BALD EAGLE ASSESSMENT

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Final Draft
January 30, 2004

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INTRODUCTION

Since 1968, the Maine Department of Inland Fisheries and Wildlife (MDIFW) has developed wildlife species assessments to establish management goals, objectives, and strategic plans. Assessments are based upon available information and judgments of wildlife biologists responsible for individual species or groups of species. Previous plans for bald eagles (*Haliaeetus leucocephalus*) were completed in 1976, 1980, and 1986. The last plan was updated in 1991 and again in 1996.

Assessments provide the background for species planning initiatives. A "Natural History" section reviews biological characteristics of the species useful to understanding its status. The "Management" section recaps previous actions, strategic plans, relevant rules, and regulatory authority. Historic, current, and projected future conditions for the species are discussed individually for "Habitat," "Population," and "Use and Demand" analyses. The major points of an assessment appear in a "Summary and Conclusions."

State management programs for bald eagles have been ongoing since 1976. MDIFW, the U. S. Fish and Wildlife Service (USFWS), the University of Maine, and the National Park Service collaborated on 6 graduate research studies of Maine's eagles from 1976 to 1997. This assessment is based primarily upon this work as well as continuing inventory and management efforts. Other data are provided as necessary to fill information gaps or strengthen crucial findings. A management system (MDIFW 1989) outlined decision-making processes and state criteria for bald eagle recovery. Programs in Maine and 23 other states evolved under the framework of the Northern States Bald Eagle Recovery Plan (USFWS 1983).

NATURAL HISTORY

There is extensive literature on bald eagles, a bird esteemed since 1782 as the national emblem of the United States. Early studies examined their natural history. Lincer *et al.* (1979) compiled > 2000 articles on bald eagles published by 1978. A recent literature search found > 1500 additional references. Research during the last 24 years focused on management needs and challenges to species recovery. There are many excellent accounts of eagle biology and conservation (Herrick 1934, Bird *et al.* 1983, Green 1985, Swenson *et al.* 1986, Stalmaster 1987, Gerrard and Bortolotti 1988, Palmer *et al.* 1988, Beans 1996, Buehler 2000).

Description

Bald eagles are the largest bird of prey regularly seen in Maine. Golden eagles (*Aquila chrysaetos*) are similar in size but are very rarely seen. An eagle's fully extended wings span nearly 7 feet (Figure 1b). Body weights range from 9 to 13 pounds. Females are 10 -20% heavier than males, but the sexes are otherwise similar. We easily recognize adult bald eagles (Figure 1a) by their striking plumage. White feathers on the head, neck, and tail sharply contrast the dark brown body plumage. Their common name is derived from an old English / Welsh word "balde" meaning "white," not "devoid of feathers!" The scientific name literally translates as "white-headed sea eagle." Adult bald eagles have a yellow beak, cere, and iris.

Immature bald eagles, less well known, superficially resemble golden eagles. Body feathers are brown, variably mottled with white. There are 4 annual molts of juvenile plumage. First-year eagles are almost entirely dark-feathered, the beak and cere are black, and the iris is chocolate-colored. Feathers on the head and neck,

Figure 1. Adult plumage (a), flight silhouette (b), and subadult (= immature) plumages (c) of bald eagles.

(a) 

(b) 

(c) 

eye color, and beak color all lighten with age until the definitive adult plumage and sexual maturity are reached at 5 years of age (Figure 1c, McCollough 1989). The terms “juvenile, immature, or subadult” merely indicate the dissimilar plumages of individuals not yet of breeding age, not a smaller body size than adults.

A distinctive silhouette and flying behavior enable distant identification of bald eagles (Clark 1983). They frequently soar or glide effortlessly on large wings extended in a straight-line, horizontal plane. Large raptors sometimes mistaken as bald eagles soar differently. Golden eagles and especially vultures (C*athartes* spp.) hold their wings above the horizontal, while ospreys (*Pandion haliaetus*) curve their wingtips downward. Individual primary feathers of these birds appear as “fingers” near the wingtips. A bald eagle’s large “lobster claw” beak creates a large head / neck profile, almost half as long as the tail during flight (Wheeler and Clark 1995).

Taxonomy

Bald eagles and other diurnal birds of prey are in the order Falconiformes. There are 5 taxonomic families -- including Accipitridae with approximately 205 species of eagles, hawks, kites, Old World vultures, and harriers. In this group, the genus *Haliaeetus* (sea eagles) is present on every continent except South America. Eight species of sea eagles are known worldwide. Bald eagles are most closely related to white-tailed sea eagles (*H. albicilla*) found in Europe and Asia.

Two subspecies of bald eagles, northern (*H. l. alascanus*) and southern (*H. l. leucocphalus*), were once recognized on the basis of size differences on either side of the 40th parallel. Thus, small males from Maine are bigger than large females from

Florida. This is attributed to clinal variation and no longer considered a valid distinction between subspecies (Stalmaster 1987, Palmer *et al.* 1988).

Distribution and Movements

Bald eagles are the only eagle species restricted to North America. They now breed in 48 states, all Canadian provinces, and northernmost Mexico (Buehler 2000). A fossil record in Hawaii is a relative, the white-tailed sea eagle (Fleischer *et al.* 2000). Infrequent reports from Greenland and Siberia are the only recorded departures of bald eagles from North America. They are numerous only in a few regions such as Alaska, the Great Lakes states, the Pacific Northwest, and parts of interior Canada. The primary strongholds of bald eagles along the Atlantic seaboard are Florida, the Chesapeake Bay (Maryland and Virginia), Maine, and Nova Scotia.

Bald eagles have been slow to reoccupy their former breeding range. New York, Massachusetts, and several states in other regions hastened species recovery by conducting reintroductions (Nye 1983). The species is still sparsely distributed in western Maine and elsewhere in New England. They do not nest in Vermont at present, although historic breeding is questionable there (Mattson 1988). In 2003, Maine supported 91 of 341 bald eagle pairs nesting in New England (Amaral unpubl). Adults seem to be non-migratory (Todd 1979), but nearly half of the first-year cohort moves southward during fall and early winter (McCollough 1986).

There is an influx of wintering eagles into the lower 48 states from Alaska and Canada (Spencer 1976). Individuals identified in Maine during winter were mostly (83%) from Maine, but also included thirty from the Canadian Maritimes and one each from South Carolina, Michigan, Ontario, and Saskatchewan. All but 2 visitors were

subadults (McCollough 1986). Non-breeding eagles dispersing from Florida summer in Maine and eastern Canada (Broley 1947).

Eagle abundance and distribution increase during the winter in many regions, especially in central and southern states (Millsap 1986) and in Mexico. This trend is not very evident in Maine, although many eagles shift from inland to coastal regions in winter. Midwinter populations elsewhere in New England rival Maine's totals and likely include dispersing eagles from Maine and eastern Canada. Wintering eagles in New York include many migrants from Quebec and Ontario, although one was an adult nesting along the Maine / New Brunswick border in 2000 (Nye pers. comm.).

Fifty-eight eagles with Maine origins have been observed outside the state: predominantly subadults in New England, New York, and the Chesapeake Bay region. The most distant and rapid dispersal from Maine was a first-year eagle found 900 miles away in South Carolina only 15 weeks after fledging (Todd 1979). One radio-tagged eagle made three trips from eastern Maine to Connecticut during a 17-week period in its first winter and the following spring (McCollough 1986).

Eagles winter statewide but distribution is skewed toward the coast. Adults have been seen during midwinter at > 125 nests in coastal Maine and > 50 inland. They are rather sedentary and shift locally only to acquire food (Todd 1979). Year-round residency facilitates territory retention (Fraser 1981, Buehler *et al.* 1991c). Chronic use of wintering sites is evident, although 14 subadults moved 65 - 135 miles during midwinter (McCollough 1986). Subadult eagles are notoriously mobile and will react to locally abundant foods (Knight and Knight 1983, 1986; Restani *et al.* 2000). Many researchers cite fidelity to traditional wintering areas (Harmata and Stahlecker

1993). Wintering eagles use communal, nocturnal roosts in many areas in order to optimize their microclimates (Buehler *et al.* 1991d, Adams *et al.* 2000).

Habitat and Diet

In all seasons, bald eagles usually associate with seacoasts, rivers, or lakes. Proximity to open water with adequate prey, mature trees in shoreland zones, and limited human activity are fundamental habitat requirements. Energy demands of developing eaglets far exceed those of adults (Dykstra and Karasov 2001). This favors nest sites near food supplies. Eagles breeding in Maine occupy an array of settings. Nesting distribution is equally divided between coastal and inland habitats.

Table 1. Principal habitats at 402 bald eagle nesting areas in Maine, 1962 – 2003.

Coastal Maine	**[subtotal = 191 nesting areas (48%)]**
♦ Estuarine (tidal rivers, coastal mainland & islands < 1 mile offshore)	90 nesting areas (23%)
♦ Marine (coastal islands 1 - 10 miles offshore)	101 nesting areas (25%)
Interior Maine	**[subtotal = 211 nesting areas (52%)]**
♦ Lacustrine (lakes, ponds & impoundments)	166 nesting areas (41%)
♦ Riverine (rivers & streams)	45 nesting areas (11%)

Fish are widely preferred foods of bald eagles. Eagles fish mostly in shallow, low-velocity waters or intertidal areas. Large lakes (> 2000 acres) and wide rivers (> ½ mile width) are favored (Todd 1979). Chain pickerel (*Esox niger*), brown bullhead (*Ictalurus nebulosus*), suckers (*Catostomus* spp.), and perch (*Morone americana, Perca flavescens*) are typical prey in interior Maine (Todd *et al.* 1982, Welch 1994).

In coastal waters, eagles nesting inshore eat mostly migrant fish such as alewives (*Alosa* spp.) or eels (*Anguilla rostrata*) and bottom-dwellers like sculpins (*Myoxocephalus* spp.). However, the diet offshore includes waterfowl, seabirds, and

wading birds (Todd *et al.* 1982, Young 1979). Most are caught in foraging or molting flocks, not at nest colonies. Attacks on great blue herons (*Ardea herodias*) are an exception. Gulls (*Larus* spp.), cormorants (*Phalacrocorax* spp.), eiders (*Sommateria* spp.), and black ducks (*Anas rubripes*) are typical prey in coastal Maine (Todd *et al.* 1982) and nearby New Brunswick (Wright 1953, Stocek 2000).

Bald eagles use opportunistic foraging strategies (Watson *et al.* 1991). They can catch their own food (predation), especially seasonally abundant prey. Thus, Maine eagles have been observed wading in runs of alewives or eels, swimming in schools of shrimp, or patrolling flocks of waterfowl and seabirds. Eagles regularly eat carrion (scavenging) and will consume dead deer, livestock, seal pups, etc. They can forcibly take food (kleptoparasitism) from other fish-eating birds.

Such habits are common in winter when ice cover limits foraging prospects. Coastlines and major rivers that remain ice-free are Maine's primary winter habitats. In the central and southern U.S., wintering eagles also use lakes, reservoirs, or uplands (Millsap 1986). Wintering eagles often congregate near dams that maintain open waters, stun fish, and often concentrate waterfowl (Spencer 1976).

Breeding Ecology

The long breeding season entails 7 - 8 months of residency at nests. Adult associations with nests in Maine may continue through winter. Claims to territories, courtship flights, and nest repairs intensify during February and March. Peak timing of reproductive events is 4 - 5 weeks later in interior Maine than in coastal areas. Breeding phenology can vary by as much as 6 weeks locally (Todd 1979).

