Maine. Although classified as shorebirds, woodcock have habits approaching that of upland game birds. Woodcock occur in the forests of eastern North America; in Maine, young to middle-aged early successional hardwoods, associated with abandoned fields or forest openings on moist, loamy soils, provide optimum habitat conditions. Woodcock migrate between northern breeding and southern wintering grounds. Woodcock that nest or are hatched in Maine winter east of the Appalachian Mountains, primarily from southern New Jersey through Georgia. Maine's pre-hunting season population for 1995 was estimated at approximately 891,380 - 1,205,900 birds, which did not include migrant birds from Canada.

Historical records reveal that woodcock habitat, and presumably the number of woodcock as well, were abundant in the mid to late 1800s, when small farms were numerous in Maine. Since these earlier times, millions of acres of farmland have reverted to forestland, and large gains and losses in woodcock habitat have occurred in the twentieth century.

Woodcock numbers presumably fluctuated in accordance with habitat over this time period. Uncontrolled hunting in the past adversely affected woodcock numbers; when market hunting was abolished, and seasons and bag limits were imposed, woodcock numbers increased. With refinement of population surveys in the 1960s came the knowledge that woodcock were more widespread and abundant than previously thought.

In the 1960s and continuing through the 1970s, regulations were gradually liberalized to allow greater opportunity to harvest woodcock; woodcock became an increasingly popular game bird over its entire range, with the greatest growth of hunting interest occurring in southern states. As interest in woodcock hunting grew, harvests increased, peaking in Maine in 1973, when 37,000 hunters killed over 210,000 birds. Unfortunately, this increase in hunting pressure came at a time when woodcock habitat in the Eastern region was being lost to development and forest succession, and woodcock numbers were declining.

In 1982, the USFWS restricted woodcock hunting regulations in the Northeast in response to predicted adverse effects on the woodcock breeding population following a spring blizzard. In 1985, the USFWS further restricted hunting regulations for eastern states by shortening the season from a maximum of 65 days to no more than 45, eliminating September and February hunting, and cutting the bag limit from 5 to 3 birds per day. Since 1997, woodcock hunting seasons in the Eastern region have been limited to 30 days, starting no earlier than 6 October.

During 1968-2000, the woodcock breeding population index in the Eastern region declined at an annual rate of 2.3%, while the breeding population index for Maine declined 2.2% annually. The average recruitment index has remained at 1.7 immatures per adult female during this period, and recent research in Maine and elsewhere in the Northeast has refuted concerns that moderate hunting pressure on the breeding range is depressing populations. Degradation and loss of habitat, caused by forest maturation and changing land use, are thought to be the reasons for the population decline.

Since the mid 1970s, woodcock hunter participation and harvests appear to have declined. In 1988, 17,546 hunters killed 75,609 woodcock, and the most recent HIP data indicate 9,200 (\pm 42%) hunters killed 35,600 (\pm 72%) woodcock in 1998. Wing-collection Survey data show an erosion of seasonal woodcock hunting success during the past decade, from about 12 to 7.5 birds per season, while the daily success index has remained stable at approximately 2 birds per successful hunt; Maine woodcock hunters either are having more unsuccessful hunts, or are hunting fewer days per season. Nonresident hunters, who consistently comprised approximately 20% of the estimated number of woodcock hunters in the State through 1983, made up only 8% of Maine woodcock hunters in 1988.

Woodcock habitat, although fairly easy to identify, is relatively short-lived and is not well represented in standard forest inventories. Maine's habitat index increased since 1982 in all parts of the state except in southern Maine, where it decreased. However, the estimated statewide resident woodcock population decreased slightly, indicating one or more of the following: 1) the estimates of population and habitat are too imprecise to indicate any differences that may actually exist; 2) the habitat index inadequately indexes woodcock habitat quantity and quality; 3) declines (unmeasured) in habitat quality were more important than any increases in habitat quantity; 4) the method used to estimate population is inadequate; 5) the woodcock population varies, across the state, in relation to habitat carrying capacity (i.e., suitable habitat along some survey routes is unoccupied by woodcock).

