RUFFED GROUSE ASSESSMENT

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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. Accurate data may not always be available or are too limited for meaningful statistical analysis; however, trends are sometimes clear and deserve management consideration.

This 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 historic, 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 sections summarizes the major points of the assessment.

This document is an update of the 1985 Ruffed Grouse Assessment written by R. Bradford Allen. For a thorough review of Ruffed Grouse natural history and conservation throughout its North American range, the reader is referred to The Birds of North America account for Ruffed Grouse (*Bonasa umbellus*) by Rusch et al. (2000) and *The Wildlife Series* Ruffed Grouse by Atwater and Schnell (1989).

NATURAL HISTORY

Description

Ruffed Grouse, commonly known as “partridge” in the Northeast, is among the smaller of the 11 species of grouse (Order Galliformes, Family Phasianidae, Subfamily Tetraoninae) native to North America. Ruffed Grouse weigh 17-25 oz (450-750 g), while Rock Ptarmigan (*Lagopus mutus*) of the Arctic weigh are smallest at 13-17 oz (360-470 g), Sharp-tailed Grouse (*Tympanuchus phasianellus*) of western steppe habitat weigh 26-40 oz (740-1400 g), and Sage Grouse (*Centrocercus urophasianus*) weigh as much as 7 pounds (3,200 g) (Gullion 1984, Rusch et al. 2000). Male Ruffed Grouse are slightly larger than females. Both sexes bear a similar cryptic plumage of mottled gray, brown, black, and white. Diagnostic features include a short crest on the head, a dark ruff on each side of the neck, mostly-feathered tarsus (lower leg), and a banded tail having a prominent dark (usually black) subterminal band. Two color morphs (red and gray phases) occur, with gradations between the two extremes. These color morphs are particularly evident in the tail plumage. The red phase predominates in the southern part of the species’ range, and the gray phase is more common in the north. Fleshy pectinations grow along the sides of the toes in fall and winter, and are shed during spring; these are thought to aid in walking on snow (Uttal 1941).

Distribution

Ruffed Grouse is the most widely distributed game bird in North America (Svoboda and Gullion 1972), inhabiting deciduous and coniferous forests from the Pacific to the Atlantic coast, as far north as Alaska and as far south as Georgia. Their distribution overlaps closely with the range of quaking aspen (*Populus tremuloides*) (Jakubas and Gullion 1991), their most important food source. During 1956-1963, populations of grouse were established in Newfoundland, on islands in Lake Michigan, and in northeastern Nevada, where they had not formerly lived. They occur throughout all counties of Maine, inhabiting mixed growth, upland and lowland hardwoods, old fields, and orchards (Brown 1944). They have not been recorded outside of North America.

Diet

Ruffed Grouse are omnivorous, feeding on buds, catkins, green leaves, fruits, and some invertebrates. Chicks feed almost entirely on invertebrates during first 3 weeks post hatch, then increasingly include more vegetative material in the diet, and become largely folivorous (leaf-eating), florivorous (flower- and bud-eating), and frugivorous (fruit-eating) as adults. The crop, an expandable portion of the foregut, enables grouse to feed rapidly for a short period of time, after which they can seek resting cover, and thereby reduce susceptibility to predation or harsh weather. A grouse can fill its crop in as little as 15 minutes when feeding on aspen flower buds (Svoboda and Gullion 1972), but probably would take much longer when feeding on alternative foods such as paper birch (*B. papyrifera*) buds and catkins, due to the

smaller size of these items and poorer accessibility associated with lower rigidity of birch branches (Jakubas and Gullion 1991).

When snow covers the ground, grouse live primarily on the dormant flower buds and catkins of aspens (*Populus spp.*), birches (*Betula spp.*) and cherries (*Prunus spp.*). Quaking aspen is generally regarded as the single most important year-round source of food for Ruffed Grouse in Maine (Brown 1944, 1946; Schemnitz 1970; Gullion 1984). However, grouse feed in some quaking aspen trees or clones (multiple trees with an interconnected route system), and not in others. They prefer aspen with low levels of coniferyl benzoate (a plant compound with repellent qualities that occurs only in flower buds), and high levels of protein (Jakubas and Gullion 1991). Grouse in Minnesota and Alberta tended to feed in older trees (Svoboda and Gullion 1972, Doerr et al. 1974, Jakubas and Gullion 1991), whereas birds in Maine fed predominantly in healthy young trees (Schemnitz 1970). Because levels of coniferyl benzoate and protein in aspen can vary by tree or clone, and from year to year, use by grouse also varies among trees and years.

Habitat

Ruffed grouse are most abundant in northern forests where aspens (*Populus* spp) are a dominant component of the forest (Gullion and Svoboda 1972, Gullion 1977); grouse generally achieve highest densities in young (<25 years) forests. Although they are primarily associated with deciduous hardwood forests, grouse inhabit all forest types in Maine. Habitat quality is directly related to the composition and arrangement of the cover types (Bump et al. 1947, Gullion and Svoboda 1972, Gullion 1977). Because of

the relatively small home range size (4-25 acres [2-10 ha]) of grouse, good habitat must meet all food and shelter requirements within a relatively small area (Bump et al. 1947, Gullion 1984)).

Cover that is suitable for drumming (displaying) male grouse during spring courtship is also suitable as fall and winter cover (Berner and Gysel 1969, Gullion 1977). Males typically drum from a log or other object of sufficient height that allows a view of the surroundings (Boag and Sumanik 1969) in cover that provides vertical and overhead protection from predators. Drumming sites favored by male grouse in the Lake States have a high stem density (2,000-8,000 stems/acre [4,800-19,200 stems/ha]) of hardwood saplings or tall shrubs (Gullion 1970), and a closed canopy about 30 feet (9 m) tall (Gullion and Svoboda 1972, Gullion 1977); such optimal conditions can occur in 13-25 year-old aspen stands. Drumming sites in habitats outside the Lake States, where aspen often is less prominent, may have lower stem densities.

Mature (pole size and larger) aspens and birches provide overhead cover, and their buds and catkins are an important food source for grouse during late fall through early spring. There has been controversy concerning the value of conifer cover as Ruffed Grouse habitat. Researchers in the West and Midwest (Gullion and Marshall 1968, Gullion 1970, Rusch and Keith 1971a) suggested that coniferous softwoods may be detrimental to survival of grouse. Low growing conifer saplings may provide concealment for mammalian predators, such as fisher (*Martes pennanti*), American marten (*M. americana*), and bobcat (*Lynx rufus*); whereas mature conifers may provide perching cover from which raptors can ambush grouse. However, researchers in the

Northeast (Bump et al. 1947, Chambers 1956, Woehr 1974) reported grouse clearly preferred conifers over deciduous hardwoods for winter roosts. Gullion (1991) later conceded that conifer plantations in Minnesota may be adequate grouse habitat if patches >1 ac (>0.4 ha) of aspen regeneration occur within or adjacent to the plantation. Conifers provide important thermal cover in winter when conditions (e.g., low snow depth, crusting) do not permit snow roosting (roosting under the surface of powder snow). Thompson and Fritzell (1988) estimated that snow roosting, and roosting in or under conifer canopies, provided grouse approximately 5X and 3X, respectively, the energy savings of grouse roosting in deciduous cover. Snow roosting may also provide protection from predators. In Wisconsin, the number of nights with good snow roosting conditions was correlated with spring grouse densities (Kubisiak et al. 1980), and Gullion (1970) suggested that good grouse survival and production also followed winters having good snow roosting conditions. When snow roosting conditions do not exist, dense conifers provide an important component of grouse habitat in winter (Thompson and Fritzell 1988).

Brood cover is characterized by forest edges and openings (e.g., regenerating hardwood patch cuts) having well developed herbaceous and shrub understories (Bump et al. 1947, Edminster 1947, Sharp 1963). Gullion (1970, 1977) found optimal brood habitat in Minnesota in regenerating aspen stands with 5,000-12,000+ stems/acre (12,000-28,800 stems/ha). Regenerating hardwood stands are short-lived as brood cover, becoming too open for brood use 7-10 years after harvest (Sharp 1963, Gullion 1977).

Breeding Biology

Ruffed Grouse are normally solitary in their social behavior (Gullion 1984), although they may form loose aggregations in fall and winter. With the onset of spring, most male Ruffed Grouse become aggressively territorial and defend an area of woodland approximately 4-8 acres (2-3 ha) in size (Archibald 1975, Rusch et al. 2000); however, about one-third of males may not defend territories (Gullion 1981). Male grouse then proceed to "drum", producing a series of progressively faster thumps (from a distance, reminiscent of a two-cycle engine starting up) as the wings are beat upward and forward; the sound results from sudden changes in air pressure created when the wings are suddenly stopped in front of the breast. Drumming is a territorial display which also serves to advertise the male's location to females. Males typically occupy the same breeding sites in subsequent years (Gullion and Marshall 1968, Rusch and Keith 1971b). Females, however, are more likely to shift breeding or wintering home ranges. Home ranges of females (5-25 acres [2-10 ha]; Maxson 1989, Rusch et al. 2000) are two to three times larger than males', and may overlap; thus, a female may visit more than one male, and one male may fertilize several females. Females are receptive to displaying males for only a few days, and after fertilization occurs they leave the male to seek nesting cover. Most (>80%) females breed in their first year of life (Maxson 1977, Small et al. 1996, Haulton 1999); half of yearling males hold territories or drum, while nearly all adult males do so (Gullion 1984).