A clutch of I - 3 eggs is laid as early as February 25 in coastal Maine or as

late as May 6 inland. Incubation, mostly (80%) by the female, lasts 35 days (Herrick 1932). Renesting is infrequent in northern latitudes, but 5 cases are documented in coastal Maine. All were early failures with renesting by the end of April. This option is lost for failures occurring later. Second clutches are more common among eagles nesting in Florida's where breeding begins in December (Wood and Collopy 1993).

Hatching occurs between April 1 and June 10 statewide, mostly during May. Eaglets stay in nests 11 - 13 weeks before fledging between late-June and August. Fledglings in Washington Co. accompanied their parents in adults' home ranges for 5 - 10 weeks before dispersal during August 20 - October 21 (McCollough 1986). Other studies revealed postfledging activity at nests lasting 3 - 18 weeks (Gerrard *et al.* 1974, Harper 1974, Kussman 1976, Hunt *et al.* 1992, Wood *et al.* 1998).

Bald eagles are thought to mate for life. Replacement of a deceased mate can occur within the same season if populations are secure and a surplus of non-breeding adults exists (Jenkins and Jackman 1993). Such events occur now in Maine, but adult deaths once led to years of residency by a single adult when the population was in jeopardy. Competition can sometimes lead to premature mate replacement in established pairs. In 1993, an aggressive male displaced a marked adult that had inhabited a Hancock Co. nest for at least 3 years.

Breeding pairs habitually occupy a nest or local assemblage of alternate nests. Many nesting areas in Maine are used by successive generations of eagles. Nests are large (averaging 4 feet wide and 3 feet deep, but become bulkier with prolonged use), flat-topped, and constructed of sticks with finer vegetation lining a well-defined nest bowl. Bald eagles usually construct nests under a live, open crown of a

prominent tree at heights above the surrounding forest canopy. Tall pines (*Pinus* spp.) are favored wherever available; 65% of 974 different nest trees used by eagles during 1962-2003 were white pines (*P. strobus*), the state tree. Eagles use treetop nests (similar to those of ospreys) in deformed spruces (*Picea* spp., 25% of all sites) only on Maine's coastal islands where pines are often lacking. Hardwood trees (supporting 9% of 974 eagle nests documented in Maine) include northern red oaks (*Quercus rubra*), birches (*Betula* spp.), and aspen (*Populus* spp.).

A total of 974 nests found in Maine during 1962-2003 were all < 5918 feet from open water, but the majority (91%) are within 1320 feet. In fact, most (69%) are within 250 feet. Nest locations near water provide proximity to foods and easy flight access. Access to upland nests may be enhanced by adjacency to forest edges or topography. Clear flight paths to nests, updrafts favorable for flying, and optimal visibility are benefits of nests near an ecotone. The quality of foraging areas is the foremost factor in eagle habitat selection (MacDonald and Austin-Smith 1989).

Survival, Longevity, and Recruitment

Survival of hatch-year fledglings in Maine averaged 73% (McCollough 1986). A winter feeding program may have boosted this rate, but similar survivorship was noted in Prince William Sound, Alaska (Bowman *et al.* 1995). Low first-year survival typifies high-density populations in parts of Saskatchewan (Gerrard *et al.* 1978), southeast Alaska (Hodges *et al.* 1987), and Florida (Wood 1992). Higher survival rates have been measured in recovering populations in Maryland (Buehler *et al.* 1991e) and the Yellowstone region of Montana and Wyoming (Harmata *et al.* 1999).

McCollough (1986) reported 85% annual survivorship among second- and

third-year eagles in Maine increasing to 95% in older birds. Comparable data are reported from all but two (Hodges *et al.* 1987, Harmata *et al.* 1999) of the studies above. The latter theorized that the near adult plumage of eagles aged 3 - 5 years led to their exclusion from optimal foraging areas by resident adults and increased mortality in these age classes. This is presumably a density-dependent influence. A normal lifespan is 15-20 years. Longevity records are 22 years in Maine, 28 years elsewhere in the wild (Schempf 1987), and 39 years in captivity (Wiemeyer 1981).

Recruitment is poorly documented in most populations. Encounters with adults that were banded as nestlings in Maine have been virtually all in either Maine or New Brunswick. One emigrated to Labrador. Maine's resident eagle population is closely allied to those in adjacent areas of New Brunswick and potentially all of the Maritime provinces of Canada. There are a few instances of immigration into Maine's breeding population. A male from Michigan resided at a Hancock Co. nest for at least 2 years (Matz unpubl.). A female from Nova Scotia was found near a Penobscot Co. nest. Two adults from a reintroduction program in Massachusetts appeared separately at nests in coastal Hancock Co. and northern Piscataquis Co.

Recruitment rates and age at first breeding are unknown in Maine. Harmata *et al.* 1999) found the mean age of first breeding was 6 years at locations averaging 65 miles from the natal nest. There is some initial evidence supporting a popular theory that females can disperse farther from natal sites because of intense, resource-based competition among males (Greenwood 1980). In other words, females are relatively free to relocate since it is beneficial for males (which establish territories) to be more familiar with local foods, hazards, etc.

MANAGEMENT

Regulatory Authority

Both federal and state governments have authority for bald eagles. Agencies undertake these responsibilities cooperatively. There are enforcement provisions in both federal and state courts. The Code of Federal Regulations (CFR) and U.S. Code (USC) reference applicable federal rules and statutes, respectively. Maine's Revised Statutes and Annotations (MRSA) cite pertinent state legislation.

The traditional protection of eagles as a migratory bird was bolstered by its inclusion on both federal and state lists of Threatened and Endangered Species in all 48 contiguous states (Federal Register 43: 6230-6233). In 1978, the species was designated "Threatened" in 5 states (Michigan, Minnesota, Oregon, Washington, and Wisconsin) and "Endangered" in Maine and 42 others. This triggered automatic recognition as "Endangered" on the state list under original provisions of Maine's Endangered Species Act. Widespread improvements among eagle populations led to federal reclassification of the species as "Threatened" across the lower 48 states in 1995 (Federal Register 60: 36000-36010). In 1996, the Maine legislature enacted a MDIFW proposal to also "downlist" the species to a status of "Threatened."

Federal Legislation and Regulations: Four federal statutes directly protect bald eagles: the Endangered Species Act (16 USC: 1531-1543), the Bald and Golden Eagle Protection Act (16 USC: 668-668d), the Migratory Bird Treaty Act (16 USC: 703-711), and the Lacey Act (16 USC: 3372 and 18 USC: 42-44). All prohibit "take," defined as possession, transport, export, import, purchase, sale, trade, or offer to exchange of eagles, parts thereof, eggs, or nests. Permits may be granted for

scientific or exhibition purposes. Regulations prohibit falconry use of eagles and allow Native Americans to possess eagle parts for ceremonial use (50 CFR 22).

Protection of eagle habitat is considered during reviews of activities requiring federal funds or permits through Section 7 of the U.S. Endangered Species Act: It directs USFWS and the Secretary of the Interior to consult with other federal agencies "to insure that actions authorized, funded, or carried out by them do not jeopardize the continued existence of Endangered and Threatened Species or result in the destruction or modification of habitat of such species which is determined to be critical." Critical habitat was never formally designated for bald eagles.

Other federal laws are important. The Clean Water Act, Clean Air Act, National Environmental Policy Act, and Pesticides Control Act address contaminant issues that plagued eagles, other raptors, and fish-eating birds. Safety measures to lessen electrocution hazards from power lines appear in the Rural Electrification Act.

State Legislation and Regulations: Enabling state laws (12 MRSA, Chapter 713) direct MDIFW to "preserve, protect and enhance the inland fisheries and wildlife resources of the state; encourage the wise use of these resources; ensure planning for the future use and preservation of these resources; and provide for the effective management of these resources" (§7011). State protection for bald eagles is bolstered by their status as "Threatened" in Maine (§7753). Prohibitions (§7756) under Maine's Endangered Species Act (1975) and a 1987 amendment include:

- export from the state;
- hunting, trapping, or possession in the state;
- transport, delivery, carry, ship, sale, offering for sale or processing;
- deliberate feeding, baiting, or harassment (except for educational or scientific purposes intended to enhance its survival or propagation).

Incidental take is a new provision (§§7756.2-C, D) enacted in 1999 stipulating that lawful activities which do not threaten the recovery of listed species may occur under a plan that minimizes such takings and is approved by the Commissioner.

A 1988 amendment to Maine's Endangered Species Act (§7755) created a mechanism for habitat protection. Areas designated as "Essential Habitat" are locales currently or historically providing physical or biological features vital to conservation of listed species and may require special management considerations. The statute directs that "a state agency or municipal government shall not permit, license, fund, or carry out projects within these areas without review by MDIFW." Essential Habitats are defined and mapped by rule. Protection guidelines (MDIFW Rules Chapter 4.10, Appendix 1) and Essential Habitat designations for bald eagle nest sites were first adopted in 1990. Annual updates continued through 2003.

Several other state laws also address eagle habitat. The Natural Resources Protection Act (38 MRSA Article 5-A) enables "Significant Wildlife Habitats" to be mapped for listed species. Permits are then required for alterations of soils, waters, vegetation, or permanent structures (§480-C). The Site Location of Development Act (38 MRSA Article 6) targets "developments of state or regional significance that substantially affect the environment" (§§482, 487-A). Important wildlife habitats, especially for listed species, are deemed unusual natural areas under this standard.

Some laws influence eagle habitat regardless of species status. The Shoreland Zoning Act (38 MRSA §§435-449) provides guidelines for setbacks, vegetation clearing, and land uses within 250 feet of large water bodies. Maine's Comprehensive Growth Management Act (30-A MRSA) lists state goals to guide local

comprehensive planning and land use ordinances required in all municipalities (§§4312, 4321). The overall theme is to promote orderly development. Approved plans must include: "protection of the state's other critical natural resources, including without limitation, wetlands, wildlife and fisheries habitat." State policies are attempting to address the sprawl of urban and suburban communities. The Land Use Regulation Commission (12 MRSA) administers a comprehensive plan for land uses (§§685A-C) within "wildlands" in the state's unorganized townships.

Protection for wild birds assures perpetually closed seasons on bald eagles and all other birds (except game species, §7401). Hunting, possession, and destruction of nests or eggs are prohibited (§7456). Special permits may apply:

- "exhibition" = any person intending to keep, purchase, sell, or transport wildlife for either exhibition or attracting trade (§7231);
- "rehabilitation" = temporary care of injured wildlife (§7235-B);
- "importation" = import, receive, or introduce wildlife (§7237);
- "transportation" = any person intending to take or transport wildlife within the state for breeding or advertising purposes (§7241); or
- "scientific collection" = actions related to approved research (§7242).

State falconry rules (MDIFW Chapter 4.08) prohibit the use of bald eagles. The Maine Indian Claims Settlement Act of 1980 conveyed management authority for all wildlife on lands owned by the Penobscot Indian Nation and Passamaquoddy Tribe.

Past Goals and Objectives

There are 3 previous strategic plans for bald eagles in Maine (MDIFW 1976, 1980, 1986). All state similar goals for species recovery. Objectives served as benchmarks for increasing populations or management thresholds within the traditional five-year horizon of early plans. Updates in 1991 and 1996 adjusted objectives attainable during extensions of the 1986 plan's tenure.