Because woodcock depend on early successional habitats, the future trend in woodcock habitat will be tied closely to land uses that create or degrade such habitat,

such as commercial or residential development, forestry practices, and farm land abandonment. Increased demand for wood (by both the paper and lumber industry) is expected to continue, and harvest is expected to exceed net growth through 2015. However, benefits derived from more intensive forest management may be offset somewhat throughout the state by losses of abandoned agricultural land to development, and overmaturation of forests. Habitat (current or potential) lost to development can be considered permanently lost. Woodcock habitat lost to forest succession can be manipulated and returned to suitable woodcock habitat in a relatively short period of time. The only large scale habitat alteration that appears to be improving conditions for woodcock is intensive forest cutting in the form of clear cutting or heavy partial harvests. Despite limitations in the projections of future habitat and population trends, reductions in habitat suitability (quality) for woodcock of 5% in the Forest/Agriculture/Residential WMD group, and 3% in the Industrial Forest WMD group, are assumed by 2015, with parallel declines in the woodcock population. Future use opportunity likely will decrease in the more densely populated parts of the state, and will likely fail to satisfy demand in local areas where traditional coverts no longer support woodcock or provide access to users (i.e. hunters and birders). Future trends in hunter characteristics, success rates, and demand will likely parallel trends of recent times. While no significant statewide increase in demand to hunt woodcock is expected for the duration of this planning period, use opportunity may decrease if access to woodcock habitat is restricted.

This assessment draws heavily on results of published and unpublished research on American Woodcock from Maine and elsewhere in its range, annual Singing-ground

and Wing-collection Surveys, and from Maine forest inventory data. An accurate assessment of Maine's woodcock population is limited by: 1) an inability to effectively quantify woodcock habitats; 2) a lack of information regarding woodcock abundance levels in relation to habitat type in Maine; and 3) a lack of consistent, accurate information regarding hunting pressure and harvest of woodcock in Maine. A conservative approach to harvest management of Maine's woodcock population has been employed, for several reasons: 1) the reproductive potential of the species is low, so recovery from overharvest is difficult; 2) this species is a migratory animal that is subject to hunting pressure and habitat alteration along its entire migration route and in wintering areas; and 3) the reliability of surveys designed to measure the status of woodcock populations remains questionable.

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Table 1. Woodcock species management history.

Year	Estimated Harvest	Estimated Effort	Statutes and Regulations Season	Bag Limit
1930's	37,000	?	≈1 Oct - 31 Oct	4
1940's	?	?	≈ 1 Oct - 30 Oct*	4
1950's	20,800	4,200	≈ 1 Oct - 9 Nov	4
1960	33,300	9,100	1 Oct - 9 Nov	4
1961	32,100	8,300	2 Oct - 10 Nov	4
1962	38,100	9,200	1 Oct - 9 Nov	4
1963	31,000	8,900	1 Oct - 19 Nov	5
1964	43,800	10,500	28 Sept - 10 Nov	5
1965	46,700	10,500	27 Sept - 15 Nov	5
1966	74,900	19,100	26 Sept - 15 Nov	5
1967	65,300	13,600	25 Sept - 15 Nov	5
1968	91,900	15,600	24 Sept - 15 Nov	5
1969	68,600	17,700	24 Sept - 15 Nov	5
1970	81,500	19,300	1 Oct - 30 Nov	5
1971	94,300	25,300	24 Sept - 15 Nov	5
1972	174,900	28,900	25 Sept - 15 Nov/ 2 Oct - 15 Nov	5
1973	210,700	37,300	24 Sept - 15 Nov/ 1 Oct - 15 Nov	5
1974	164,000	30,300	23 Sept - 15 Nov	5
1975	110,300	28,300	24 Sept - 15 Nov/ 1 Oct - 15 Nov	5
1976	151,300	28,200	24 Sept - 27 Nov/ 1 Oct - 27 Nov	5/4
1977	133,700	27,000	24 Sept - 15 Nov	5
1978	99,200	23,000	2 Oct - 15 Nov	5
1979	142,700	27,400	24 Sept - 15 Nov	5

Appendix A. Tables 1-10, 1985 Assessment.

198 0	172,800	27,000	24 Sept - 28 Nov	5
198 1	164,200	31,600	25 Sept - 28 Nov	5
198 2	109,800	25,400	5 Oct - 8 Dec	5
198 3	107,600	24,200	1 Oct - 30 Nov	5
198 4	?	?	1 Oct - 30 Nov	5
198 5	?	?	1 Oct - 14 Nov	3

*1940-47: 15 day seasons.

Table 2. Comparison of woodcock harvest and the midpoint of the woodcock species plan objective harvest, 1975-1983.