Most Ruffed Grouse nests are located at the base of trees in open hardwood stands, although other sites are commonly used, such as the base of stumps or under slash, bushes, or brush piles (Bump et al. 1947). Female grouse choose nest sites in

open stands or stands that are open at ground level, to allow good visibility of the surroundings and permit escape from predators (Johnsgard and Maxson 1989). A clutch normally numbers 10-12 eggs and is incubated for about 24 days. Peak of hatch occurs during June in northern states.

A commonly held misconception is that a female grouse is capable of producing two broods of young in a single season. A hen may renest if the first clutch of eggs is lost, but renesting after a successful hatch has not been documented. Although number of nesting females and clutch size may vary little, nest success (the proportion of nests that hatch at least one chick) can be quite variable. Nest success varies from 24-69% (Bump et al. 1947, Gullion 1970b, Maxson 1978, Small et al. 1996, Haulton 1999), and averages 61% (Hewitt et al. 2001). The percent of nest losses attributed to predation was 52% in the central Appalachians (Haulton 1999) and 89% in New York (Bump et al. 1947). Hen success (proportion of females that hatch at least one chick in all nesting attempts) was estimated at 69.2% (n=105) in five states (Kentucky, Maryland, Ohio, Virginia, West Virginia) (Haulton 1999).

Young Ruffed Grouse are precocial, capable of following their mother and feeding themselves within a few hours of hatch. During the first three weeks post hatch, the hen broods her young each night and during periods of cold or wet weather. The hen escorts the young for 12-14 weeks, after which the broods begin to break up and a general autumn dispersal begins (Johnsgard 1975).

Dispersal

Dispersal among Ruffed Grouse serves to fill unoccupied habitat and promote genetic mixing. Autumn dispersal of juvenile grouse began in September and continued through early October in Wisconsin (Small and Rusch 1989), and through mid October in West Virginia (Plaugher 1998). Juvenile grouse may disperse several miles from their natal area, with females traveling farther, and for a longer period of time, than males (Chambers and Sharp 1958, Hale and Dorney 1963, Godfrey and Marshall 1969, Small and Rusch 1989). The net (straight-line) autumn dispersal distance for juvenile female grouse (n = 14) in Wisconsin was nearly three miles (4.8 km), while the net dispersal distance for juvenile males (n = 10) was under one and one-half miles (2.1 km) (Small and Rusch 1991). During fall and winter, drumming males typically stay within one-quarter of a mile (400 m) of their breeding site. Adult females may move twice as far. In spring a second dispersal takes place, mainly among juvenile males. After their first breeding season, grouse become relatively sedentary.

Survival and Longevity

Ruffed Grouse chick survival is quite variable, ranging from 7-51% (Bump et al. 1947, Gullion 1970b, Rusch and Keith 1971b, Rusch et al. 1984, Larson 1998, Haulton 1999), and averaging 35% (Hewitt et al. 2001). Survival during the first 12 weeks post hatch of radio-marked Ruffed Grouse chicks in Michigan was 32% (Larson 1998), with most mortality attributed to avian predators. Haulton (1999) estimated substantially lower survival of Ruffed Grouse chicks in the central Appalachians. Survival was 13.5% five weeks post hatch, and only 7% 20 weeks post hatch. Most mortality

occurred during the first week after hatch, with a surprisingly high incidence (38%) of total brood loss (n = 34 broods). Survival of Ruffed Grouse chicks in British Columbia was higher in years when weather was warm in June, during which time chicks would have been 2-3 weeks old (Davies and Bergerud 1988); Bump et al. (1947) found that below-average temperatures in March and June were correlated with increased mortality, and further suggested that low March and/or June temperatures contributed to declines in fall populations.

Mortality rates vary temporally and by age class. Nine percent of nesting hens in the central Appalachians were killed by predators (Haulton 1999). Survival of juveniles generally is lower than that of adults (Small et al. 1991, Balzer 1995), except during winter, when adult and juvenile survival are similar (Small et al. 1991). Survival of adults was lowest (57%) during winter in Wisconsin (Small et al. 1991). Juvenile survival was lowest during autumn and spring, periods of increased dispersal movements.

Annual survival of adult male Ruffed Grouse has been estimated from returns of banded birds to breeding territories, and observations of radio-marked birds in the Great Lakes and western Canada (Gullion 1984, Small et al. 1991, Balzer 1995, Lauten 1995, Rusch et al. 2000). Annual survival averaged 34%, varying by age class, region, habitat, and phase of the population cycle. Most mortality was attributed to predation. In Wisconsin, 29.8% of deaths among 563 radio-marked birds were attributed to hunters, 46.2% to raptors, and 20.4% to mammalian predators (Rusch et al. 2000). Parasites caused 0.9% of deaths, and accidents 2.7%. Exposure and starvation rarely have been documented, although McGowan (1969) attributed the deaths of several

Ruffed Grouse in Alaska to starvation when a thick accumulation of ice made food unavailable.

Ruffed Grouse populations in the Midwest exhibit cyclic fluctuations in numbers, with peaks occurring approximately every 10 years. This population cycle is linked to a similar, regular 8-11 year cycle in snowshoe hare (*Lepus americanus*) numbers (Rusch et al. 1978, 2000). Predator numbers in Alaska and Canada irrupt in response to highs in the hare cycle; when hares become scarce, emigrating predators, particularly Northern Goshawks (*Accipiter gentilis*) and Great Horned Owls (*Bubo virginianus*) prey heavily on sympatric Ruffed Grouse, driving grouse numbers down on a regular, predictable cycle, with population highs and lows that can differ by two orders of magnitude (Rusch et al. 1978). Population cycling among grouse in Maine has not been studied, and MDIFW does not monitor grouse populations. New Hampshire annually conducts drumming counts, but population cycling is not apparent. Although population cycling is not evident among Ruffed Grouse in the Northeast (however, see Bump et al. 1947), populations here can fluctuate widely from year to year. It is unknown how much annual variation in grouse numbers is due to weather or predation, or environmental factors that influence predation rates.

MANAGEMENT

Regulatory Authority

Maine Department of Inland Fisheries and Wildlife has regulatory authority for managing Ruffed Grouse in Maine.

Past Goals and Objectives

The latest Ruffed Grouse Assessment was written in 1985 and updated in 1991. 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 (1985-2000):

Maintain grouse population at 1985 levels (Appendix A, Table 6).

OBJECTIVES:

Abundance Objective: Maintain (fall) grouse population at or near 1.5 to 2.0 million (Appendix A, Table 6).

Harvest Objective: Maintain harvest and hunter numbers at or near 1985 levels (Appendix A, Tables 7 and 9), and extend the hunting season to December 15 (Table 1).

Past and Current Management

Over time, there has been a shift in the emphasis of Ruffed Grouse as food for native Americans and settlers to a place of high esteem as the most sought after game

bird in Maine. The history of Maine's Ruffed Grouse regulations reflect its change in status from a species eagerly pursued by market hunters to a quality game bird revered by sport hunters.

The first law to protect grouse in Maine was enacted in 1858, making it illegal from 1 March to 1 July to kill, possess, buy, or sell "any of the birds, called larks, robins, partridges, woodpeckers, or sparrows..." (Maine State Law Chapter 11, Section). In 1882, laws governing market hunting began to appear. The closed season for take, possession, transportation, purchase, and sale of Ruffed Grouse (and American Woodcock *[Scolopax minor*]) 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). The following appeared in the Department of Inland Fisheries and Game Annual Commissioner's Report of 1900: "In 1899 the sale of partridge was prohibited by statute: this so offended a few marketmen that they have since its passage refused to procure licenses to retail deer to their local customers, their purpose evidently to break down this partridge law. Now it is admitted on all sides that the partridge is the best game bird in North America; it is a native of Maine. Hunting partridges for the market had been so persistent that they had become exceedingly scarce in many sections of the State, and their practical extermination seemed but a question of a short time."

Throughout the past century, grouse hunting regulations were changed numerous times as wildlife managers' understanding of grouse ecology changed, and also in response to changing public sentiment. Prior to 1901, there was no bag limit on

grouse. During the early 1900s, the season was approximately 10 weeks in length (15 September to 30 November) with a 15 bird daily bag limit. In 1911 the bag limit was reduced to five birds, and in 1915, the season length was reduced to 8 weeks. The daily bag was further reduced to four in 1929. Reductions in season length occurred in the 1930s, providing a 6 week season (Maine Fish and Game Laws, 1903, 1907, 1921, and 1929). From 1939-1979, there was a closed season on grouse from the 16th of November through the following 30th day of September (Table 1). During this time it was unlawful to take more than 4 birds a day, and a season limit was in effect until 1965. The regulations also stated that it "shall be unlawful to use these birds or any part of these birds for bait in traps and that it shall be unlawful to buy or sell these birds."

An effort was initiated by the public in 1979 to extend the grouse season to increase utilization of an underharvested resource. Several public hearings were held, and ultimately the closing date in 1979 was moved back to the end of the deer season in the northern deer zone (24 November). In 1982, a change in the woodcock season resulted in another change in the grouse season. That year, the U. S. Fish and Wildlife Service (USFWS) delayed woodcock seasons until 5 October in several northeastern states where populations were adversely affected by a severe spring blizzard. The delayed opening (and usual 65 day season) resulted in a closing date of 8 December for woodcock. This restricted use of the woodcock resource motivated recommendations to the Commissioner's Advisory Council for a general liberalization of grouse seasons. For the 1982 grouse season, a 31 December closing date was adopted.