1975

- *Goal:* To increase Maine's breeding eagle population and support all agencies whose programs aid protection, research, and inventory of Maine's bald eagle population.
- *Objective:* To maintain or increase annual productivity (0.4-1.0 eaglets per nesting attempt) by 30-50 breeding pairs.

1980

- *Goal:* Restore a self-sustaining bald eagle population to suitable habitat throughout Maine.
- *Objective:* Increase Maine's breeding eagle population by average increments of at least 5-10 nesting pairs / 5 years (1985 target of 65 nesting pairs) and maintain productivity in excess of 1.0 eaglets per nesting attempt.

1986

- *Goal:* Increase the population and expand the range of breeding bald eagles, and maintain or improve the suitability of habitats for bald eagles. The goal is intended to eventually restore a self-sustaining population to suitable habitats throughout Maine.
- *Population Objective:* Increase the statewide bald eagle population to at least 100 - 110 breeding pairs (including increases of 5-10 pairs in WMU 7-8 and 5-10 pairs in WMU 1-4). Maintain a minimum productivity of 0.85 eaglets per occupied breeding area in WMU 5-6 annually through 1990.
- *Habitat Objective:* Maintain a broad distribution of suitable breeding habitats and improve the quality of feeding habitat in winter for bald eagles by 10% over 1985 levels by 1990.
- *Endangered Species Objective:* Establish criteria by 1990 for delisting of bald eagles from endangered and threatened status.

1991 & 1996 Updates

- *Goal:* Increase the population and expand the range of breeding bald eagles, and maintain or improve the suitability of habitats for bald eagles. The goal is intended to eventually restore a self-sustaining population to suitable habitats throughout Maine.
- *Population Objective:* Increase the statewide bald eagle population to at least 200 nesting pairs producing at least 200 fledglings per year.
- *Habitat Objective:* Protect 50 nesting areas through conservation ownership and an additional 100 nesting areas through ownership, easement, leases, management agreements, or regulations.

Past and Current Management

Many individuals and organizations have directly or indirectly aided bald eagle management in Maine. Major initiatives are summarized below.

Recovery Planning: Passage of Maine's Endangered Species Act in 1975 enabled joint state and federal efforts to recover federally listed species. USFWS developed 5 recovery plans for bald eagles: Chesapeake Bay, Southwest States, Northern States, Pacific Northwest, and Southeast States (USFWS 1982a, 1982b, 1983, 1986, 1989, respectively) to assess status, research needs, management strategies, and recovery criteria. Suggested population targets (Appendix 2) for Maine and 23 other states appear in the Northern States Bald Eagle Recovery Plan.

Population Surveys: Annual surveys to monitor the breeding population have been ongoing in Maine since 1962. Initial searches were ground- and boat-based (Sprunt and Ligas 1966). Such methods are impractical to census the vast, remote regions of suitable habitat in Maine. However, they clearly portrayed a declining population exhibiting severely depressed productivity (Sprunt *et al.* 1973). Aerial surveillance supplemented these efforts and replaced them after 1968.

Searches for new nests intensified in 1976, and the monitoring program has been consistent since (Postupalsky 1974, Todd 1988). An inventory of all traditional nest sites and searches for potential nests is conducted in late-March and April while resident eagles are actively breeding (Fraser *et al.* 1984). Occupied nests are rechecked in June or July to evaluate reproduction. These surveys are the primary means of gauging population size, trends, and distribution. They also guide research at nests, contaminant studies, and nest site management.

Periodic indices of Maine's winter population have used various methods. None have proven entirely satisfactory. Aerial surveys are required for dispersed populations (as in Maine) but are biased by the less striking plumage of subadult eagles. Todd (1979) found 4 local concentrations of eagles in coastal Maine; two were seasonal aggregations not related to year-round residency of breeding adults.

Observations of banded eagles at winter feeding stations yielded greater counts and subadult proportions (McCollough *et al.* 1994), due partly to altered dispersal. Monitoring key localities over time can verify trends (Dunwiddie and Kuntz 2001), but this approach has not worked well in Maine due to extensive winter habitat and considerable population shifts in response to variable winter severity.

Population Enhancements: Extraordinary measures were attempted to offset very low productivity and pending regional extirpation of eagles in western Maine. Addled, native eggs were replaced by eggs (1974 - 1976) or eaglets (1975, 1979, and 1981) from captive-breeding or donor populations. This created a supply of eaglets and potential recruitment in order to avoid more costly, risky management: reintroductions of the species after local extirpation (Engel and Isaacs 1982).

Various initiatives addressed the frequency of human-related deaths and injuries among Maine eagles. Publicity stressing legal protection, penalties, and eagle status arose in response to illegal shooting. The Maine Warden Service conducted special training and eagle enforcement functions in the late-1980s. Trapping regulations were revised to limit midwinter use of baits, and trapper education stressed avoiding non-targets. Eagles, sometimes caught by a single talon, seem uninjured but may succumb to stress or secondary infection without treatment

(Redig *et al.* 1983). Local bans on snaring, stop devices to prevent full snare closure, and precautions regarding baits were implemented after 2 accidental captures of eagles. Use of non-toxic shot in waterfowl hunting became mandatory by 1991 due partly to many cases of lead poisoning among eagles that ingested pellets after consuming hunter-killed or crippled ducks (Pattee and Hennes 1983).

Ice fishermen, trappers, farmers, and many others traditionally feed eagles in winter. Eagles, wary at the onset, will accept supplemental foods (McCollough *et al*. 1994), but safeguards are crucial. They are occasionally fouled in lures, hooks, or monofilament line from fish. Hunting coyotes over bait in Maine is synonymous with feeding ravens and eagles, but carcasses must not contain large-caliber bullets which cause lead poisoning (Harmata *et al.* 1999) or inappropriate poisons and medicines which are toxic to scavengers (Allen *et al.* 1996, Elliott *et al.* 1996a, Wilson *et al.* 1998). Agricultural carrion laws minimize this potential in Maine.

Modeling of eagle populations (Grier 1979, 1980) stressed efforts to increase eagle survivorship as the most effective means to increase their numbers. Large-scale provisions of supplemental foods for eagles wintering in Maine reduced mortality of first-year birds by as much as 19%, facilitated release of rehabilitated eagles, aided reoccupancy of nearby abandoned nests, and enhanced production of large broods by adjacent breeding pairs (McCollough 1986). Clinical treatment, rehabilitation, and release of injured eagles are a limited benefit, but are widely appreciated by the public and potentially helpful in regions of low population density.

Habitat Protection: In 1972, USFWS began agreements with Maine landowners to voluntarily establish a 330-foot radius sanctuary around active nests

and seasonally limit activities within 660 feet. MDIFW assumed this task in 1983 (Todd and Owen 1986). Seasonal buffers were enlarged to a 1320-foot radius around all intact nests. This ¼-mile radius better met the needs of nesting eagles in accord with public land policies and national guidelines (Mathisen *et al.* 1977, Garrett *et al.* 1993). Temporal strategies are crucial to minimize impacts of disturbance (Steidl and Anthony 1996). Individual management plans with site-specific guidelines were prepared in 1982 for property owners of 110 nest territories in Maine. Without meaningful incentives, many cooperative agreements for voluntary nest protection fell to escalating habitat pressures in the late-1980s.

Most decisions on land-use permits in eagle habitats occur on the town level. Inconsistent, subjective decisions by various communities led to dissatisfaction among all parties. New issues (*e.g.*, recreational use of state-owned islands and aquaculture projects in coastal waters) had no standards for consideration of eagles or other wildlife resources. The array and magnitude of these problems resulted in statute changes in 1998 and subsequent rulemaking by MDIFW to designate eagle nests as Essential Habitats (Appendix 1). This ensures advance notification to landowners and MDIFW review of any project permitted, licensed, funded, or carried out by towns and agencies. Evaluations are based on objective regulatory standards but are customized by site-specific circumstances.

Of 153 Essential Habitats reviews conducted since 1990, 79% required timing safeguards and 33% had siting considerations. Precautions were customized to individual sites depending on distances, buffers (woodlands and terrain), duration, and intensity of project activities. Tolerances of different eagle pairs and existing land

uses at a site are important considerations. Disturbance is usually correlated to noise level and distance (Buehler *et al.* 1991b, Fraser *et al.* 1996, Grubb and King 1991, McGarrigal *et al.* 1991, Stalmaster and Kaiser 1997). Eagles flushed at distances averaging 1650 feet from intrusions in Hancock Co., Maine (Matz 1997).

A total of 151 projects were approved during formal Essential Habitat reviews from 1990 - 2003. Only one was denied. Another received a variance. Decisions were mostly in organized townships (93%) and fully under municipal jurisdiction (65%). Projects were primarily home or camp construction and renovation (54%); utility or road projects (21%); and waterfront permits (docks, aquaculture, shore stabilization = 18%). Public acceptance of this rule was generally favorable due, in part, to staff respect for the needs of landowners and the stewardship role that they provide for nesting eagles. At least 7 projects escaped formal reviews, due largely to turnover among municipal officials in 5 Maine communities.

Acquisition of important eagle habitats in Maine by purchase or conservation easements has been ongoing for > 25 years. There is no program dedicated to purchase eagle habitat, but most agree that the burden of protecting nest sites cannot be borne alone by private individuals and corporate owners. In the mid-1970s, < 10 eagle pairs nested on conservation land. At present, 152 different eagle pairs have resided on conservation land and an additional 61 nesting areas benefit from local land conservation. Key cooperators in this initiative are MDIFW, the Maine Bureau of Parks and Lands, USFWS, Acadia National Park, The Nature Conservancy, Maine Coast Heritage Trust, and local land trusts (Appendix 3).

A notable proportion, 41% of all eagle nesting attempts during 1962-2003, occurred on sites now under lasting conservation status. This results from both key acquisitions and easements for eagle habitat as well as eagles pioneering on highly suitable "open space" parcels previously held by conservation organizations. Eagle habitat conservation also deals with local perching areas (Chandler *et al.* 1995) and roosts (Buehler *et al.* 1991a). The adequacy of conservation efforts to collectively serve as a habitat "safety net" for eagles (MDIFW 1989) is still under review.

The U.S. Environmental Protection Agency, Army Corps of Engineers, and Federal Energy Regulatory Commission formally consulted with USFWS on impacts to Maine eagles under Section 7 of the U.S. Endangered Species Act. Several consultations examined broader environmental influences such as water quality, paper mill discharges, dams, contaminants, and fish composting. Reviews of smaller projects subject to federal review (moorings, aquaculture, boating access funds, and Farmers' Home Administration loans) generally coincided with state regulatory actions.

An oil refinery proposed in Washington Co. during the late-1970s was initially denied permits because of concerns from potential oil spills and heavy metal emissions. Realities of the Exxon Valdez oil spill in Alaska, > 175 dead eagles (Bowman *et al.* 1997) and short-term population declines (Murphy *et al.* 1997), could have been catastrophic for the region's lone eagle stronghold in that area: Cobscook Bay and adjacent Passamaquoddy Bay, New Brunswick. Oil-spill contingency planning by MDIFW considers the vulnerability of bald eagles.

