BLACK BEARS AND THE OAK RESOURCE IN NORTHEASTERN MINNESOTA

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ABSTRACT. Acorns (Quercus spp.), the only high quality fall bear food in many eastern hardwoods forests, enable black bears (Ursus americanus) to forage and fatten 1-2 months longer each year than would otherwise be possible. Oak trees are scarce in northeastern Minnesota, and black bears grow, mature, and reproduce more slowly there than where oak is common. Black bears foraged for acorns up to 119 miles outside their usual ranges in northeastern Minnesota. Oak stands in northeastern Minnesota are often limited in acreage or poor in quality but are beginning to receive more consideration in timber management prescriptions for their wildlife and biodiversity values. Regeneration methods for oaks on the shallow soils of the Canadian Shield are poorly known. There is a need to identify existing oak stands in northeastern Minnesota and to develop methods for maintaining this important forest type.

BLACK BEARS AND OAKS IN EASTERN NORTH AMERICA

Acorns are eaten by over 96 species of birds and mammals across North America and constitute perhaps the most important wildlife food on the continent (Martin et al. 1951). Black bear migrations to oak forests have been documented in Michigan (Kennicott 1859:252), Wisconsin (Moore 1928, Cooke 1940:420), Minnesota (Rogers 1987:33). Tennessee (Garshelis and Pelton 1981. French 1985), and Ontario (Ranta 1979). In southern Ontario on 8 September 1977, Ranta (1979) observed 32 bears feeding on bur oak (Quercus macrocarpa) acorns along an 8-km stretch of the Wanapitei River. In Great Smoky Mountains National Park, Tennessee, Garshelis and Pelton (1981) found that radio-collared black bears gathered in white oak (Q. alba) stands each fall. As acorns ripen throughout the southern Appalachian mountains, black bears often leave available berry crops and even cease panhandling activities to move into acorn producing areas (Pelton 1989). At that time of year, black bears adjust systemically and hormonally to increased digestion of fats and carbohydrates at the expense of protein digestion, according to preliminary digestibility studies of penned bears (Brody and Pelton 1988).

When acorn crops fail, black bears in eastern hardwoods forests commonly roam widely in search of food (Matson 1946, Schorger 1949, Pelton 1989). Black bears in Tennessee moved 2-4 times farther in fall in years of poor acorn crops than in years of abundance (Pelton 1989). Schorger (1949) reported spectacular migrations of black bears in Wisconsin in poor years, with some bears moving outside the usual bear range and being shot. An acorn crop

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failure in Great Smoky Mountains National Park in 1984 resulted in 20 bears being shot in surrounding farmlands and subdivisions (Pelton 1989).

In the southern Appalachians, shortages of acorns, especially of white oak (Q. alba) acorns, significantly reduce birth and survival rates of black bears (Pelton 1989, Eiler et. al. 1989). Poor acorn production results in delayed sexual maturity in young females and skips in the 2-year normal breeding interval of older females (Pelton 1989, Eiler et al. 1989). There is a significant linear relationship between abundance of white oak acorns and percentage of lactating females the following summer (Pelton 1989, Eiler et. al. 1989). An acorn crop failure in 1984 caused near total reproductive failure in black bears in Great Smoky Mountains National Park (Pelton 1989). Cub and yearling survival rates range from < 20% to >80%, depending upon acorn production (Pelton 1989). Significant population declines occur when there are more than the usual number of years of poor acorn production (McLean, Univ. of Tennessee, unpublished data; Pelton 1989). Although acorns of the white oak group may be preferred over those of the red oak group (Martin et. al. 1951, Garshelis and Pelton 1981), members of the red oak group may be more reliable producers, with some acorns being produced each year and good crops every 2-5 years (Fowells 1965, Elias 1980).

Black bears show higher growth and reproductive rates in Pennsylvania than they do anywhere else, partly due to the abundance and variety of oaks there (Alt 1980, Kordek and Lindzey 1980). Thirty-eight percent of Pennsylvania females produce litters by 3 years of age, and 88% do so by 4, with litters averaging 3 cubs every 2 years thereafter (Kordek and Lindzey 1980). Minnesota females without acorns show lower reproductive rates (see below). By the time those females produce their first litters at 6 years of age, Pennsylvania females would have produced 2 litters, and some of the cubs from the first litters would be producing cubs of their own.