However, in 1983, the Legislature enacted Section 7455 of Chapter 709 which required that the grouse season end no later than 30 November. During the 1983 and 1984 grouse seasons, grouse hunting was legal from 1 October to 30 November. Due in part to a recommendation by MDIFW's Ruffed Grouse public working group, the Legislature in 1985 amended Section 7455 of Chapter 709, authorizing the Commissioner to extend the grouse season until 10 December in coastal Wildlife Management Units (WMU) 6, 7, and 8. Requests from the public prompted the Department to adopt the extension in time for the 1985 hunting season.

In 1999, the Department replaced the WMU system (Figure 1) with the Wildlife Management District (WMD) system (Figure 2) for administering wildlife management within the state. Concurrent with the adoption of the WMD system, the Department changed the closing date of grouse hunting season in WMDs 7-30 to 31 December (Table 1).

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, the only information on statewide ruffed grouse harvest is from a 1988 survey of upland bird hunters (Teisl et al. 1992). Since 1993, moose hunters have been asked to report how many grouse they and other members of their party see or kill during the 6-day moose hunting season. The number of people who hunted grouse in Maine in 1996 was estimated by U.S. Departments of Interior and Commerce (USDI and USDC) during a nationwide survey (USDI and USDC 1998). The USFWS' annual Breeding Bird Survey (BBS) does not adequately monitor Ruffed Grouse numbers, as BBS routes are typically run in June, which is one month or more later than the optimal

time to count drumming grouse. The Department currently does not monitor hunter numbers, harvest pressure, harvest, or population levels of Ruffed Grouse.

Table 1. Ruffed grouse harvest management in Maine, 1939-2000.

Year	Estimated Harvest [1]	Estimated Number of Hunters [1*]	Statutes and Regulations
1939-1954	---	---	1 Oct. to 15 Nov.; Limit 4, season limit 25
1955	185,700	41,700	" "
1956	194,900	43,700	" "
1957	232,400	49,000	" "
1958	151,700	39,100	" "
1959	135,100	35,700	" "
1960	164,000	57,500	" "
1961	170,000	54,200	" "
1962	134,200	51,900	" "
1963	196,600	56,600	" "
1964	179,400	58,100	" "
1965	181,500	56,000	" "
1966	285,400	85,100	" " possession limit 8
1967	232,200	69,100	" "
1968	273,000	87,200	" "
1969	146,900	75,300	" "
1970	160,900	80,300	" "
1971	252,500	82,300	" "
1972	373,900	90,000	" "
1973	292,000	93,700	" "
1974	295,700	89,400	" "
1975	297,300	91,500	" "
1976	286,200	88,800	" "
1977	352,900	93,300	" "
1978	322,400	86,500	" "
1979	462,600	104,600	1 October to end of deer season in Northern Zone (24 November)
1980	366,800	103,800	" " (29 November)
1981	658,000	132,600	" " (28 November)
1982	644,200	133,800	1 October to 31 December
1983	514,600	116,400	1 October to 30 November
1984	---	---	" "
1985-1995 [2]	609,910	77,522	1 October to 30 November (WMUs 1-5) 1 October to 10 December (WMUs 6-8)
1996-1998 [3]	---	56,000	" "
1999-2000	---	---	1 October to 31 December (WMDs 7-30) 1 October to 30 November (WMDs 1-6)

[1] Estimates of harvests and number of hunters are provided by: MDIFW Game Kill Questionnaire for 1955-1983; Teisl et al. (1992) for 1985-1995; and USDI and USDC (1998) for 1996-1998.

[2] Estimates of harvests and number of hunters based on 1988 survey data.

[3] Estimate of number of hunters based on 1996 survey data.

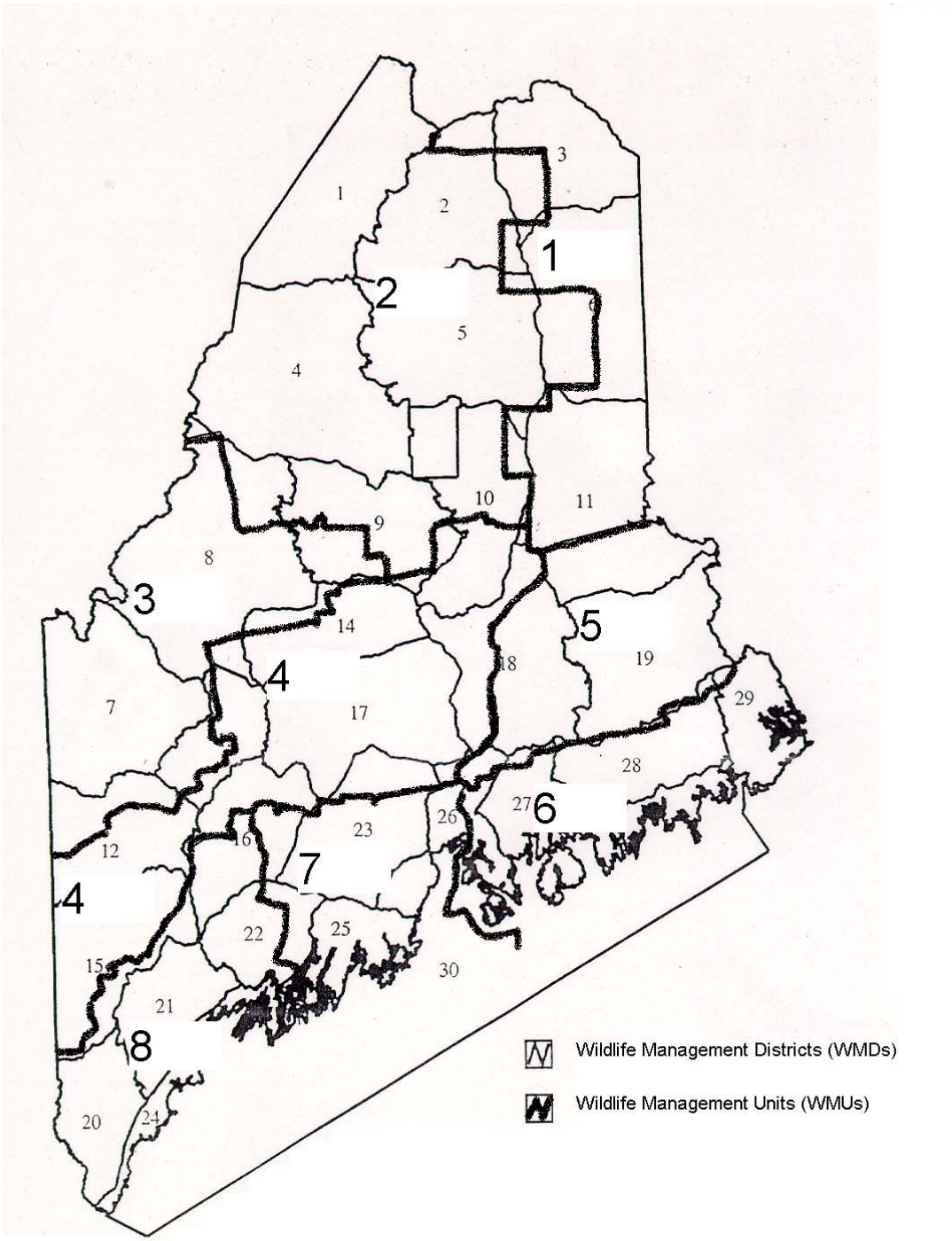

Figure 1. Comparison of Maine Department of Inland Fisheries and Wildlife's Wildlife Management Unit (WMU) and Wildlife Management District (WMD) Systems.