HABITAT ASSESSMENT

Historic Trends

Increased human populations, altered land uses, access to remote areas, depleted fisheries, reduced water quality, and contaminants have all degraded eagle habitats. Some impacts were tempered or partly reversed. For instance, cutting of nest trees and tall white pines was a limiting factor as early as 1900 in Sagadahoc Co. (Spinney 1926). However, many cleared lands have now reverted to forests. Woodlands cover 89% of Maine's land area. Intensive forest practices (e.g., short rotations, even-aged management, or stand conversions) can still be influential.

Similar debates arise in evaluations of food resources. For example, dams have both positive and negative influences. Shallow impoundments promote warm-water fisheries favored as the foods of eagles nesting in interior Maine. Wintering eagles often congregate at dams to enhance foraging opportunities. Conversely, fluctuating water levels in impoundments enhance the methylation of mercury, a contaminant passed to eagles via the food chain. As barriers to fish passage, dams can also reduce or eliminate seasonally important eagle foods such as alewives.

Another case history in coastal Maine further demonstrates the complexity of man's influences. Rich fisheries and numerous islands in the Gulf of Maine once provided ideal eagle habitat. Overfishing and clearing of islands for agriculture or settlement were major setbacks. Inshore fisheries improved little, but a rebound in seabird populations presented alternative prey. Unfortunately, a diet of gulls and cormorants boosts contaminant influences. Mature trees suitable for eagle nests are now present, but many are in even-aged stands at risk to disease or infestation.

Current Assessment

The availability of suitable habitat is not yet limiting to bald eagles nesting and wintering in Maine. Carrying capacity is undetermined since measures of food and disturbance impacts are inadequate. Conservative estimates exceed 500 nesting pairs in Maine. Lengths of shoreline and areas of large water bodies suggest abundant, potential habitat (Table 2). Separations of ¼ - ½ mile between pairs of nesting eagles (Howell 1937, Broley 1947, Robards and King 1966, Grier 1969, McEwan 1977) equate with the range of territorial defense behavior (Mahaffey and Frenzel 1987). Such statistics yield much higher estimates of carrying capacity.

Table 2. Indices of potential bald eagle habitat in Maine (MDIFW 1976, unpubl.)

Coastal Maine	
♦ Shoreline length of mainland + islands:	4,165 linear miles
♦ Intertidal area:	73.7 square miles
Interior Maine	
♦ Shoreline length of lakes >50 acres in size:	23,744 linear miles
♦ Area of lakes >50 acres in size:	1,476 square miles
♦ Shoreline length of rivers > ¼ mile in width:	? linear miles

Models for eagles nesting in four habitat types across Maine (Livingston *et al.* 1990, Appendix 4) proved valid during initial species recovery when low density enabled high selectivity. Eagles nesting along rivers opted for large basin areas, less forest edge, and closeness to shore compared to random sites. Lake settings used by eagles were positively associated with superdominant trees and negatively correlated to land areas subject to human use and distance to shore. Diadromous fish and areas of shallow water at low tide were positive associations at inshore

coastal estuaries, and length of roadways was a negative variable. Nesting on small islands in offshore marine habitats yielded a positive correlation to openings and negative correlations to forest edge and areas of shallow waters or intertidal areas.

The lack of correlation to foraging variables in the marine model implies that food availability is not limiting to eagles nesting in the Gulf of Maine (Livingston *et al.* 1990). Food supplies may influence eagles in other settings. Rich, diverse, and vulnerable foods clearly enhance eagles' opportunistic foraging (Peterson 1986, Hansen 1987), but they are difficult to quantify and model as habitat variables.

Urban, industrial, and commercial developments are potentially detrimental to eagle habitat unless specific habitat features are maintained in strategic settings. Of course, this is the exact intent of Essential Habitat regulations protecting bald eagle nest sites in Maine since 1990 (Appendix 1). Therefore, recent trends suggesting no significant habitat loss are misleading. This generality applies both to breeding and wintering habitats owing to the considerable overlap of seasonal residency.

The variable distribution and flexible habits of wintering eagles is an asset to management. The remarkable response by eagles to supplemental winter feeding (McCollough *et al.* 1994) implies that foods may be fundamentally limiting to winter habitat quality in Maine. There are no suitable estimates of winter carrying capacity. Winter severity, extent of ice cover, distribution of wintering waterfowl, and human activities all influence wintering eagle numbers and distribution. Some disturbances are more influential in winter than to nestiing eagles (Stalmaster and Newman 1978; Steenhof 1978; Buehler *et al*. 1991a, 1991b; Stalmaster and Kaiser 1997). There are relatively few insights on winter ecology of Maine's bald eagles.

Proiections

Overall habitat availability will not be limiting to short-term growth of Maine's eagle population. Ninety-three documented nest territories lacked pairs in 2003 but remain suitable for nesting. Density-dependent factors should not impair population growth except in eastern Maine and a few isolated coastal areas. Ample, potential habitat exists for growth in low-density regions elsewhere across Maine.

Many eagle habitats could be degraded by diminished regulatory protection after delisting. The trend is certain, but precautionary management (conservation ownership, cooperative agreements, or alternative rules) may curb setbacks. It is virtually impossible to gauge the risk. Past insights may help. In 1985, > 80% of all eagle nests in Maine were under cooperative agreements for 2 - 13 years, but new threats arose at 40% of these sites by 1989. Eight projects escaped oversight of the Essential Habitat rules during 1990 - 2003, but only one (springtime construction < 800 feet away) caused nest failure and abandonment. Fortuitous timing, project guidance after permitting, or the minor nature of six resulted in negligible impacts.

Recent tendencies suggest adaptive behavior by nesting eagles or evolving distinctions between suitable and optimal habitats. Eagles increasingly nest closer to disturbances (roads, dwellings, etc.) and further from open water in Maine, as previously noted elsewhere (Andrew and Mosher 1982, Fraser *et al.* 1983, Swenson *et al.* 1986, Wood *et al.* 1990, Therres *et al.* 1993). The longevity of nesting eagles in the fragmented landscapes of central Maine is uncertain. If successive eagle generations nest in such areas, it will help clarify if coexistance with human activities is a lasting phenomenon of eagle recovery rather than an arifact of

aggressive management and regulations.

Improved access to Maine's wildlands and waters heightens the potential for disturbances. Untimely intrusions cause nest failures during critical periods such as courtship, incubation, or fledging. Reoccuring problems lead to nest abandonment (Fraser *et al.* 1983). Subtle intrusions can disrupt eagle activity budgets and reduce survivorship (Steidl and Anthony 2000). Disturbances in foraging areas may be an even greater concern (Montopoli and Andeson 1991). Posting to ward off intruders is a last recourse in some problem settings. Boating intrusions readily flush foraging eagles (Stalmaster and Kaiser 1997). Buoys to restrict boating were used in Kansas (Babbitt and Haines 1999) and New Hampshire (Martin pers. comm.).

The future of suitable fisheries is a concern in some waters. Greatly reduced alewife (*Alosa pseudoharengus*) landings (> 70% during the past 30 years, Maine Dept. of Marine Resources 2001) imply declining stocks. Dams with inadequate fishways limit fish passage. A law closing fishways on the St. Croix River (12 MRSA §6134) and beaver dams on smaller streams now also affect these alwife runs. Watts *et al.* (2004) attribute the strong recovery of bald eagles in the Chesapeake Bay to abundant, widespread spawning runs of anadromous fish (*Alosa* spp.).

Small alewife yields led to commercial netting of suckers from inland lakes for lobster bait. Only local threats exist thus far, but a single-season haul of > four tons of suckers in Sebasticook Lake (Kircheis pers. comm.) reveals the implications of no harvest limits. Both alewives and suckers impact food availability to eagles at a critical time, brood rearing. Eels are common eagle prey in Maine, but a booming elver fishery in the early-1990s raised doubts about the sustainability of that fishery.

POPULATION ASSESSMENT

Historic Trends

Breeding Population: There are a few insights but no reliable estimates of historic eagle numbers in Maine. Early colonial explorers (Rosier 1605, Smith 1614, Josselyn 1672) found many “gripes" (*i.e.*, eagles) along the coast. More than 70 lakes, ponds, streams, points, or islands named “Eagle” or “Swan” (from the Abenaki Indian word "Sowangan" meaning "eagle") suggest their historical presence (Palmer 1949). Exceptional abundance of eagles was cited locally in Englishman Bay, Washington Co. (Longfellow 1876) and in Merrymeeting Bay, Sagadahoc Co. (Spinney 1926). Past conjectures, 100 nesting pairs (Knight 1897, 1908) and 60 pairs (Palmer 1949), were mostly compilations of reported nests and thus greatly understated population levels in the early 20th century.

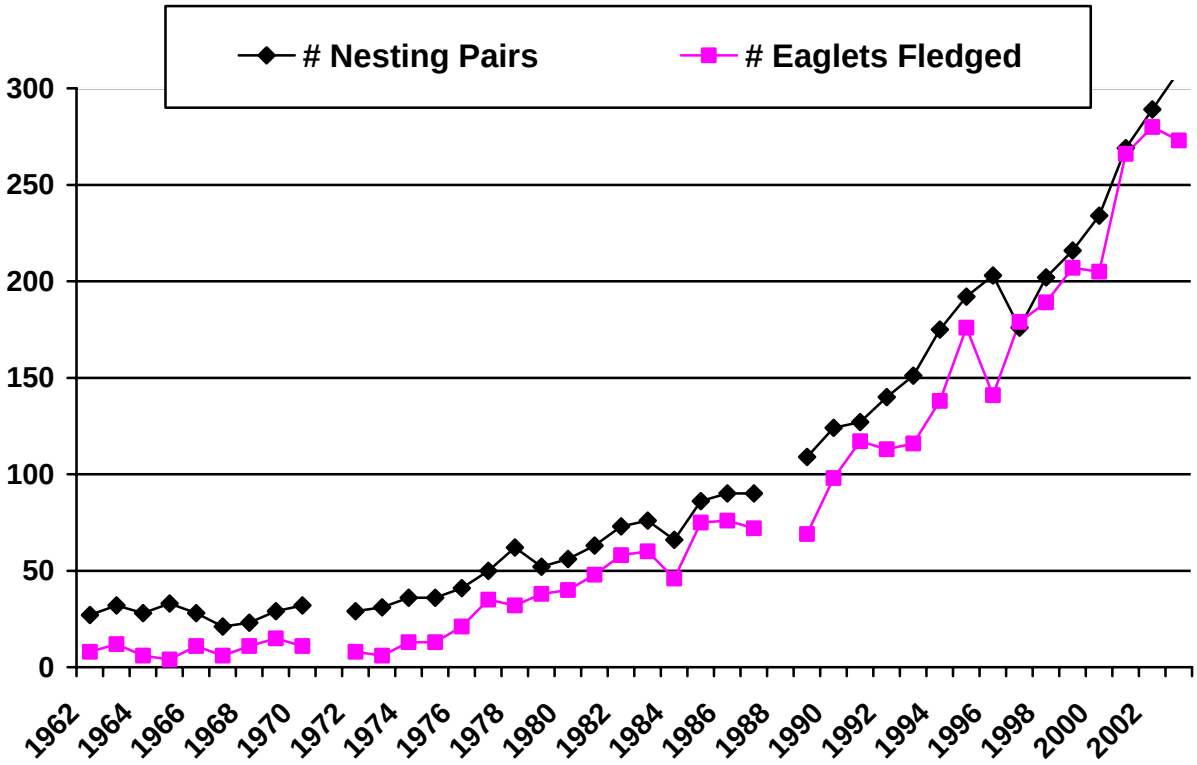
Aggregations of at least 25 - 52 eagles were noted in summer at Casco Bay, Cumberland Co. (Josselyn 1672); Lake Umbagog, Oxford Co. (Brewster 1880); and Flagstaff Lake, Somerset Co. (Spofford 1962) and during migration on Damariscotta Lake, Lincoln Co. (Bent 1937); Penobscot Bay, Knox Co.; and Narraguagus River, Washington Co. (Palmer 1949). Eagle concentrations vanished after population declines, including setbacks among eagles breeding in Maine and falling number of summering eagles visiting from the Southeast (Broley 1947, Stocek 1979).