Year	Objective Harvest	Harvest	Deviation (%)
1975	150,000 - 180,000	110,300	-33
1976	165,000	151,300	-8
1977	"	133,700	-19
1978	"	99,200	-40
1979	"	142,700	-13
1980	"	172,800	+5
1981	"	164,200	-1
1982	"	109,800	-33
1983	"	107,800	-35

- = Under-objective harvest.

+ = Over-objective harvest.

Table 3. Present woodcock habitat suitability - 1985.

Wildlife Management Unit	Total land area (mi ²)	Estimated woodcock habitat (mi ²)	Woodcock habitat suitability index value	Number of woodcock habitat units
1	3,152	537	0.64	2,017
2	8,004	274	0.61	977
3	3,954	139	0.51	556
4	5,519	694	0.73	4,029
5	2,727	125	0.50	486
6	2,492	318	0.53	1,321
7	2,022	230	0.64	1,294
8	2,684	280	0.47	1,261
Statewide	30,554	2,597		11,941

*Woodcock habitat units equal total land area times the habitat suitability index value for WMU's 1, 4, 6, 7, and 8. However, because much of WMU's 2, 3, and 5 is heavily forested and therefore less desirable to woodcock, the above relationship would grossly overestimate the number of habitat units in these regions of the State. The number of habitat units in WMU's 2, 3, and 5 were derived by establishing a ratio of habitat (mi²) and HSI values with those of the nearest WMU.

Table 4. Projected woodcock habitat suitability, 1990.

Wildlife Management Unit	Total Land Area ¹	Woodcock Habitat (mi ²) ¹	Woodcock Habitat Suitability Index Value ²	Number of Woodcock Habitat Units ³
1	2,994	510	0.60	1,796
2	7,604	260	0.58	868
3	3,756	132	0.48	503
4	5,243	659	0.69	3,618
5	2,591	119	0.47	434
6	2,367	302	0.50	1,184
7	1,921	219	0.60	1,153
8	2,550	266	0.44	1,122
Statewide	29,026	2,467		10,678

¹Total land area and woodcock habitat is 95% of 1985 figures. This hypothetical adjustment reflects a loss in the quantity of woodcock habitat by 1990 and does not represent an actual loss of land.

²Woodcock habitat suitability is 95% of 1985 figures. This adjustment reflects a loss in habitat quality by 1990.

³Woodcock habitat units for WMU's 2, 3, and 5 were derived using the procedure described for Table 3, page 13.

Appendix A. Tables 1-10, 1985 Assessment.

Table 5. Current (1985) and projected (1990) maximum supportable spring woodcock population by WMU.

Wildlife Management Unit	1985 Maximum Supportable Spring Population		1990 Projected Maximum Supportable Spring Population	
	Range	Best Guess	Range	Best Guess
1	48,400 - 123,000	98,800	43,100 - 109,600	88,000
2	23,400 - 59,600	47,900	20,800 - 52,900	42,500
3	13,300 - 33,900	27,200	12,100 - 30,700	24,600
4	96,700 - 245,800	197,400	86,800 - 220,700	177,300
5	11,700 - 29,600	23,800	10,400 - 26,500	21,300
6	31,700 - 80,600	64,700	28,400 - 72,200	58,000
7	31,100 - 78,900	63,400	27,700 - 70,300	56,500
8	30,300 - 76,900	61,800	26,900 - 68,400	55,000
Statewide	286,600 - 728,300	585,000	256,200 - 651,300	523,200

Appendix A. Tables 1-10, 1985 Assessment.

Table 7. Recent harvest, effort, and success rates (5-year average 1979-1983).

Wildlife Management Unit	Allowable Harvest ¹	Harvest	Estimated Number of Hunters	Successful Hunters	Percent Successful	Hunters/mi ² of Grouse Habitat
1	23,200 - 31,700	4,100	1,100	850	76	2
2	13,700 - 18,500	1,600	600	450	75	2
3	3,800 - 5,600	109,00 ²	2,200	1,500	69	16
4	33,900 - 43,000	38,900	8,100	5,700	70	12
5	4,500 - 6,600	118,00 ²	2,100	1,500	70	18
6	30,600 - 42,600	31,000	3,600	2,700	76	11
7	14,800 - 20,300	17,400	4,700	3,000	64	20
8	13,300 - 19,300	23,400	7,300	4,500	62	26
Statewide	137,800 - 187,600	139,100	29,700	20,200	66	11

¹Allowable harvest is 15% of the estimated 1985 fall population.