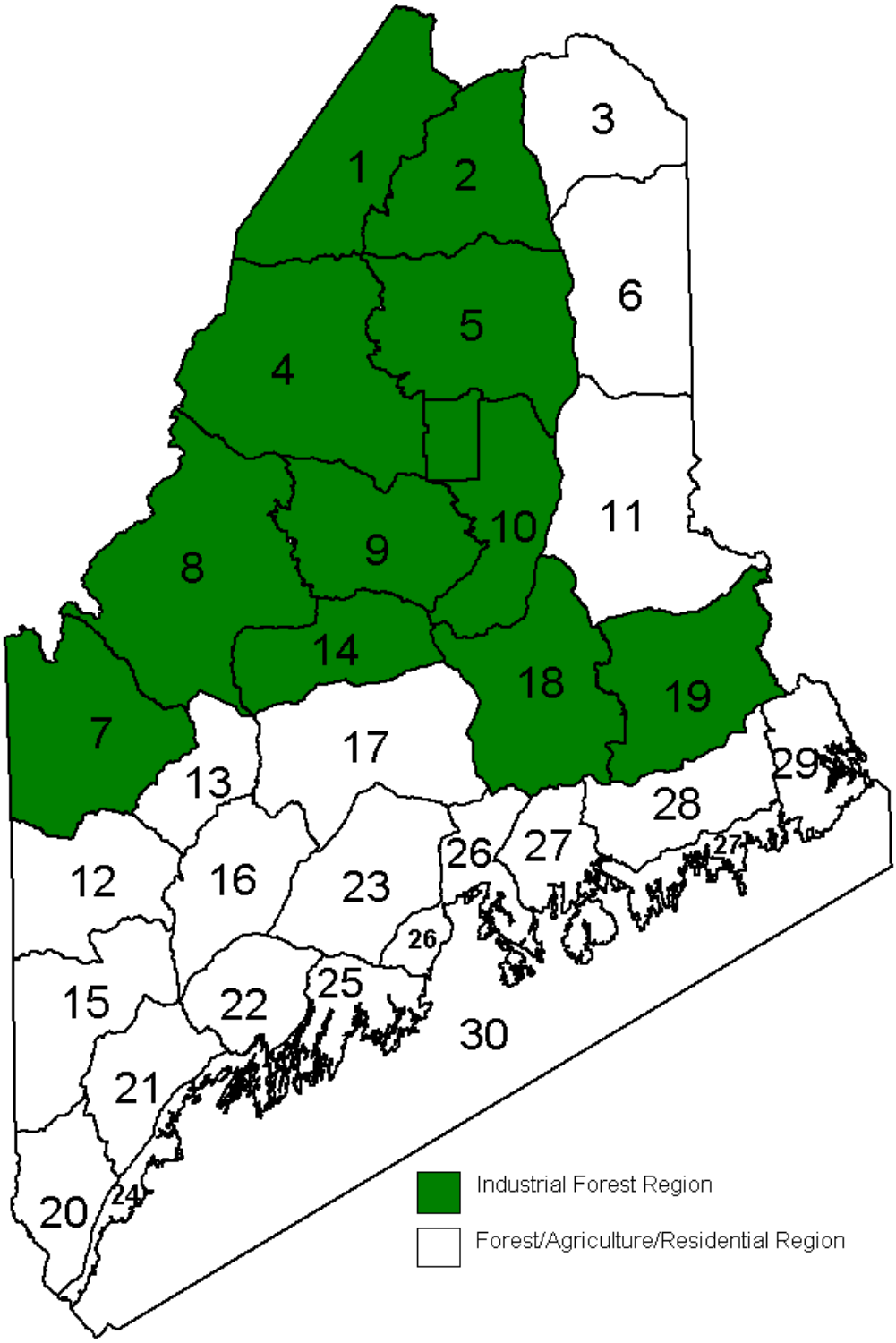

Figure 2. Maine Department of Inland Fisheries and Wildlife's Wildlife Management District (WMD) System.

HABITAT ASSESSMENT

Past Habitat

Ruffed Grouse have long been residents of North American forests. Fossil records reveal that they were present in these forests during the 12,000 years since the last continental ice sheets. According to Gullion (1984), Ruffed Grouse in the primeval forest probably occupied habitats maintained by fire and windstorms, because grouse favor forests in younger stages of succession.

Ruffed Grouse utilize all forest types to varying degrees but generally achieve their highest densities in young deciduous hardwood forests. The quality of an area to support grouse is further enhanced by a good interspersion of forest age classes, as well as reverting, abandoned farmland.

In the mid to late 1800s, private farms were numerous 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 today (Benson and Frederic 1982, Bureau of Census 1999). The natural succession of these abandoned farmlands to forestlands created vast acreages of prime Ruffed Grouse habitat. Farmland reverting to forest, and forest management to supply the pulp and paper industry resulted in significant changes in Maine's forests. Again, this alteration in land use resulted in improved habitat conditions for grouse.

Since the 1960s, Maine's forest area 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 to residential or commercial

development (Gadzik 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 grouse habitat in a large portion of the State.

Current Habitat

For the purpose of the current habitat assessment, 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 (BSP) comprise the "industrial forest" region; WMDs 3, 6, 11-13, 15-17, and 20-30 constitute the "forest-agriculture-residential" region (Figure 2). 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 28,000 square miles, or 90% of the State of Maine, is forestland of cover types considered grouse habitat (Table 2). Grouse habitat figures include white/red/jack pine, spruce/fir, elm/ash/red maple, oak/pine, oak/hickory, maple/beech/birch, and aspen/birch forest cover types. The area of forest by cover type group and stand class is presented in Appendix B.

Ruffed Grouse habitat data from 1995 were analyzed by WMU for comparison with 1982 data (Table 3; Appendices C, D). Forest cover type data from 1982 were adjusted for comparison to 1995 data by applying the percent area of each stand class in each forest type group in each WMU, to the standardized estimate of the area for

Table 2. Ruffed Grouse habitat[A] in Maine by land use category in 1995.

Forest Type	Industrial Forest (WMDs 1,2, 4,5,7-10,14, 18,19, & BSP) (mi^2)[B]	Forest/Agriculture /Residential (WMDs 3,6, 11-13,15-17, 20-30) (mi^2)[B]	Statewide All WMDs (mi^2)
White/red/jack pine	541	1,426	1,967
Spruce/fir	6,199	4,096	10,295
Oak/pine	11	180	191
Oak/hickory	19	656	675
Elm/ash/red maple	233	513	746
Maple/beech/birch	5,786	4,657	10,443
Aspen/birch	1,707	1,980	3,687
Total area of grouse habitat	14,496	13,508	28,004
Total nonforest area	531	2,502	3,033
Total land area	15,028	16,009	31,037

[A]Grouse habitat figures include white/red/jack pine, spruce/fir, elm/ash/red maple, oak/pine, oak/hickory, maple/beech/birch, and aspen/birch forest cover types. Pitch pine is included in white/red/jack pine group.

[B]Land 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).

Table 3. Ruffed Grouse habitat[A] in Maine by Wildlife Management Unit in 1982 and 1995.

Wildlife Management Unit	Total Area[B] (mi^2)	1982[B] (mi^2)	1995[B] (mi^2)
1	3,437	2,633	2,877
2	7,391	7,300	7,268
3	3,834	3,745	3,733
4	6,372	5,580	5,616
5	2,375	2,262	2,221
6	2,782	2,434	2,443
7	2,094	1,638	1,616
8	2,540	1,922	1,881
Statewide	30,825	27,514	27,655

[A]Grouse habitat figures include white/red pine, spruce/fir, pitch pine, elm/ash/red maple, oak/pine, oak/hickory, maple/beech/birch, and aspen/birch forest cover types.
[B]Land 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).

each WMU. This results in minor discrepancies in 1982 habitat area estimated for the current (Table 3) and 1985 (Appendix B) assessments.

There has not been significant change in total area of forest cover types considered suitable for grouse since the earlier grouse management plans (Table 3). However, there have been changes in species composition (Figure 3; Appendices C, D) and age structure (Figure 4; Appendices C, D) of Maine's forest, from which changes in habitat quality can be inferred. The quality of grouse habitat can vary greatly, depending on tree species and age composition of a forest stand, as well as interspersion of suitable wintering, nesting, and brood-rearing cover within the home range of a grouse. Unfortunately, data regarding interspersion of habitats are lacking for Maine. The 1985 Ruffed Grouse management plan used a habitat suitability index (HSI) model (Allen 1985) to assess habitat quality. Unfortunately, two variables used in combination (average of the two indices) to represent fall to spring cover were later found to be mutually exclusive when used with aspen/birch cover types; therefore, HSI values, at least for Aspen/Birch cover types, were probably biased low. A further limitation was that its applicability was limited to only Northern Hardwoods and Aspen/Birch cover types. For these reasons, the earlier HSI model was not used to estimate habitat suitability for grouse in the current assessment. Instead, a more simplistic approach was used in this plan to compare relative habitat quality between years and among areas.

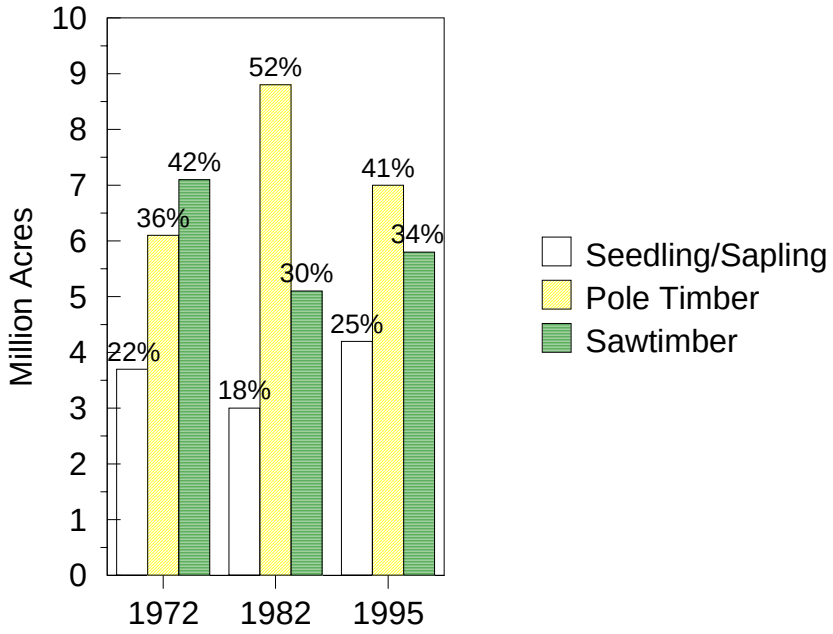

Figure 3. Changes in proportion of timberland in 3 stand-size classes, Maine, 1972-1995. Maine Forest Service data; Gadzik et al. 1998