Frequent reproductive failure among nesting eagles became apparent during the era of DDT use starting in 1945. Poor nesting success was detected in areas of Maine by the early 1950s (Townsend 1957). Statewide surveys during 1962 - 1976 revealed low numbers of breeding eagles (21 - 41 pairs annually), high failure rates

(72% of all nesting attempts yielded no eaglets), and very low productivity (0.35 fledglings per nesting pair = half the level in other populations).

Steadily increasing numbers of nesting eagles and levels of eaglet production are recorded since 1976 (Figure 2, Appendix 5). Improvements are notable on a rate basis as well. Greater productivity (both nesting success and brood size) were observed since 1977 and are the best indicators of improved population health and initial recovery. The reproductive rate of Maine eagles during the period 1977-1991 was 0.72 fledglings per nesting pair. Annual growth rates were highly variable (likely due to recruitment patterns) but still averaged an 8% increase. Recovery during this period (Owen *et al.* 1991) was primarily localized in eastern coastal waters (Hancock and Washington Co.) and the Penobscot River valley (Penobscot Co.).

Figure 2. Trends of bald eagle nesting and eaglet production in Maine, 1962-2003.



Winter Population: Past accounts of Maine's wintering eagles portrayed them as "common to occasionally numerous" in coastal Maine and "widely scattered" in the interior (Knight 1897, Palmer 1949). There is no reliable trend information. Marked variability was evident in tallies of eagles from 1946-1977 Christmas Bird Counts and 1962-1978 winter waterfowl surveys (Todd 1979). Public cooperators sighted only 28 - 59 birds in 1962, 1963, and 1975 (Cammack 1975, Sprunt 1963, Sprunt and Ligas 1964). Aerial inventories and / or compilations of reported eagle sightings provided consistent totals of 107 - 120 wintering eagles during 1977-1982. Both methods have inherent, major flaws. The lack of systematic coverage and the inability to monitor remote winter habitats are serious deficiencies of fixed-point observations. Surveys from aircraft severely underestimate numbers of immatures.

The midwinter eagle population in Maine is typically quite dispersed. Large-scale provision of supplemental foods attracted unprecedented local aggregations of 15 - 75 wintering eagles (McCollough 1986). At least 274 different eagles (including 175 banded individuals, mostly immatures) were seen at 7 winter feeding stations in eastern coastal Maine during the 1984-85 winter. Age ratios radically shifted from a 3:1 majority of adults to a 2:1 predominance of immatures but are biased against numbers of adult eagles since most lacked bands or distinct plumage.

Current Assessment

Breeding Population: Since 1991, eagles nesting in Maine maintained 8% average annual growth (Figure 2). Increases were more consistent during this time frame. Spurts of 15% growth recorded in 1998 and again in 2001 result from peaks in productivty 6 years previous and are not survey artifacts. Relatively large cohorts

were likely recruited into the population in those years. Conversely, a 13% decline in 1997 is attributed to 20 dead adults (an exceptional number) the year before. Models demonstrate that adult mortality is the most important variable in eagle population dynamics (Grier 1979, 1980).

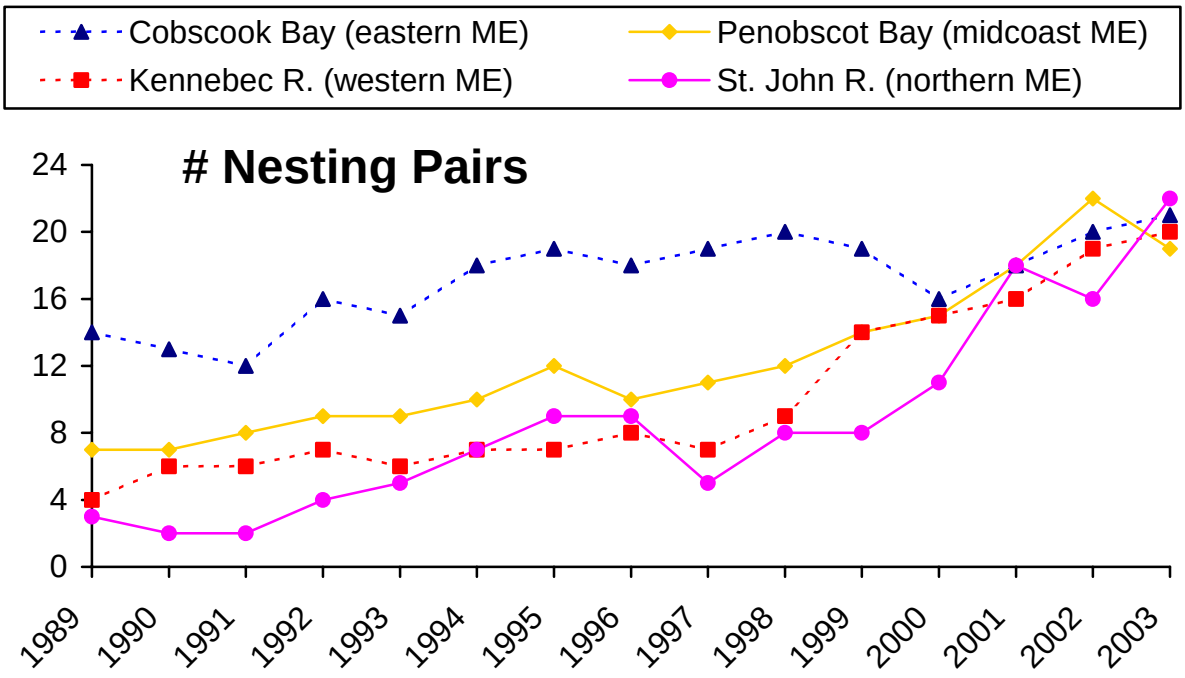
Record statistics continually emerge from ongoing surveys. The population census, 309 nesting pairs, peaked in 2003. Record production, 280 eaglets fledged, occurred in 2002. Annual productivity in 1997 and 2001 reached 1.0 fledglings per nesting pair: a rate indicative of healthy eagle reproduction (Sprunt *et al.* 1973). Survey totals are minimum figures, perhaps 10% below actual numbers, but yield reliable trends because of consistent methods. Annual monitoring of all territories once discovered reveals striking cases of the eagle's comeback in Maine (Table 3).

Table 3. Examples of nesting bald eagles reoccupying traditional Maine territories.

Nest Location	Initial Residency	Abandoned	Reoccupied
Androscoggin Co.			
- Lothrop Island	1969 - 1972	1973 - 1989	1990 - 2003
Kennebec Co.			
- Cobbosseecontee Lake	1966	1967 - 1997	1998 - 2003
- Nehumkeag Island	1962 - 1974	1975 - 2000	2001 - 2003
- Vaughan Brook area	1969	1970 - 1998	1999 - 2003
Knox Co.			
- Mark Island	1962	1963 - 1981	1982 - 2003
Lincoln Co.			
- Courthouse Point	1962 - 1965	1966 - 2001	2002 - 2003
Sagadahoc Co.			
- Abagdasset Point	1962 - 1972	1973 - 1999	2000 - 2003
- Bald Head	1962 - 1974	1975 - 1988	1989 - 2003
- Chops area	1962 - 1976	1977 - 1989	1990 - 2003
- Little Swan Island	1962 - 1969	1970 - 1988	1989 - 2003
Waldo Co.			
- Bowden Point	1962 - 1966	1967 -1982	1983 - 2003

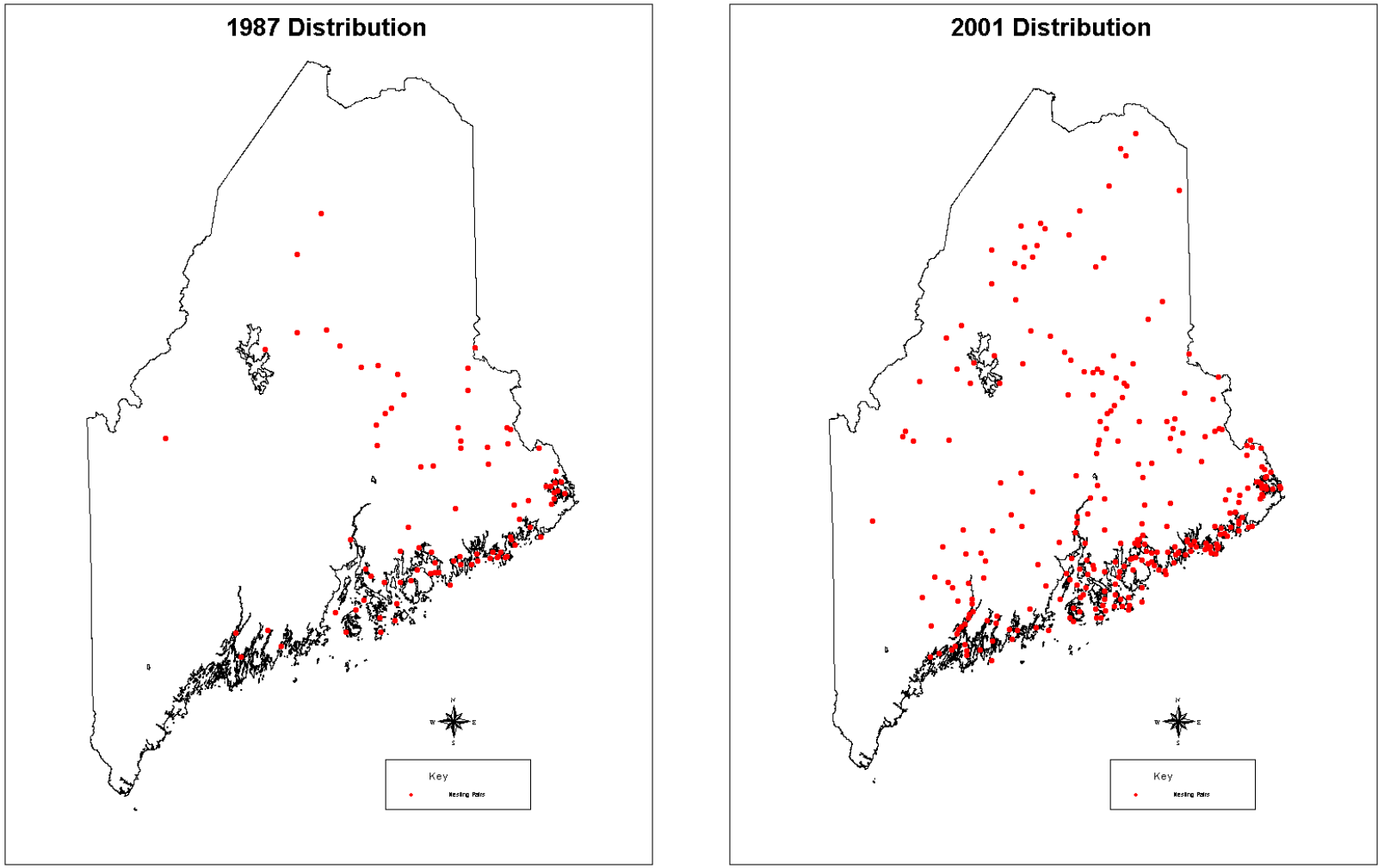
The timing of recovery within Maine (Figure 3) varies with proximity to eastern Maine. Cobscook Bay area and adjacent Passamaquoddy Bay (New Brunswick) were the only 1970s strongholds for nesting eagles between Maryland and Nova Scotia. Local populations levelled off there by the early 1990s. Eagle resurgence followed through the midcoast, southwest Maine, and the northern interior regions sequentially in accord with spatial separation from areas of high breeding density.