BLACK BEARS AND OAKS IN NORTHEASTERN MINNESOTA

In northeastern Minnesota, northern red oak (Q. rubra), pin oak (Q. ellipsoidalis), and bur oak occur in widely scattered patches (Lakela 1965, Elias 1980); but none is abundant. Together, these species comprise <0.05% (1/2,000th) of the total acreage of the Superior National Forest (Superior National Forest file data, Duluth, MN). Consequently, acorns and other hard mast are lacking in most parts of northeastern Minnesota in fall, and bears must fatten in summer on soft mast. Hazelnuts also are an important summer food in some years. Bears in northeastern Minnesota begin to lose weight and become lethargic in preparation for hibernation in September, the month when bears in oak forests are often beginning a 1-2 month period of rapid weight gain on acorns (Rogers 1987). The majority of bears in northeastern Minnesota enter dens in late September or early October, 1-3 months earlier than bears in oak forests. As a result, black bear growth and maturation are slower in northeastern Minnesota than in oak forests (Rogers and Allen 1987).

During 1971-1976, 14-23 mature female black bears were radio-tracked per year in a portion of the Superior National Forest where oaks were absent. Scattered stands of northern red oak existed 15-30 miles to the south, and 1 of the radio-collared bears (Female 320) found them. In 1971, 1972, and 1976, she concentrated her fall feeding in an oak stand 19 miles outside her territory and visited other oak stands up to 11 miles farther away. In years when acorns were scarce (1973, 1974, 1975), she fed on raspberries, dogwood berries, hazelnuts, and mountain ash berries in the vicinity of the oak stands. Those foods were more abundant there than in her home area which she left each year in late summer or fall.

The value of the acorns to Female 320 became apparent in 1972 when we obtained weights for Female 320 in spring and fall and compared them to weights of 7 mature females that did not find acorns (Table 1). Wild fruits were scarce that year. Female 320 left her den that spring weighing 120 pounds, 22 pounds less than the average weight (142 pounds) of the 7 other females (Table 1). The 7 gained an average of only 8% through the year, and 1 of them lost weight. Female 320 fed on acorns in September and early October and nearly doubled her weight; she entered her den weighing 237 pounds (Table 1). While Female 320 fattened on acorns, the other females lost weight: a 5-year-old that weighed 188 pounds on 8 September 1972 weighed only 157 on 28 October, and an 11-year-old that weighed 212 on 9 September weighed 197 on 25 October.

Table 1. Weight, gains by mature female black bears with and without access to acorns in northeastern Minnesota, 1972.

Age (yrs)	Spring Wt. (lbs)	Fall Wt. (lbs)	Percent change	Dates weighed
No acorns available				
5	130	157	+21%	Mar 11 – Oct 28
5	136	136	0	Mar 13 – Nov 8
7	113	126	+12%	Mar 31 – Nov 17
7	146	148	+1%	Mar 26 – Oct 21
7	171	189	+11%	Mar 19 – Oct 22
11	139	124	-11%	Mar 25 – Nov 3
11	156	197	+26%	Mar 11 – Oct 25
Average	142	154	+8%	Mar 22 – Oct 31
Acorns available				
11	120	237	+98%	Mar 12 – Nov 6

The bears that weighed 157, 126, 197, and 237 pounds in fall were, due to give birth in January, according to the normal 2-year cycle of reproduction, but only the 2 heaviest did so.

Black bear fecundity correlates with food supply and fall body weights (Rogers 1987). The females listed in Table 1 further demonstrated these relationships. Female 320 and 3 others that mated in 1972 were due to produce litters in January 1973, but only 320 and the heaviest (197 pounds) of the other 3 did so (Table 1). Black bear females that weigh less than 148 pounds in fall rarely give birth; those that weigh 148 to 175 in fall may give birth but experience unusually high cub mortality; and those that weigh 176 pounds or more in fall usually produce heavy cubs that survive well (Rogers 1976).

Female 320 produced litters of 3 cubs every other year during the 7 years her reproductive rate was monitored (8-14 years of age). Her cubs were significantly ($P < 0.001$) heavier by fall, on the average (53.5 pounds), than 57 other cubs born in the study area during the same period (38.1 pounds), and 88% of her cubs survived through 1 year of age (Rogers 1987). By contrast, females without access to acorns produced their first cubs at 6.4 years of age, on the average (range 4-8 years, N = 16), with litters averaging only 2.33 cubs (range 1-3, N = 48) and survival averaging less than 75% through 1 year of age. Female 320 produced cubs every 2 years, whereas intervals between litters for other bears in the study averaged 2.3 years (range 2-4, N =32). The greatest habitat deficiency for black bears in northeastern Minnesota appears to be scarcity of mature oak. At least 2 of the cubs that Female 320 led to the oak stands returned there independently. One of them became the only female born in the study area to produce cubs at 4 years of age and raise them successfully, as is common in states where oaks are abundant.