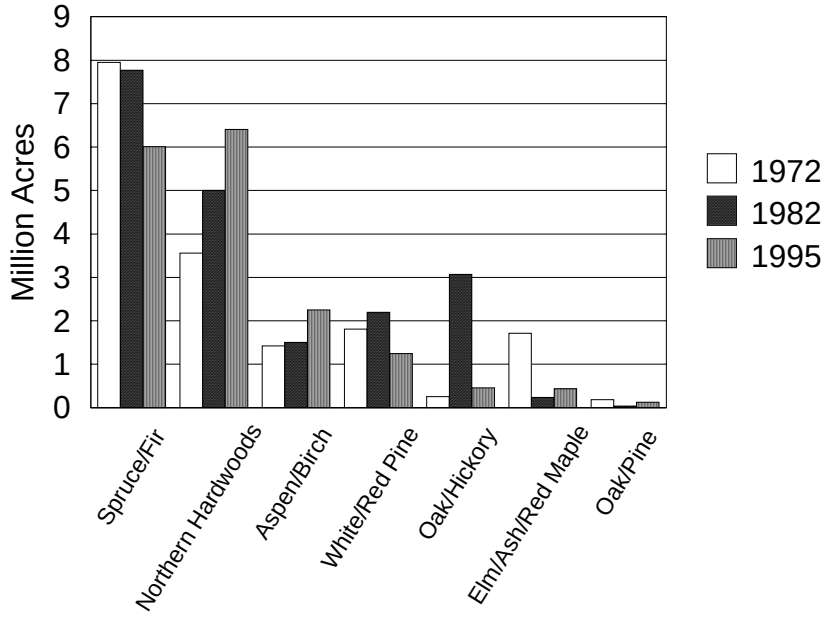

Figure 4. Estimated areas of forest types in Maine from 1972, 1982, and 1995 forest inventories. Maine Forest Service data; Gadzik et al. 1998.

Habitat suitability within each WMU and statewide was indexed by applying typical density estimates of drumming male grouse in spring to area estimates of stand class in each forest cover type group (Appendices B, C, D), and dividing by the maximum density figure applied across the total land area. This yields a value ranging from 0-1, with higher values indicating relatively better quality grouse habitat. Because densities of grouse in different forest types in Maine have not been estimated, density estimates from other areas, typically from states in the Midwest, were used in these calculations. An example of the calculations used to estimate relative habitat quality for WMU 3 in 1985 follows:

> sum of: [pine sawtimber (62.39 sq. mi. x 5 drummers/sq. mi.) + pine poletimber (31.70 sq. mi. x 10 drummers/sq. mi.) + spruce-fir sawtimber (394.38 sq. mi. x 3 drummers/sq. mi.) + spruce-fir poletimber (1303.47 sq. mi. x 15 drummers/sq. mi.) + spruce-fir seedling/sapling (233.14 sq. mi. x 21 drummers/sq. mi.) + maple-beech-birch sawtimber (563.66 sq. mi. x 3 drummers/sq. mi.) + maple-beech-birch poletimber (750.30 sq. mi. x 15 drummers/sq. mi.) + maple-beech-birch seedling/sapling (102.16 sq. mi. x 21 drummers/sq. mi.) + aspen-birch sawtimber (48.10 sq. mi. x 15 drummers/sq. mi.) + aspen-birch poletimber (202.99 sq. mi. x 21 drummers/sq. mi.) + aspen-birch seedling/sapling (53.15 sq. mi. x 54 drummers/sq. mi.)] equals **49,205** drummers;
> divided by: [total land area in WMU 3 (3834 sq. mi.) x maximum drummer density figure (54 drummers/sq. mi.) = **207,036** drummers];
> yields an HSI of: **0.238**

The HSI values (Table 4) indicate that habitat conditions for Ruffed Grouse have improved in all WMUs from 1982 to 1995. The shift to a younger forest (Figure 3), particularly among an increasing hardwood component (Figure 4), likely has improved habitat suitability for Ruffed Grouse since 1982.

Table 4. Ruffed Grouse habitat suitability[1] in Maine, as indexed by potential densities of drumming males in spring, by Wildlife Management Unit in 1982 and 1995.

Wildlife Management Unit	Habitat Suitability Index[1]	
	1982	1995
1	0.222	0.289
2	0.2	0.270
3	0.238	0.283
4	0.207	0.266
5	0.234	0.310
6	0.245	0.271
7	0.187	0.223
8	0.166	0.197
Statewide	0.211	0.267

[1] Habitat suitability was indexed by applying published density estimates of drumming male grouse in spring, to area estimates of stand class in each forest cover type group (Appendices B, C, D) and dividing by the maximum density figure applied across the total land area.

Area occupied by seedling/sapling stands has increased from 18% (3.0 million acres) of Maine's forests in 1982, to 25% (4.2 million acres) in 1995. 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 (Gadzik et al. 1998). 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 generally has higher value as grouse habitat. Annual harvests of hardwoods in Maine increased 20% from 1990 to 1996 (Gadzik et al. 1998).

Limitations to methods used to assess habitat quality in this and previous plans include: 1) a general lack of data quantifying the relationships between Ruffed Grouse and their habitats in Maine; and 2) our inability to measure interspersion of stand classes at the scale of a grouse home range, an important characteristic of suitable Ruffed Grouse habitat (Cade and Sousa 1985).

Habitat Projections

Because grouse utilize all of Maine's forests to varying degrees, the future carrying capacity of grouse habitat will largely be the result of 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 Ruffed Grouse habitat. However, future timber supplies are difficult to predict. Forecasts must incorporate growth and yield information; changes in demand for

species and size classes, and changes in harvest technology, bring another level of uncertainty to predictions, and the occurrence and effects of natural phenomena, such as spruce budworm outbreaks, drought, and wildfires, are even less predictable.

Consumption of 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 (Gadzik et al. 1998). This will likely result in shorter rotations, creating a younger forest, which generally benefits grouse. 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 (Gadzik et al. 1998). Although these intensive forest management practices may have a deleterious effect on grouse habitat (Coulter and Baird 1982), currently only about 4% of timberland in Maine is affected (Gadzik 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 to 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 Ruffed Grouse.

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 may support as much as 28%, or more, of the state's grouse population (Appendix B). 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 will likely be a decrease in young stands of this forest type, and a concomitant decline in quality of grouse habitat, during the next 15 years if the declining trend in use of clear cutting continues (Chilelli 1998b). The ice storm that occurred throughout much of the central part of the state in 1998 likely had the effect of setting back succession a few years in Aspen/Birch and other shade intolerant hardwoods, and so was not detrimental to grouse habitat. However, some delayed mortality among mature aspens injured in the ice storm continues to take place.

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 may have a slight positive influence on grouse habitat.

Commercial and residential development in Hancock and southern Penobscot Counties, the Capitol Region, and southern Maine is projected to increase through 2050 (Plantinga et al. 1999), likely reducing the area and quality of grouse habitat in these regions. Further, as many as 34% of small, non-industrial landowners in New England who own less than 50 acres, have no intention of ever commercially harvesting wood (Birch 1996); as these small woodlots mature, they become less diverse in age classes and tend to become poorer habitat for grouse. 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 grouse) habitat on some small ownerships in the future (Coulter and Baird 1982).

Widespread reversion of agricultural land to forests created large acreages of favorable grouse habitat, particularly young aspen stands. In southern Maine, this trend has reversed, and it is likely that young stands of Aspen/Birch, and so carrying capacity for grouse, 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 Ruffed Grouse 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

Historical documents reveal that Ruffed Grouse were present in all portions of the State, but undoubtedly to a lesser extent in the more remote areas. Ruffed Grouse numbers probably increased around settlements as the pioneers cleared forestland. According to Day (1953), native Americans used wild fire to clear land and possibly to attract grouse.

Little data exist on the number of Ruffed Grouse in Maine in these early times. However, tales of the multitudes of Ruffed Grouse around settlers' clearings are numerous (Bump et al. 1947). Following the settlement of Maine, market hunting became common; and Furbush (1912), writing of Massachusetts, states "...two men in the vicinity (Westfield, Massachusetts) took one hundred and twenty of these birds from snares in one day...".

Grouse populations are known to fluctuate in all parts of their range. In addition to the annual fluctuations of local populations, more widespread fluctuations are common at periodic intervals, with approximately 10 years constituting one complete cycle (Rusch et al. 1978, 2000). Bump et al. (1947) felt that a weather relationship, and a contributing population density influence, most likely were controlling the synchronization; however this population cycle is now widely believed to be predator driven, linked to a similar, regular 8-11 year cycle in snowshoe hare (Rusch et al. 1978, 2000).

Today, Ruffed Grouse are common statewide and their densities vary across all of Maine. The highest densities probably occur in the transitional zone between the "big woods" and developed areas, in aspen-dominated forests having a good interspersion of age classes and abandoned agricultural land.

Current Populations

Local fall populations may vary widely from year to year, depending on the size of the breeding population in the spring, and hatching and survival of eggs and chicks during the summer. The only index to grouse populations in Maine currently available (number of grouse seen per 100 hours of hunting) is provided by the Maine moose hunter survey (Table 5). These data illustrate the year to year variability in grouse abundance, although differences in dates of the moose hunt, as well as weather and leaf fall, can affect visibility of grouse. For example, the size of the fall grouse population in much of northern Maine in 2000 was deemed excellent by many hunters and MDIFW staff, however moose hunters reported the fifth lowest sighting rate in 7 years of surveys, probably due in part to inclement weather during the early days of the hunt. Nevertheless, 1995 was a banner year by all accounts for grouse numbers in much of the state, as was borne out by the moose hunter survey (Table 5).