Figure 3. Recovery trends of local bald eagle populations in Maine, 1989 - 2003.



Measures of local nesting density also help gauge eagle recovery. In the Cobscook Bay area, mean separations of pairs changed little from 1989 (2.2 miles) to 2003 (1.6 miles). Growth in other regions (Figure 4) escalated during this period. Separations of pairs across Maine averaged 6.2 miles in 1989, but only 4.4 miles in 2003. Range expansion has been a very slow phenomenon during eagle recovery. Most explain this by fidelity of eagles to their natal areas and density dependence.

Figure 4. Distribution of bald eagles breeding in Maine – 1987 (a) and 2001 (b).



Productivity can vary regionally in Maine. Brood size and nesting success are traditionally greater in coastal habitats, but not since 2001. Eagle reproduction has been similar in all habitat types, although there is marked annual variability along rivers. Variable levels of nesting success are attributed to limited food availability in high-density populations in Alaska (Hodges 1982, Hansen and Hodges 1985, Hansen 1987) and British Columbia (Elliott *et al.* 1998). Contaminants have impaired bald eagle productivity and recovery rates in Oregon (Anthony *et al.* 1994).

Winter Population: Routine winter inventories no longer occur in Maine. Aerial surveys during the 1996-1997 winter identified at least 258 wintering eagles (MDIFW unpubl.). This figure is more than double the totals from comparable efforts during 1977 – 1979 (see "Historic Trends"). However, the resident breeding population increased four-fold in that period, and aerial surveys still suffer from visibility biasses that overlook the less conspicuous plumage of immature eagles.

Projections

Sustained growth (akin to the 8% average since 1976) is likely for the next 5 years. If recruitment and survival do not lessen, Maine could boast 384 pairs by 2006. New pairs will emerge from 1999 - 2003 cohorts; all were larger than any previous eaglet crop. Numbers could double every 12 - 13 years unless contrary problems arise (*e.g.*, diminished habitat protection, elevated mortality, etc.).

Some setbacks are likely after delisting. Fixed budgets and inventory efforts cannot adequately track population trends on a statewide scale. At some point in the future, surveys will likely use dual-frame sampling to achieve greater statistical rigor (Grier 1977, Fraser *et al.* 1984, Haines and Pollock 1998, Anthony *et al.* 1999). Such

efforts require independent, overlapping samples and should be stratified to reflect existing differences in density, productivity, nesting habitat, habitat protection status, and background contaminants information.

Continued measures of productivity are of little use to modelling (Grier 1979, 1980) now that Maine's population has surpassed numbers at risk to extirpation (MDIFW 1986). However, reduced nesting success may serve as an early warning of slowed recovery. This is expected if the population nears carrying capacity in the state, but dropoffs prior to that point may reflect impacts from traditional influences of inadequate habitat protection and contaminants or perhaps other limiting factors.

Limiting Factors

A variety of influences have influenced bald eagle recovery in Maine. None have precluded the recent comeback of this species but could be locally influential or become limiting, if circumstances change in the future.

Weather: Inclement March weather correlated with low annual productivity of bald eagles in Maine (Matz 1998). Sharp declines in nesting counts, or high levels of nest loss, coincided with untimely, harsh spring weather (heavy, wet snowfall or high winds). Similar findings are noted in other northern populations (Swenson *et al.* 1986, Gerrard *et al.* 1992). This is presumably a reoccuring, stochastic event.

Food Resources: Prey availability is potentially limiting to eagles, moreso as recovering populations approach carrying capacity. Brood size of eagles nesting in Maine (1989 - 2003 mean = 1.49 eaglets per successful nest) is less than that in other major populations (Stalmaster 1987). In Alaska, food resources before and during incubation are linked to marked annual and spatial variation in productivity (Gende *et*

al. 1997, Steidl *et al.* 1997). A similar phenomenon could be quite influential in interior Maine where egg-laying usually precedes ice-out on lakes.

Another potential deficiency in Maine may be the relative absence of foraging aggregations. Bald eagles are notorious for exploits of seasonally abundant prey. During initial population recovery (1980s), late-spring aggregations of 10 - 35 eagles (mostly immatures) utilized five different alewife runs in Washington Co. streams. These no longer occur. The lack of large foraging groups utilizing natural prey leads to a more dispersed population of non-breeders and perhaps reduced survivorship.

Human-related Eagle Deaths and Injuries: The prevalence of human-related deaths is still problematic as evidenced from 1428 necropsies by USFWS during 1963 - 1984 (Wood *et al.* 1990): 23% trauma, 22% gunshot, 11% poisoning, 5% trapping, and 9% electrocution. These are additive losses in long-lived species, potentially a strong influence on bald eagle populations (Grier 1979, 1980).

Intentional acts are the most troublesome. There are only two convictions among > 20 investigations of eagle shootings in Maine since 1972. Shotgun pellets in eagles that die from other causes indicate that additional, non-lethal shootings are not uncommon. Lead ammunition, whether tissue-embedded or ingested, can cause lead poisoning (Wayland *et al.* 1999). A Hancock Co. adult killed in 2001 by rifle shot had survived a previous shotgun injury. Experienced waterfowl hunters note a need for precautions since they frequently see eagles attack their decoys.

Trauma cases dominate accidental deaths and injuries of eagles. Collisions with utility wires (mostly local distribution lines) occurred at 14 locations in six Maine counties. Five counties experienced losses from motor vehicle impacts of eagles

scavenging in roadways. Lead ingestion killed eagles in seven Maine counties, including a Piscataquis Co. adult in 2001 and 1 immature in both Knox Co. and Piscataquis Co. during 2003. Rodenticides caused eagles deaths in 2 counties, including a Lincoln Co. subadult in 1999. Single losses resulted from entanglement in fishing gear (Penobscot Co.) and aircraft collision (Kennebec Co.).

Eagles were often caught by leghold traps set for bobcat during the 1970s. In the last 20 years, infrequent eagle deaths or injuries from trapping are reported in 5 counties despite increased trapper education. Proximity of bait is a reoccuring theme. Multiple otter sets with fish bait killed 2 Penobsct Co. subadults after river fluctuations in 1988. An adult died from trap injuries in an Aroostook Co. coyote set by an exposed bait pile in 2001. Two Hancock Co. adults were killed by snares deployed for coyotes in 1987. Muskrat traps have been taken from nests in 2 counties. At least 6 eagles with missing digits or foot wounds indicative of trap injury were observed at winter feeding stations in the mid-1980s (McCollough 1986).

Environmental Contaminants: A variety of chemicals occur in Maine eagles. This is a brief review of several known to be acutely toxic or that chronically impair reproduction. Other impacts may yet be discovered from this complex subject. Organochlorines have been very influential, especially DDE (dichloro-diphenyl-diichloro ethylene, a metabolite of the insecticide DDT), PCBs (polychlorinated biphenyls), and PCDDs (polychlorinated dibenzo-*p*-dioxins). They are chemically stable, persistent, virtually ubiquitous in the environment, and bioaccumulate.

DDT was widely used in forestry, agriculture, and mosquito control. Banned for use in the U.S. since 1972, its persistent by-products are widespread. DDE was

correlated with eggshell thinning in many species. PCBs are complex mixes of up to 209 different congeners. Their toxicities vary and may be synergistic or antagonistic with one another (Eisler and Belisle 1996). PCBs had many industrial uses, their residues are widely distributed and move easily by atmospheric transport, and some are still used in closed systems. PCDDs can be very toxic at trace levels, especially TCDD (2,3,7,8-tetrachloro-dibenzo-*p*-dioxin). TCDD arises from incinerators and bleaching processes at pulp and paper mills. PCBs and PCDDs are quite lethal to developing embryos (Peterson *et al.* 1993); they chiefly affect the central nervous system (Henshel 1998).

In the 1970s, record levels of DDE, PCBs, and Mirex in wildlife tissue were once detected in eagle eggs and carcasses from Maine (Krantz *et al.* 1970, Mulhern *et al.* 1970, Belisle *et al.* 1972, Wiemeyer *et al.* 1972, Cromartie *et al.* 1975, Prouty *et al.* 1977, Kaiser *et al.* 1980, Reichel *et al.* 1984), coincident with lower productivity than elsewhere. Residues in eagle prey did not decline in the 1970s (Wiemeyer *et al.* 1978). DDE levels in Maine eagle eggs declined in the 1980s, but some still exceeded the threshold for reproductive impairment (Wiemeyer *et al.* 1984, 1993). PCB residues did not lessen during the 1980s. Grier (1982) reviewed a correlation between the continental recovery of bald eagles and dwindling DDE levels.

Achievement of normal reproductive rates was slower in Maine than most eagle populations, partly due to lingering contaminant influences. Analyses of 182 blood samples from eaglets in Maine during 1991 - 1995 revealed residual dietary exposure: 65% had measurable levels of DDE, and 37% were tainted with PCBs by ages of 2 - 3 months (Welch 1994, Matz 1998). Organochlorine residues in eaglet

blood did not correlate to productivity at nests sampled in the 1990s, unlike patterns noted in the Great Lakes region (Bowerman 1993). This implies other influences.

Gradual dosages to long-lived eagles may ultimately impair reproduction, a problem manifest among individual eagles, not on a population scale. Analyses of Maine biota in six coastal bays infer a likely point source of PCBs in Hancock Co. (Matz 1998). Two local eaglets had very elevated PCB levels in 1992 -1995. Eagle that consume fish-eating birds raise their vulnerability to conntaminant loading. Some areas of coastal Maine and Alaska (Anthony *et al.* 1999) have this problem.

Despite lower PCB vulnerability of inland eagle diets and total residues 45% below the 1980 - 1991 mean (N = 19), eggs in three Penobscot Co. nests collected during 2000 had high residues of PCB congener #126 (Mierzykowski *et al.* 2001). Its toxicity rivals TCDD (Eisler and Belisle 1996). Each egg surpassed “no effect” levels cited in other bald eagle populations with clear PCB problems (Kubiak and Best 1991; Bowerman *et al.* 1994, 1995; Dyskstra 1995; Elliott *et al.* 1996b, 1996c, 1996d, 1998) and in Sweden’s white-tailed sea eagles (Helander et al. 1982). Residues of TCDD in eggs from two Penobscot Co. nests in 1993 were above the “no effect” level (USFWS 1995; Todd 1996, 2000).