²In WMU's 3 and 5, the harvest estimates are considerably larger than the estimated allowable harvest. It is not known whether an overharvest exists or whether harvests in these WMU's include a large number of birds produced in other WMU's or Canadian provinces.

Table 8. Woodcock harvest size¹ and composition by sex and age², 1979-1999.

Year	Harvest ¹	Federal Wing Survey Samples						
		Adult ³ Males	(%)	Adult Females	(%)	Immatures	(%)	Immatures/ Adult Female
1979	142,700	310	(20)	431	(28)	810	(52)	1.9
1980	172,800	293	(18)	424	(27)	863	(55)	2.0
1981	164,200	299	(24)	299	(24)	619	(52)	2.0
1982	109,800	180	(18)	257	(25)	577	(57)	2.2
1983	107,600	240	(19)	336	(27)	665	(54)	2.0
1984	----	202	(18)	343	(31)	569	(51)	1.6
1985		159	(20)	261	(33)	368	(47)	1.4
1986		102	(18)	160	(28)	313	(54)	2.0
1987		195	(23)	245	(29)	410	(48)	1.7
1988	⁴ 75,609	142	(18)	231	(28)	436	(54)	1.9
1989		191	(26)	210	(29)	329	(45)	1.6
1990		121	(22)	148	(26)	290	(52)	2.0
1991		264	(23)	265	(23)	627	(54)	2.4
1992		185	(16)	366	(32)	588	(52)	1.6
1993		68	(20)	105	(31)	165	(49)	1.6
1994		151	(18)	259	(31)	428	(51)	1.7
1995		143	(17)	307	(36)	395	(47)	1.3
1996		136	(19)	244	(34)	344	(47)	1.4
1997		160	(20)	227	(28)	414	(52)	1.8
1998		26	(19)	36	(26)	75	(55)	2.1
1999		189	(23)	276	(33)	365	(44)	1.3
Total		3,756	20	5,430	29	9,650	51	1.7

¹Data source: game kill questionnaire (1979-83).

²Data source: federal wing-collection survey (Tautin 1979-85).

³Adult male to adult female ratio during 1979-99 = 0.7/1.0.

⁴Data source: Teisl et al. 1992.

Appendix A. Tables 1-10, 1985 Assessment.

Table 9. Projected 1990 woodcock harvest, effort, and success rates.

Wildlife Management Unit	Allowable Harvest ¹	Harvest	Estimated Number of Hunters	Successful Hunters	Percent Successful	Hunters/mi ² of Woodcock Habitat
1	20,700 - 28,200	4,000	1,000	730	73	2
2	12,400 - 16,800	1,500	400	300	82	2
3	3,300 - 4,900	6,500	2,000	1,300	65	15
4	29,900 - 38,500	34,700	7,500	5,100	68	11
5	3,900 - 5,900	5,500	1,300	1,100	66	11
6	27,700 - 38,000	20,000	3,000	2,000	68	10
7	13,200 - 18,200	13,600	3,300	2,000	60	15
8	11,500 - 17,200	18,500	6,200	3,700	60	23
Statewide	122,600 - 167,700	104,300	25,100	16,300	65	10

¹Allowable harvest is 15% of the estimated 1985 fall population.

Appendix A. Tables 1-10, 1985 Assessment.

Table 10. Past, present, and projected future woodcock harvests (actual, allowable, and objective) and hunters (total and successful).

Year	Harvest			Hunters	
	Actual	Allowable	Objective	Total	Successful
1971	94,300			25,300	17,700
1972	174,900			28,900	21,000
1973	210,700			37,300	25,700
1974	164,000			30,300	21,200
1975	110,300	225,000	165,000	28,300	19,300
1976	151,300	"	"	28,200	19,400
1977	133,700	"	"	27,000	17,800
1978	99,200	"	"	23,000	16,100
1979	142,700	"	"	27,400	18,600
1980	172,800	"	"	27,000	18,600
1981	164,200	"	"	31,600	21,500
1982	109,800	"	"	25,400	16,000
1983	107,600	"	"	24,200	15,500
1984	?	"	"	?	?
1985	? 137,800 - 187,600			?	?
1990	104,300	122,600 - 167,700		25,100	16,300

Appendix B. Estimated areas of American Woodcock habitat by wildlife management unit (WMU) in Maine, 1995.
 (areas determined from 1995 U.S. Forest Service Forest Resurvey of Maine data (%) applied to 1995 estimates of land area by WMU)