An accurate estimate of the Ruffed Grouse population does not exist, as no reliable measures of statewide population levels are taken. Population estimates calculated for this plan are merely indices for comparing relative potential population size between years of interest, and among regions of the state. For the purpose of this plan, estimates of grouse density statewide were based on a review of grouse densities

Table 5. Grouse harvests by moose hunters and others in their hunting party, Maine, 1993-2000.

Hunter/Harvest variable	1993	1994	1995	1996	1997	1998	1999	2000
Permit holders reporting	888	1,069	1,252	1,321	1,323	1,739	2,542	1,887
Number of grouse seen	4,624	5,804	18,069	4,880	6,868	11,604	17,754	11,731
Number seen/100 hrs of hunting	-	**35**	**107**	**20**	**25**	**43**	**37**	**33**
Grouse taken by permit holders	1,039	1,432	4,160	871	1,268	2,424	3,268	1,933
Grouse taken by others in party	1,022	1,146	3,779	836	1,024	2,182	2,990	2,081
Total grouse taken	2,061	2,578	7,939	1,707	2,292	4,606	6,258	3,930

in various forest types as reported in the literature (Appendix E; Bump et al. 1947, Palmer and Bennett 1963, Stoll et al. 1973, Gullion 1977, Sousa 1978, Kubisiak et al. 1980, Theberge and Gauthier 1982, Gullion and Alm 1983, Backs 1984, Hunyadi 1984, McCaffery et al. 1996). Figures ranging from 5-54 drummers/mi^2 during spring, depending on forest cover type and stand age class, were used to calculate a population index of drumming males (Appendix B); the proportion (0-30%; Gullion 1981) of non-territorial males was not included in the index of drumming males. Assuming a 1:1 sex ratio in spring (Rusch and Keith 1971b), the drummer population was multiplied by 2 to arrive at a spring population level (males plus females). Bump et al. (1947) considered an adult to juvenile age ratio of 1:1 during fall to represent an average production year; therefore the spring population (i.e., drummer population x 2) was multiplied by 2 to arrive at a potential fall population size (Table 6). An example of the calculations used to estimate potential fall grouse population in WMU 3 in 1982 follows:

> sum of: [pine sawtimber (62.39 sq. mi. x 5 drummers/sq. mi.) + pine poletimber (31.70 sq. mi. x 10 drummers/sq. mi.) + spruce-fir sawtimber (394.38 sq. mi. x 3 drummers/sq. mi.) + spruce-fir poletimber (1303.47 sq. mi. x 15 drummers/sq. mi.) + spruce-fir seedling/sapling (233.14 sq. mi. x 21 drummers/sq. mi.) + maple-beech-birch sawtimber (563.66 sq. mi. x 3 drummers/sq. mi.) + maple-beech-birch poletimber (750.30 sq. mi. x 15 drummers/sq. mi.) + maple-beech-birch seedling/sapling (102.16 sq. mi. x 21 drummers/sq. mi.) + aspen-birch sawtimber (48.10 sq. mi. x 15 drummers/sq. mi.) + aspen-birch poletimber (202.99 sq. mi. x 21 drummers/sq. mi.) + aspen-birch seedling/sapling (53.15 sq. mi. x 54 drummers/sq. mi.)] equals **49,205** drummers;
> multiplied by **2** (assuming 1:1 sex ratio) equals **98,410** drummers and females in the spring population;
> multiplied again by **2** (assuming average production) equals **196,820** grouse in the fall population in WMU 3 in 1982.

Table 6. Estimated potential (1995) spring and fall grouse populations by WMD Group.

Wildlife Management District Group	Estimate of Potential 1995 Ruffed Grouse Population			
	Spring[1]			Fall[2]
	Range		Estimate	Estimate
Industrial Forest (WMDs 1,2, 4,5,7-10,14, 18,19, BSP)	136,150	-873,904	450,238	900,476
Forest/Agriculture /Residential (WMDs 3,6, 11-13,15-17, 20-30)	156,136	-821,298	455,704	911,408
Statewide	292,286	-1,695,202	905,942	1,811,884

[1] Assumes 1:1 male to female ratio

[2] Assumes 1:1 adult to juvenile ratio

Estimates of potential populations in the Industrial Forest and Forest/Agriculture/Residential WMD groups are similar. The spring estimate of potential grouse population is 905,942 (range 292,286-1,695,202), while the fall estimate is 1,811,884, within the 1991-2000 fall abundance objective of 1.5 to 2.0 million birds.

Potential spring grouse numbers were estimated by WMU to compare between 1995 and 1982. The carrying capacity for grouse increased in all regions of the state from 1982 to 1995 (Table 7). The 1982 spring population index of 703,684 (range 252,212-1,554,790; Table 7) estimated in the current assessment is 77% of the statewide maximum supportable winter population of 913,400 grouse (range 281,000 - 1,124,200) generated for the 1985 plan using a different method (Appendix A: Table 5).

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 the potential spring population in 2015 at 869,650 grouse (range 280,395 - 1,627,920; Table 8).

Differing land uses over the next 15 years will result in changes in habitat conditions for grouse between WMD groups, but these differences are difficult to quantify. However, population projections assume future trends in grouse habitat conditions. Trends in grouse numbers will likely be downward in certain areas of the state and be stable or improve slightly in others. Periodic fluctuations may annually occur depending on weather and habitat conditions. Reduced use of clear-cutting in Spruce/Fir and Aspen/Birch, in favor of partial harvesting, will likely have a negative

Table 7. Recent (1982) and current (1995) potential spring grouse populations by WMU.

Wildlife Management Unit	1982 Potential Spring Population			1995 Potential Spring Population		
	Range		Estimate	Range		Estimate
1	28,110-	166,708	82,582	32,106-	184,704	107,254
2	54,886-	415,058	159,012	66,044-	438,418	216,142
3	30,150-	217,366	98,410	36,220-	229,642	117,216
4	57,290-	313,732	141,972	63,176-	338,012	183,336
5	20,372-	125,932	60,218	22,406-	130,984	79,678
6	21,198-	132,112	73,688	24,570-	138,834	81,580
7	17,764-	88,742	42,224	20,168-	96,632	50,378
8	22,442-	95,140	45,578	24,096-	103,760	54,154
Statewide	252,212-	1,554,790	703,684	288,756-	1,660,986	889,738

Table 8. Projected (2015) spring and fall potential grouse populations by WMD Group.

Wildlife Management District Group	Potential 2015 Ruffed Grouse Population			
	Spring[1]			Fall[2]
	Range		Estimate	Estimate
Industrial Forest (WMDs 1-2, 4,5,7-10,14, 18,19, BSP)	132,066-	847,687	436,731	873,462
Forest/Agriculture /Residential (WMDs 3,6, 11-13,15-17, 20-30)	148,329-	780,233	432,919	865,838
Statewide	280,395-	1,627,920	869,650	1,739,300

[1] Assumes 1:1 male to female ratio

[2] Assumes 1:1 adult to juvenile ratio

effect on Ruffed Grouse and other species that rely on early successional forests; alternatively, partial harvesting of Northern Hardwood stands my improve interspersion of food and cover, and so improve habitat conditions for grouse in that cover type. Fuelwood harvesting may create favorable habitat for grouse in localized areas of the state. Habitat conditions will likely continue to deteriorate on previously abandoned farmland. Grouse habitat will continue to be lost to urban and industrial development.

Limiting Factors

The ability of forestland to support grouse is limited by the habitat's ability to provide food and shelter. With respect to grouse, it is generally agreed that shelter (cover) is more limiting than food (Bump et al. 1947, Gullion and Marshall 1968). The quality of the cover (both low conifers and snow cover) plays an important role in determining grouse survival during the winter, and thus the size of the breeding population the following spring. However, dense cover without food trees interspersed is not good habitat, as grouse that are unable to feed efficiently must spend more time foraging, and so may be more vulnerable to predation (Jakubas and Gullion 1991). Keith and Rusch (1989) suggested that winter survival may have a major influence on the cyclic trend among grouse in the Lake States.

Because of the relatively small home range size of grouse, the composition and arrangement of cover types that provide food and shelter requirements within a relatively small area determine the carrying capacity for Ruffed Grouse. The main causes of mortality for Ruffed Grouse are egg and chick mortality caused by influences of weather; predation; and hunter harvest. Although severe weather events (i.e.,

protracted periods of cold, wet weather during May and June) can cause increased mortality among eggs and chicks (Bump et al. 1947), direct effects of weather on survival are difficult to quantify. Bump et al. (1947) felt that extremely low temperatures in March and June may make grouse more susceptible to predation, and observed that below-average temperatures in March and/or June preceded all major population declines in New York during 1890-1942. Keith and Rusch (1989) suggested that the direction of population cycles in Alberta was primarily influenced by survival of juvenile grouse during summer.

Predation and hunting account for nearly all deaths of immature (fledged) and adult grouse; predators are believed to drive the natural 10-year population cycle of Ruffed Grouse in the Lake States and central provinces. While the effects of market gunning during the late 1800s were grave for grouse and other wildlife species, modern sport hunting generally is not considered important in regulating Ruffed Grouse populations, except in situations where isolated populations are subjected to high hunting pressure.