Trends in PCB levels are unknown. Early analyses could not differentiate PCB congeners or detect trace PCDD residues in samples from the 1980s and earlier. Thus, definitive evaluations of toxicity were not possible. PCB #126 is also prevalent among eagles in New Jersey (Clark *et al.* 1998) and in the Great Lakes region (Kubiak and Best 1991, Bowerman 1993). TCDD is problematic near some British Columbia kraft pulp mills (Elliott *et al.* 1996b, Elliott and Norstrom 1998).

Mercury, a heavy metal contaminant, also harms eagles. It is also persistent in the environment and more plentiful than organochlorine contaminants. Eggs from eight nests collected in three eastern Maine counties during 1975-1993 had harmful mercury levels (Wiemeyer *et al.* 1984, 1993). Residues in eaglet blood samples were much higher at inland lakes than other Maine habitats (Welch 1994). They exceed mercury exposure among Great Lakes eagles (Kozie and Anderson 1991, Bowerman 1993, Donaldson *et al.* 1999), are similar to Florida data (Wood *et al.* 1996), and are below Oregon levels (Frenzel 1984, Anthony *et al.* 1993).

Rates of mercury methylation by bacteria are greatest in anoxic, freshwater environments (Gilmour and Henry 1991, Gilmour *et al.* 1992). Methylmercury is a neurotoxin and might have subacute impacts that impair eagle survival. Inferences relating to chronic exposure are difficult, because birds shed much of their mercury burden during annual feather molts.

USE AND DEMAND ASSESSMENT

Historic Trends

The bald eagle is widely valued as the national symbol of the United States since 1782 (USFWS 1969) and traditionally revered by Native Americans. Many nations have selected eagles as their emblem and hold them in high esteem, but mankind is responsible for most impacts on them. Consumptive influences are not prominent, but eagle bones appeared in early shell heaps (Moorehead 1922). Early Maine settlers sometimes ate eagles or fed them to livestock (Palmer 1949). A Knox Co. town adopted a 20¢ bounty on bald eagles in 1806 (Lyons *et al.* 1889). Maine eagle eggs brought top prices (Sawyer 1891) when egg-collecting was popular.

Current Assessment

Opportunities for the general public to view, photograph, and enjoy eagles are the primary direct uses of this resource. Wildlife observation, especially birding, is a major pursuit in Maine. In 1996, approximately 454,000 individuals engaged in wildlife watching in the state (U.S. Dept. Interior and U.S. Bureau of Census 1996). A large economic value arises from tourism related to wildlife watching. The 1996 estimates was $122 millon in expenditures by some 321,000 non-residents visiting Maine. Modern photo essays of eagles advocate respect and precautions while observing eagles (Hutchinson and Silliker 2000).

The species is also valued as a barometer of environmental quality. As a top-level predator, strong eagle populations suggest healthy ecosystems. Bald eagles serve as a flagship species for endangered species conservation. The scientific, utilitarian, and cultural values of biological diversity are widely appreciated as are the

ethical arguments for preserving biological deversity, particularly species threatened by the actions of society (Kellert 1980).

High levels of interest in Maine eagles are further evidenced by public reports of eagle sightings and nests even at the risk of regulatory implications. As an example, 545 different landowners were notified in November, 2001 of a new eagle nest on or near their property and subject to Essential Habitat regulations potentially limiting property use. Follow-up consultations with 160 parties revealed only two that were preoccupied with land rights beyond their sympathy for eagles. Voluntary sacrifices of property use by landowners accepting stewardship roles for nesting eagles have been a mainstay of the program in Maine for 30 years.

A survey sampling opinions of Maine residents (MacDonald *et al.* 1994) followed initial implementation of MDIFW's regulatory approach to protecting eagle habitat. Among 667 respondents, altruism and viewing opportunities were cited as primary reasons for widespread support of bald eagle conservation:

- 89% knew that bald eagles live in the state.
- 83% realize that eagles were an endangered species in Maine.
- 68% desired an increase of Maine's eagle population.
- "Important" reasons to support recovery were (in order of priority):
  - Bald eagles have a "right to exist."
  - Respondents want bald eagles to exist in Maine even if they never see one.
  - They want future generations to be able to view bald eagles in Maine.
  - Bald eagles contribute to the diversity of wildlife in Maine.
  - We have an obligation to restore bald eagles in Maine.
  - Bald eagles are an indicator of environmental quality.
  - They want others to be able to see eagles in Maine even if they may not.
  - They have a personal desire to view bald eagles in Maine.
  - Bald eagles should survive because they are our national symbol.
  - Bald eagles should survive because they represent freedom.
  - They want to read about Maine's bald eagles or see them on television.

In all fairness, there are some negative attitudes toward eagles despite broad support for this species. A rare example occurred in March, 2002 when an eagle attempted to kill a small dog in Somerset Co. The incident was well documented and publicized resulting in an understandible mix of human emotions. Depredation of pets, domestic ducks, etc. are highly infrequent but may alienate some people.

Projections:

Public interest and esteem for the bald eagle will not change appreciably in future years. Like loons, moose, and puffins, the bald eagle will always carry a high public profile. The demand for viewing opportunities will escalate if current trends of expanding eco-tourism continue. Increasing eagle numbers, expanded distribution, and more frequent use of human-dominated landscapes are current trends which should enhance overall public appreciation but occasionally spark debate over the future of eagles in some localities.

Removal of bald eagles from state and federal lists of “Threatened” species carries great symbolism for conservation programs and should create an elevated public awareness. Resource managers are likely to continue public outreach in order to foster public appreciation and safeguard species recovery. Public concern for the species’ welfare will require that wildlife agencies continue to monitor the species and provide appropriate management.

SUMMARY AND CONCLUSIONS

Bald eagles in Maine and elsewhere in the lower 48 states were recognized as "Endangered" or "Threatened" in 1978. Few species have recovered sufficiently to warrant removal from these designations. This contributes to frequent political debate on the virtues of endangered species laws and programs. The dilemma is not surprising in view of long recovery periods, ongoing management concerns, and diminished protection after delisting (Doremus and Pagel 2001).

The bald eagle currently faces this quandry. It is deserving of delisting from its present status of "Threatened" under existing criteria in all five national recovery plans (Federal Register 64:36453-36494). Yet there are inevitable pressures from habitat loss which, combined with other factors influencing eagles, could jeopardize recovery. Models of populations and habitats in the Chesapeake Bay area forecast a potential crash of eagle numbers within 50 years (Fraser *et. al* 1996, Watts 2000).

Maine set modest population objectives for bald eagle recovery in line with targets in the Northern States Bald Eagle Recovery Plan (USFWS 1983). However, there are additional state delisting criteria (Table 4, MDIFW 1989) on population trend, productivity, and maintaining a "safety net" of habitats. A basic assumption is that (regardless of eventual numbers of eagles reestablished in Maine) some level of monitoring and management will be necessary after delisting. Future setbacks in these recovery concepts have not been formalized as "relisting" triggers. However, they arguably should be and certainly will prompt more aggressive management. The remarkable recovery of bald eagles achieved to date is a reminder of a special resource nearly lost and now an inspiration for conservation awareness.

Table 4. State criteria for reclassification of bald eagles in Maine from Endangered and Threatened status under the Maine Endangered Species Act (MDIFW 1989).

Status Reclassification	Criteria for Regulatory Change	Criterion Achieved?
"Downlisting" (Endangered → Threatened)	♦ Breeding population >120 nesting pairs for 3 consecutive years &	1995
	♦ Eaglet production >120 fledglings for 3 consecutive years &	1996
	♦ Federal downlisting (Endangered → Threatened).	1995
"Delisting" (Threatened → "recovered")	♦ Breeding population >150 nesting pairs for 3 consecutive years &	1996
	♦ Eaglet production >150 fledglings for 3 consecutive years &	1999
	♦ No annual population declines >5% for 3 consecutive years &	2000
	♦ Federal delisting (Threatened → "recovered").	No – proposed
	♦ Achieve a habitat "safety net," including both --	
	▪ Conservation ownership or easements for >50 nesting areas &	No - ongoing
	▪ >100 additional nesting areas under conservation ownership, appropriate easements, or cooperative management agreements.	No - ongoing

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Appendix 1. Essential Habitat regulation for bald eagle nest sites, 1990 – present.

State of Maine, Inland Fisheries and Wildlife Rules, Chapter 8.05 Essential Habitat for Species Designated as Endangered or Threatened.

The following areas, identified as currently or historically providing physical or biological features essential to the conservation of an Endangered or Threatened Species and requiring special management considerations, and the management guidelines for the protection of these areas, are adopted in accordance with the provisions of Title 12, §§7754 (2,3) and 7755-A (1,2,3). The Commissioner has identified and mapped such habitats as depicted on the maps entitled "Essential Habitat For Endangered And Threatened Species" which are incorporated herein.

A. Bald Eagle Nest Site

1. Purpose. To provide special protection to maintain breeding habitat and to prevent disturbance which may cause nesting failure of bald eagles. Protection is focused on the nest site.

2. Definitions. When used in this section, the following words and terms shall have the following meaning:

   a. Nesting area. "Nesting area" means a locality containing one or more nest sites and that has been used by a pair of nesting bald eagles.

   b. Occupied. "Occupied" means the presence of one or a pair of adult eagles, eagle eggs, or eagle chicks any time between March 1 - July 15.

   c. Project. "Project" means a planned undertaking, newly initiated or reinitiated.

3. Designation Criteria. Bald eagle nest sites identified and mapped by the Commissioner of Inland Fisheries and Wildlife as Essential Habitat must be within a nesting area occupied in at least one of the three most recent years and have either a nest that has existed for two consecutive years, or the only existing nest in that nesting area. Bald eagle nest sites designated as Essential Habitat will be deleted as follows:

   a. All nest sites in the nesting area will be deleted if a nesting area has not been occupied, as defined, at any time during the most recent five years.

   b. An individual nest site within an active nesting area will be deleted if a nest structure has not existed at any time during the most recent five years or the Commissioner determines that the site is no longer suitable nesting habitat.

3. Protection Guidelines.

a. Projects Prohibited Without the Commissioner's Approval. Any project requiring a permit or license from, or to be funded or carried out by, a state agency or municipal government partly or wholly within a bald eagle nest site designated as Essential Habitat shall not be permitted, licensed, funded, or carried out unless the Commissioner determines that the activity will not significantly alter or unreasonably harm the essential nesting habitat. Projects that may be affected include, but are not limited to: subdivision of land or buildings; construction, installation, expansion, alteration or repair of permanent structures; agricultural management; mineral exploration and extraction; forest management; road projects and construction; shoreland alteration; utility construction; water crossing; water impoundment; aquaculture; conversion of seasonal dwelling; installation of subsurface wastewater disposal system; and issuance of an exemption of the minimum lot size requirement.

b. Exemptions. The following activities are exempt from the requirements of this paragraph.

1) Projects limited to repairs, maintenance and alterations to the interior of an existing structure.

2) Emergency repairs to existing structures and utilities which due to unforeseen circumstances require immediate action.

3) Emergency activities which due to unforeseen circumstances require immediate action for public health or safety.

4) Licenses and permits to operate or occupy a completed project.

5) Projects that address the protection of the Essential Habitat and the Endangered and Threatened Species and are conducted as part of a Department Wildlife Management Area Plan or Species Management Plan, or a Land Use Regulation Commission Resource Protection Plan (P-RP) to which the Department is a party, provided that the parties of the agreement perform according to its terms.