		1995 American Woodcock habitat area index estimates.								
Forest type group category	Stand size	WMU 1	WMU 2	WMU 3	WMU 4	WMU 5	WMU 6	WMU 7	WMU 8	Statewide
		area (sq. mi.)	area (sq. mi.)	area (sq. mi.)	area (sq. mi.)	area (sq. mi.)	area (sq. mi.)	area (sq. mi.)	area (sq. mi.)	area (sq. mi.)
Elm/ash/r. maple		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	seedling/sapling	75.15	65.22	41.62	105.50	0.00	1.93	16.47	10.56	316.43
Aspen/birch		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	sawtimber	37.62	101.48	8.80	55.58	0.00	0.00	32.32	12.39	248.18
	poletimber	263.62	323.52	353.93	373.31	92.99	198.95	142.10	102.90	1851.31
	seedling/sapling	194.02	384.42	140.84	318.17	173.57	179.32	54.41	85.16	1529.91
	nonstocked	0.00	8.27	0.00	0.00	0.00	0.00	0.00	0.00	8.27
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Forest Habitat		570.41	882.89	545.18	852.56	266.56	380.20	245.30	211.01	3,954.10
Agriculture Habitat		70.67	20.39	10.10	34.18	10.46	12.09	12.42	13.47	183.78
Total Habitat		641.08	903.28	555.28	886.73	277.02	392.29	257.72	224.48	4137.88
Total Land (95FIA square miles)		3,436.76	7,390.77	3,834.18	6,372.04	2,375.34	2,782.40	2,093.55	2,539.75	30824.78

Appendix C. Estimated areas of American Woodcock habitat by wildlife management unit (WMU) in Maine, 1982.
 (areas determined from 1982 U.S. Forest Service Forest Resurvey of Maine data (%) applied to 1995 estimates of land area by WMU)

Forest type group category	Stand size	1982 American Woodcock habitat area index estimates.								
		WMU 1	WMU 2	WMU 3	WMU 4	WMU 5	WMU 6	WMU 7	WMU 8	Statewide
		area (sq. mi.)	area (sq. mi.)	area (sq. mi.)	area (sq. mi.)	area (sq. mi.)	area (sq. mi.)	area (sq. mi.)	area (sq. mi.)	area (sq. mi.)
Elm/ash/r. maple		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
seedling/sapling		27.03	0.00	0.00	34.54	14.04	0.00	8.02	26.59	110.23
Aspen/birch		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
sawtimber		50.02	53.81	48.10	18.60	39.29	17.61	0.00	11.68	239.11
poletimber		240.68	283.42	202.99	462.12	81.41	116.72	134.60	81.86	1603.80
seedling/sapling		126.37	84.25	53.15	83.57	13.87	154.00	19.53	46.94	581.69
nonstocked		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Forest Habitat		444.10	421.49	304.25	598.83	148.60	288.33	162.15	167.08	2,534.83
Agriculture Habitat		103.81	0	36.15	97.24	15.50	0.00	51.60	80.46	384.76
Total Habitat (sq mi)		547.91	421.49	340.40	696.07	164.10	288.33	213.75	247.54	2,919.59

Appendix D. Worksheet to estimate 1995 populations from 1985 estimates, by WMU.

WMU	Spring 77-85		Fall		Proportional Change*	Spring 93-97		Fall 93-97	
	low	high	low	high		low	high	low	high
1	72,500	97,700	154,500	211,200	3.22/2.04	114,436	154,213	243,868	333,365
2	42,700	56,500	91,500	123,600	3.87/5.3	31,179	41,256	66,812	90,251
3	11,400	16,700	25,100	36,500	1.33/3.74	4,054	5,939	8,926	12,980
4	104,900	132,500	226,300	287,000	3.49/3.16	115,855	146,337	249,933	316,972
5	13,700	20,200	30,200	44,000	3.4/2.78	16,755	24,705	36,935	53,813
6	94,700	129,600	204,300	284,100	4.04/4.7	81,402	111,401	175,611	244,205
7	46,500	62,700	99,100	135,500	1.91/3.58	24,809	33,452	52,872	72,292
8	40,300	59,000	88,600	128,800	2.49/3.91	25,664	37,573	56,423	82,024
Total	426,700	574,900	919,600	1,250,700		414,154	554,875	891,380	1,205,901

* Numerator is breeding population index by WMU during 1977-85;
denominator is breeding population index by WMU during 1993-97.