Conservation officials in Wisconsin, in the belief that hunting was depressing grouse populations, instituted hunting season closures for Ruffed Grouse during population cycle lows in 1919, 1929-30, and 1936-37. Minnesota closed its season in 1944, as did Wisconsin in 1945. However, Michigan, also experiencing a low in grouse numbers, decided to keep its hunting season open. When Minnesota and Wisconsin reopened their seasons in 1948, harvests in all three states were similar, and a year later were nearly identical. The closed seasons apparently had little or no effect on grouse populations, reinforcing the principle of “compensatory mortality”, the idea that a

reduction in hunting mortality would just result in increased mortality from other sources, such as predators. In other words, hunters were just killing the “surplus” of game that would die anyway.

Subsequent studies have indicated that hunting mortality is compensatory - up to a point (Balzer 1995, Kubisiak 1984). When the harvest rate (percent of the population that is killed by hunting) becomes too high, hunting mortality goes from being compensatory to being additive, that is, hunting increases the overall mortality rate. Maximum allowable harvest of Ruffed Grouse has been proposed as 25% (Edminster 1947), 30-35% (Dorney and Kabat 1960), 40% (Palmer 1956), and 50% (Palmer and Bennett 1963).

DeStefano and Rusch (1986) estimated a mean harvest rate of 40% for 835 grouse banded with $5 and $10 reward bands during three-month hunting seasons (October-December, including Sunday hunting) on a state-owned wildlife area within 30 miles (48 km) of a large population center (Green Bay) in southeastern Wisconsin. Most hunting pressure and harvest tended to occur early in the season; the majority of band recoveries in this study occurred in October, with lesser recovery rates in November and December. A relatively small proportion of hunters (20%) accounted for most (51%) of the band recoveries.

Small et al. (1991) estimated a harvest rate of 60% for Ruffed Grouse on a public hunting area that received intense hunting pressure, in Wisconsin; they concluded that, in this case, hunting mortality was additive. The grouse population on the public hunting area was sustained by birds that immigrated from surrounding private lands, where grouse experienced a harvest rate only 10% or lower. They further concluded that

numbers would decline on isolated areas if grouse experience high hunting mortality and reduced immigration from adjacent areas due to habitat fragmentation.

Recent research on two public hunting areas in the lower peninsula of Michigan found no indication that hunting negatively affects overall fall to spring survival of Ruffed Grouse (Winterstein et al. 1999). The grouse season in Michigan's lower peninsula lasts 92 days, running 15 September - 14 November and 1-31 December, and hunting on Sundays is legal. During 1993-1998, radio-marked grouse (n = 1,071 birds) on hunted and unhunted study areas experienced similar fall to spring survival rates in all but one year on one study site; on the hunted portion of this study area the year it had lower survival, hunting accounted for only 3 of 17 mortalities of radio-marked birds. On hunted study sites, hunters and mammals killed low to moderate numbers of grouse. Most mortality was caused by avian predation.

USE AND DEMAND ASSESSMENT

Past and Current Use and Demand

The earliest records of estimated Ruffed Grouse harvests were compiled in the mid 1950s (Table 1). Between 1955-1971, the average annual kill was estimated at approximately 200,000 grouse. Beginning in the early 1970s, data from the Department's Personal Hunting Report (Game Kill Questionnaire) were used to provide yearly estimates of hunting effort and harvests for several game species. These data show that harvests averaged roughly 335,000 birds through the 1970s. In 1979, regulations governing grouse seasons began to change. By 1981, the reported harvest (658,000) was almost double the previous year's kill, probably due to increased participation in grouse hunting coupled with an apparent high grouse population. The 1982 harvest was slightly less than the 1981 harvest despite a longer, three month season. The harvest decreased to 514,600 in 1983, when the season was shortened to 2 months (1 October through 30 November).

Grouse harvests peaked during the 1981 and 1982 seasons when roughly 650,000 birds were harvested each year. These harvests remain well below the estimated annual allowable harvest of 827,500 grouse (Appendix A, Table 7).

Since 1983, the only information on statewide Ruffed Grouse harvests is from a 1988 survey of upland bird hunters (Teisl et al. 1992; Tables 9 and 10). The kill estimate of 609,910 in 1988 rivals the highs recorded in the early 1980s (Table 1), and yields a higher figure of birds bagged per hunter than any other year on record. The

numbers of grouse killed in recent years is unknown, as statewide grouse harvests have not been monitored since the 1988 survey, due to budgetary constraints.

Data from the game kill questionnaire also provided estimates of Ruffed Grouse hunting effort (Table 1). While little historical data exist on Ruffed Grouse hunters, the most recent data indicate that a fairly constant number of hunters pursued grouse each year. From 1972 to 1983, an estimated average of 102,000 hunters/year actively hunted Ruffed Grouse. The most recent 5-year average for which we have data (1979-1983) of 118,000 hunters/year is somewhat higher (Table 1). This increase in the number of hunters/year may reflect the longer seasons offered over this period compared to the seasons of the early to mid 1970s. In 1983, 116,000 grouse hunters were afield; nonresidents comprised approximately 10% of this total.

More recently, Teisl et al. (1992; Tables 9 and 10) estimated that 77,528 (35%) of the 222,322 individuals who held Maine hunting licenses in 1988 hunted grouse. Only 7% of this total were nonresidents. In 1996, USDI and USDC (1998) used different methods to estimate that approximately 39% of all hunters in Maine, or 56,000 people, hunted grouse in the state. The number of hunters pursuing Ruffed Grouse today is probably similar to either of the two most recent estimates, as license sales have been stable in recent years.

The primary users of Maine's grouse resource are game bird hunters. A 1988 survey of upland bird hunters provided information on hunting activity, success, hunting methods, and satisfaction levels associated with hunting grouse in Maine (Teisl et al. 1992, Tables 9 and 10). During the 1988 grouse season, 77,522 hunters spent

Table 9. Hunter effort, success, and evaluation of the 1988 Maine Ruffed Grouse hunt.

	Residents	Nonresidents	Total
Number of Hunters	72,389	5,133	77,522
Average Number of Days Hunting Per Hunter	10	6	
Average Hours Hunting per Day Per Hunter	4	5	
Total Number of Days Hunting	723,890	30,798	754,688
Average Number of Birds Bagged Per Hunter	8	6	
Total number of Birds Bagged	579,112	30,798	609,910
Hunters' Evaluation of the Hunt			
Poor	7%	8%	
Fair	27%	15%	
Good	37%	33%	
Very Good	14%	21%	
Excellent	16%	14%	
Perfect	0	9%	
Average Response	Good	Very Good	

Data from: Teisl et al. (1992) .

Table 10. Hunting methods used during the 1988 Maine upland bird hunting season.

Hunting Method	Resident	Nonresident
Grouse:		
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%
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).

754,688 days in pursuit of Ruffed Grouse; residents averaged 10 days of hunting compared to 6 days for nonresidents, but nonresidents hunted an average of 1 hour longer per day.

The primary users of Maine's grouse resource are game bird hunters. A 1988 survey of upland bird hunters provided information on hunting activity, success, hunting methods, and satisfaction levels associated with hunting grouse in Maine (Teisl et al. 1992, Tables 9 and 10). During the 1988 grouse season, 77,522 hunters spent 754,688 days in pursuit of Ruffed Grouse; residents averaged 10 days of hunting compared to 6 days for nonresidents, but nonresidents hunted an average of 1 hour longer per day.

Grouse hunters in Maine can generally be subdivided into 3 groups: hunters who use dogs, hunters who use walking and/or stalking techniques, and hunters who ride along dirt roads looking for grouse. Residents and nonresidents were equally likely to walk on or off trails to stalk grouse. Residents, however, were twice as likely to hunt from a vehicle (drive roads looking for birds) as nonresidents, while nonresidents were twice as likely to employ the services of a dog (Teisl et al. 1992). These results are similar to the Department's 1981 Game Kill Questionnaire survey of grouse hunters, with the notable exception that hunters in 1988 were three times as likely to hunt from vehicles as were hunters in 1981.

In 1988, both residents and non residents expressed satisfaction with the hunt, generally evaluating their experiences as "good" or "very good". Nearly half of residents felt hunting pressure had increased since 3 years earlier, while one-third of nonresidents felt so (Teisl et al. 1992).

Ruffed Grouse have substantial nongame value as well. Birders enjoy watching grouse, and spring trout anglers often hear the drumming of males defending territories near riparian areas. For the wildlife photographer, a drumming male Ruffed Grouse presents an attractive challenge.

Use and Demand Projections

The number of grouse hunters will likely remain fairly stable through the next planning period. The nonconsumptive use of grouse will likely increase with the growth of bird watching.

Opportunity for both hunting and watching of grouse 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 grouse throughout the industrial forest region will likely remain unchanged through 2015.

SUMMARY AND CONCLUSIONS

The Ruffed Grouse or “partridge” is considered the premiere game bird in Maine by many sportsmen. In 1988, the last year for which we have data, an estimated 77,522 hunters harvested over 609,000 birds. Grouse occur in varying abundances in all forest types over the entire State. Only in developed urban areas and on certain offshore islands can they be considered scarce or absent. Maine’s 1995 potential fall grouse population was estimated at over 1,700,000 birds.