An 11-year-old male moved 119 miles from northeastern Minnesota to the vicinity of Palisade, Minnesota, to forage in an oak area well known to local hunters for its high bear use. The bear foraged there from 9 September to 15 October 1976, and returned home, entering his den on October 24 weighing over 425 pounds (estimated from his weight of 360 pounds the following March).

OAK PRESENCE IN NORTHEASTERN MINNESOTA

Twenty-two oak stands, <5 to 154 acres in size, are located in southern Lake County 1-7 miles inland from Lake Superior. All are perched on south-facing rock outcrops where shallow (but loamy) soil reduces competition with aspen, birch, maple, and other species. Some are up to 24 inches dbh. Two people walked the length of the largest of these stands, a 154-acre stand 0.9 mile in length, on 17 October 1988, and in 1 hour tallied 13 trees freshly climbed by bears, 15 flushed ruffed grouse, and numerous places raked by deer. Additional stands of large old red oaks are located in the vicinity of the Laurentian Shield in central St. Louis County north of Virginia and Aurora.

Scrubby stands of red oak (5-15 feet tall) occur in northern St. Louis County on very shallow soil on south-facing rock outcrops. Most of these trees are deformed from bears repeatedly breaking the branches to obtain acorns.

The declining oak resource in northeastern Minnesota is important to the biodiversity of the area. Xeric hardwoods communities, including oak communities, are very scarce in that part of the state, and oaks are of disproportionate value to wildlife, including black bears, ruffed grouse (Bonasa umbellus), and deer (Odocoileus virginianus). Acorns usually require little energy expenditure to acquire, and only about 12 acorns are needed to meet the daily energy requirements of grouse (Kirkpatrick 1989). Where oaks are scarce, loss of a single stand can leave a large area without acorns.

OAK RESEARCH AND MANAGEMENT NEEDS IN NORTHEASTERN MINNESOTA

Minnesota's oak resource is declining, and nowhere is this more of a problem than in northeastern Minnesota where oaks were scarce to begin with. Some of the scrubby, noncommercial oak stands of northeastern Minnesota have been converted to spruce, pine, or even wildlife openings. Other stands undoubtedly have been lost to competition from other tree species after decades of fire suppression. Losses of oak often go unnoticed by forest managers because scrubby patches of noncommercial oak, valuable to wildlife, are often too small (<5 acres) to be mapped or noted in stand management prescriptions. Lack of knowledge of oak locations remains a problem. There is a need to map all remaining oak stands in St. Louis, Lake, and Cook Counties and enter the locations into a geographical information system (GIS) data base readily available to federal, state, county, and private forest managers.

A second problem is that no method has been developed for maintaining or regenerating our 3 native oak species on the shallow soils of the Canadian Shield (Lorimer 1989). Oak ecology has not been adequately studied in that or similar northern areas (Crow 1988, Lorimer 1989). We recommend that oak studies in northeastern Minnesota begin with the basics: identifying species (including hybrids), identifying site characteristics important to each species, and identifying key factors affecting oak survival. Regeneration methods such as clearcutting or burning that have been successful elsewhere have not been tested on the shallow, easily desiccated soils of the Canadian Shield. Tests are needed to determine whether these methods or shelterwood, seed tree, or group selection methods best maintain mast production in this area.

As site characteristics of existing stands are learned, appropriate new sites may be identified for experimental outplantings. Such plantings could provide opportunities to determine which oak regeneration methods from other areas (Sander 1977, Crow and Isebrands 1986, Crow 1988, Kotar et. al. 1988, Lorimer 1989, Rau 1990) are most effective in this area. Some tests have already begun.

As demands for forest products increase, and timber management intensifies, the need to understand ecological relationships within and among forest communities also increases. The fact that oaks attract wide-ranging omnivores indicates a need to evaluate oaks in regional contexts as well as in local contexts. Longer cutting rotations or total

preservation of some stands may be appropriate to take advantage of the heavy acorn production of fully mature trees. In warmer regions, northern red oak begins to fruit when approximately 25 years old but does not produce abundant acorns until 50 years of age (Fowells 1965). Good acorn production may then continue for 100 years or more (Fowells 1965, Elias 1980), with maximum production occurring when a tree is around 20-22 inches dbh (Downs and McQuilkin 1944). Productivity data are needed for northern oaks if forest managers are to devise management policies for this scarce and disproportionately important resource.

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