Historically, grouse were a source of food for native Americans. European colonists created additional clearings near their settlements, which probably improved grouse habitat and local grouse numbers. Following the settlement of Maine and an apparent increase in grouse numbers, market hunting became common. As a result of market hunting, grouse became exceedingly scarce in many sections of the state.

During the early 1900s, the statewide grouse season was approximately 10 weeks in duration and had a 15 bird daily bag limit. By 1920, the season had been reduced to 8 weeks with a 5 bird limit. Further reductions that occurred in the 1930s produced regulations that were largely unchanged until 1979; during the 1980s to the present the season length has varied from 50-78 days.

The earliest records of estimated Ruffed Grouse harvests were compiled in the mid-1950s. Between 1955-1971, the average annual kill was estimated to be 200,000 grouse. Harvests averaged 335,000 birds through the 1970s. A record high kill of 658,000 birds occurred in 1981. The latest kill estimate, in 1988, was 609,910 birds. The Department does not currently monitor Ruffed Grouse harvest or hunter effort.

The amount and quality of Maine's grouse habitat is constantly changing, and the direction and magnitude of these changes are difficult to predict. Because grouse utilize all of Maine's forest to varying degrees, the trend in grouse habitat will likely be tied closely to forestry practices. 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, the benefits derived from intensive forest management (i.e., harvests) may be offset somewhat throughout the state by losses of abandoned agricultural land to urban development, and overmaturation of nonindustrial forests. It is important to note that while the quantity of the habitat could change little, the quality of that habitat could change a great deal. Despite limitations in the projections of future habitat and population trends, reductions in habitat suitability (quality) for grouse of 5% in the Forest/Agriculture/Residential WMD group, and 3% for grouse in the Industrial Forest WMD group are assumed by 2015. Future use opportunity likely will decrease in the more heavily settled parts of the state, and likely will fail to satisfy demand in local areas where traditional coverts no longer support grouse or provide access to users (i.e. hunters).

For the purpose of this plan, statewide estimates of grouse density were based on a review of grouse densities in various forest types as reported in the literature. Maine's estimated 1995 potential fall grouse population (1,739,300) is within the 1991-2000 abundance objective of 1.5 to 2.0 million birds. However, large fluctuations in populations are likely to occur, depending on environmental factors. Future trends in user characteristics, success rates, and demand likely will parallel trends of recent times. While no significant statewide increase in demand to hunt grouse is expected for

the duration of this planning period, use opportunity may decrease if access to grouse habitat is restricted.

This assessment draws heavily on the results of published and unpublished research on Ruffed Grouse from elsewhere in its range, particularly the Lake States, and from Maine forest inventory data. An accurate assessment of Maine's grouse population is limited by: **1) a general lack of data quantifying the relationships between Ruffed Grouse density and habitat quality in Maine; 2) a lack of information regarding grouse population levels in Maine (i.e., lack of population monitoring); and 3) a lack of information regarding hunting pressure and harvest of Ruffed Grouse in Maine.**

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Table 2. Comparison of grouse harvest and grouse species plan objective harvests, 1975-1983.

Year	Harvest	Objective	Deviation (%)
1975	297,300	500,000	-41
1976	286,200	500,000	-43
1977	352,900	500,000	-29
1978	322,400	500,000	-36
1979	462,600	425,000	+9
1980	366,800	425,000	-14
1981	658,000	425,000	+55
1982	644,200	425,000	+52
1983	514,600	425,000	+22
Average	433,900	425,000-500,000	+24

Table 3. Winter ruffed grouse habitat suitability, 1985.

Wildlife Management Unit	Total Area (mi^2)	Grouse[1] Habitat (mi^2)	Grouse Habitat Suitability Index	Number of grouse Habitat Units
1	3,152	2,414	0.61	1,472
2	8,004	7,905	0.40	3,161
3	3,954	3,862	0.60	2,317
4	5,520	5,134	0.52	2,669
5	2,728	2,596	0.43	1,116
6	2,493	2,180	0.67	1,460
7	2,022	1,581	0.55	869
8	2,684	2,018	0.49	988
Statewide	30,557	27,690		14,052

[1]Grouse habitat figures include white/red pine, spruce/fir, ash/red, maple/elm, oak/pine, central hardwoods, northern hardwoods, and aspen/birch forest cover types.

Table 4. Projected (1990) winter ruffed grouse habitat suitability.

Wildlife Management Unit	Total Area (mi^2)	Grouse[1] Habitat (mi^2)	Grouse Habitat Suitability Index	Number of grouse Habitat Units
1	3,152	2,414	0.61	1,472
2	8,004	7,905	0.38	3,004
3	3,954	3,862	0.57	2,201
4	5,520	5,134	0.49	2,515
5	2,728	2,596	0.43	1,116
6	2,493	2,180	0.63	1,373
7	2,022	1,581	0.52	822
8	2,684	2,018	0.49	988
Statewide	30,557	27,690		13,491

[1]Grouse habitat figures include white/red pine, spruce/fir, ash/red, maple/elm, oak/pine, central hardwoods, northern hardwoods, and aspen/birch forest cover types.

[2]HSI values are 95% of 1985 values for WMU's 2, 3, 4, 6, and 7.

Table 5. Current winter (1985) and projected winter (1990) maximum supportable grouse population by WMU.

Wildlife Management	1985 Maximum Winter Supportable Population			1990 Projected Maximum Winter Supportable Population		
Unit	Range		Best Guess	Range		Best Guess
1	29,400	117,800	95,700	29,400	117,800	95,700
2	63,200	252,900	205,500	60,100	240,300	195,300
3	46,300	185,400	150,600	44,000	160,100	143,100
4	53,400	213,500	173,500	50,300	201,200	163,500
5	22,300	89,300	72,500	22,300	89,300	72,500
6	29,200	116,800	94,900	27,500	109,800	89,200
7	17,400	69,500	56,500	16,400	65,800	53,400
8	19,800	79,000	64,200	19,800	79,000	64,200
Statewide	281,000	1,124,200	913,400	269,800	1,063,300	876,900

Table 6. Current (1985) and projected (1990) grouse population estimates by WMU.

Wildlife Management Unit	Estimated 1985 Population		Estimated 1990 Population	
	Spring	Fall	Spring	Fall
1	96,000	192,000	96,000	192,000
2	232,100	464,200	220,500	441,000
3	131,600	263,100	125,000	250,000
4	144,800	289,600	137,600	275,100
5	77,800	155,500	77,800	155,500
6	75,300	150,600	71,500	143,100
7	56,600	113,200	53,800	107,500
8	63,800	127,500	63,800	127,500
Statewide	878,000	1,755,700	846,000	1,691,700

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

Wildlife Management Units	Allowable Harvest[1]	Harvest	Estimated Number of Hunters	Successful Hunters	Percent Successful	Hunters/mi^2 of Grouse Habitat
1	114,800	93,500	16,500	14,200	86	7
2	211,200	79,700	10,600	9,400	89	1
3	139,500	88,400	14,600	12,400	85	4
4	125,300	110,000	33,200	22,900	69	7
5	72,400	62,500	11,800	9,400	80	5
6	80,800	40,300	10,600	4,900	75	5
7	62,600	38,300	14,500	9,500	66	9
8	62,900	41,200	20,300	11,800	58	11
Statewide[2]	869,500	553,900	132,100	97,500	74	4

[1]The allowable harvest was computed for the estimated 1985 fall grouse population.

[2]Discrepancies between this Table and Table 1 are primarily due to rounding errors.

Table 8. Projected 1990 grouse harvests, effort, and success rates.

Wildlife Manageme Units	Allowable Harvest	Harvest[1]	Estimated Number of Hunters	Successful Hunters[2]	Percent Successful	Hunters/mi^2 of Grouse Habitat
1	114,800	81,900	14,000	12,000	86	6
2	188,000	71,250	10,000	8,800	88	1
3	126,400	77,400	13,500	11,500	85	4
4	110,800	95,000	30,500	20,700	69	6
5	72,400	51,000	10,000	8,000	80	4
6	73,300	35,150	10,000	6,700	74	4
7	44,900	33,300	14,000	9,300	66	9
8	62,900	30,000	20,000	10,500	58	9
Statewide[2]	793,500	475,000	122,000	87,500	74	4

[1]Harvest estimates by WMU were based on average % of statewide grouse hunters between 1979-1983 with a projected harvest of 475,000 birds.

[2]Estimates of the number of hunters and successful hunters parallel the estimates of hunters and successful hunters by WMU for 1979-1983.

Table 9. Past, present, and projected future grouse harvests (actual, allowable, and objective) and users (total and successful).

	Harvest			Users	
Year	Actual	Allowable[1]	Objective	Total	Successful
1972	373,800			89,900	69,900
1973	292,100			93,700	64,700
1974	295,700			89,400	61,700
1975	297,300	825,000	500,000	91,500	62,300
1976	286,200			88,800	60,400
1977	352,900			93,300	66,300
1978	322,400			86,500	62,300
1979	462,600	827,500	425,000	104,600	77,400
1980	366,800			103,800	71,600
1981	658,000			132,600	103,400
1982	644,200			133,800	99,000
1983	514,600			116,400	85,000
1985[2]	553,900	869,500		132,100	97,500
1990	475,000	793,500		122,000	87,500

[1]Assumes 32 grouse/mi^2 after hunting season.
[2]1985 estimates are based on data averaged over 1979 to 1983. These figures are high because of peak numbers of hunters and harvests in the early 1980's.