5. Significant Alteration of Habitat. In determining whether a project significantly alters or unreasonably harms essential nesting habitat, the following factors will be considered:

a. Magnitude and time of year of noise and human activity generated by the project.

b. Physical alteration to the landscape.
c. Destruction of or alteration to key habitat components such as perch trees, roost trees, and foraging areas.

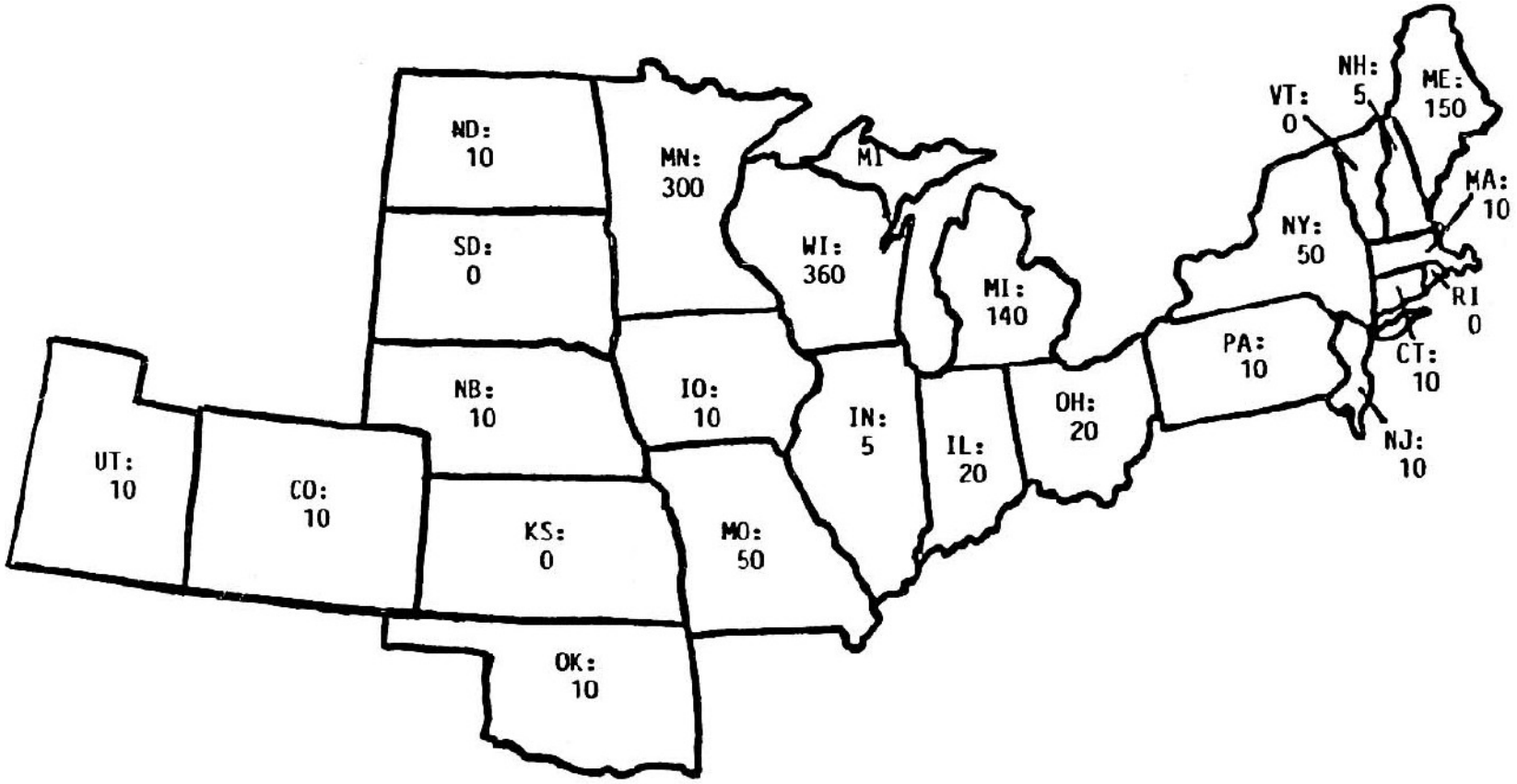
d. Reduction in the seclusion of the nest site and adjacent shoreland area.

e. Demonstrated tolerance of the particular eagles to human activity and disturbance.

f. Reduction in the future suitability of the nest site to bald eagles.

AUTHORITY: Title 12, MRSA, Sections 7035, 7753, 7754

Appendix 2. Suggested recovery targets for state breeding populations of bald eagles in the Northern States Bald Eagle Recovery Plan (USFWS 1983).



Appendix 3. Conservation ownership of bald eagle nesting habitat in Maine, 2003.

Conservation Organization Parcel Name[a]	Township(s)	Nest Site(s)[b]	Years of Eagle Residency[c]
Acadia National Park: ***Fee Ownership***			
Baker Island	Cranberry Isles	254 - area	0 / 9
Bald Porcupine Island	Gouldsboro	41A-B	16 / 35
P/o Bar Island (Bar Harbor)	Gouldsboro	41 - area	0 / 35
Bar Island (Somes Sound)	Mount Desert	26A, E	14 / 28
Bass Harbor Marsh area	Tremont	25A, C	6 / 6
Hulls Cove area	Bar Harbor	241 - area	0 / 9
P/o Isle au Haut – Long Pond area	Isle au Haut	146A-B	2 / 18
P/o Isle au Haut – Moose Harbor area	Isle au Haut	328 - area	0 / 3
Northeast Creek parcels	Bar Harbor	28B-C	9 / 30
Ripple Pond parcel	Mount Desert	26 - area	0 / 28
Rolling Island	Winter Harbor	310A	4 / 4
Saint Croix Island	Calais	129C	4 / 17
Schoodic Island	Winter Harbor	43A-H	34 / 34
Schoodic Point	Winter Harbor	43 - area;	0 / 34
		310 - area	0 / 4
Sheep Porcupine Island	Goudlsboro	41C-D	19 / 35
The Hop	Gouldsboro	40 - area	0 / 22
Thompson Island area	Trenton	346 area	0 / 3
Acadia National Park: ***Easements***			
Babbidge Island easement	North Haven	109 - area	0 / 2
Babson Island easement	Brooklin	391 - area	0 / 1
P/o Bass Harbor Marsh easement	Tremont	25 - area	0 / 6
Bean Island easement	Sorrento	35C-D	8 / 13
Black Island easement	Frenchboro	24 - area	0 / 27
P/o Black Island easement	Swans Island	150 - area	0 / 14
Bold Island easement	Deer Isle	17 - area;	0 / 30
		303 - area	0 / 3
Broad Cove easement	Mount Desert	26 - area	0 / 28
Buckle Island easement	Stonington	147 - area	0 / 19
Butter Island easement	Deer Isle	157 - area	0 / 17
P/o Calderwood Point easements	Vinalhaven	294 - area	0 / 5
Cranberry Point easement	Winter Harbor	310 - area	0 / 4
Dram Island easement	Sorrento	37 - area	0 / 32
Eastern Ear easement	Isle au Haut	146 - area	0 / 18
Eastern Mark Island easement	Stonington	326A	1 / 3
Fling Island easement	North Haven	303 - area	0 / 3
Goose Marsh Point easement	Mount Desert	210 - area	0 / 12
Gooseberry Island easement	Stonington	147 - area	0 / 19

Conservation Organization Parcel Name[a]	Township(s)	Nest Site(s)[b]	Years of Eagle Residency[c]
Acadia National Park: ***Easements*** *(continued)*			
P/o Green Island easements	Vinalhaven	276C-D	4 / 6
Hog Island easement	Gouldsboro	38A-E	21 / 21
Hardwood Island easement	Tremont	246A	9 / 9
Irish Point easement	Swans Island	370 - area	0 / 2
Ironbound Island easement	Winter Harbor	42A-D	15 / 15
Johns Island easement	Swans Island	150B-D	12 / 14
Jordan Island easement	Winter Harbor	122A-C	10 / 10
Little Babson Island easement	Brooklin	391A	1 / 1
P/o Little Deer Isle easement	Deer Isle	324 - area	0 / 2
Little Duck Island easement	Frenchboro	138A	2 / 16
Little Gott Island easements	Tremont	24 - area	0 / 27
Long Island Head easement	Frenchboro	313 - area	0 / 4
Long Point easement	Cranberry Isles	254 - area	0 / 9
Lopaus Point easement	Tremont	261 - area	0 / 1
Moose Island easement	Tremont	246 - area	0 / 9
P/o North Point easement	Swans Island	307 - area	0 / 4
P/o Opeechee Island easement	Swans Island	150 - area	0 / 14
Orono Island easement	Swans Island	307 - area	0 / 4
Pond Island easement	Deer Isle	371 - area	0 / 2
Pond Island easement	Swans Island	150A	2 / 14
Pray Brook easement	Bar Harbor	201 - area	0 / 12
Preble Island easement	Sorrento	37A-B, H	2 / 32
Pretty Marsh easements	Mount Desert	27 - area	0 / 24
Ram Island easement	Swans Island	23 - area	0 / 17
Rice Point easement	Cranberry Isles	254 - area	0 / 9
Round Island easement	Swans Island	307 - area	0 / 4
P/o Saddleback Island easement	Stonington	147- area;	0 / 19
		326 - area	0 / 3
Sheep Island easement	Deer Isle	324 - area	0 / 2
Somes Harbor easements	Mount Desert	26 - area	0 / 28
Spruce Island easement	Stonington	147 - area	0 / 19
Simpson's Island easement	North Haven	109 - area	2 / 2
Sutton Island easements	Cranberry Isles	254 - area	0 / 9
Torrey Island easement	Brooklin	391 - area	0 / 1
Toothacher Cove easement	Swans Island	370 - area	0 / 2
West Sister Island easement	Swans Island	23 - area	0 / 17
American Lighthouse Foundation: ***Fee Ownership***			
Little River Island	Cutler	211A-B	6 / 6
Belgrade Regional Land Trust: ***Fee Ownership***			
Great Pond tracts	Belgrade	1 - area	0 / 0

Conservation Organization Parcel Name[a]	Township(s)	Nest Site(s)[b]	Years of Eagle Residency[c]
Boothbay Regional Land Trust: ***Fee Ownership***			
Damariscove Island	Boothbay	292 - area	0 / 5
p/o Indiantown Island	Boothbay Harbor	249 - area	0 / 8
Inner White Island	Boothbay	292 - area	0 / 5
Spectacle Island	Boothbay Harbor	249 - area	0 / 8
Boothbay Regional Land Trust: ***Easements***			
p/o Pleasant Cove easement	Boothbay	217 - area	0 / 11
Brunswick – Topsham Land Trust: ***Fee Ownership***			
Lower Coombs Island	Brunswick	316 - area	0 / 4
Chewonki Foundation: ***Fee Ownership***			
Bowline Head	Harrington	373A	2 / 2
Coastal Mountains Land Trust: ***Fee Ownership***			
McPheters Preserve	Camden	306 - area	0 / 4
Young's Neck	Lincolnville	306 - area	0 / 4
Conservation Trust of Brooksville, Castine & Penobscot: ***Fee Ownership***			
p/o Mills Point	Brooksville	20A	9 / 35
Ram Island	Castine	210E	3 / 12
Conservation Trust of Brooksville, Castine & Penobscot: ***Easements***			
Hermit Island easement	Penobscot	20B,D	24 / 35
Mills Point easement	Brooksville	20C, E	2 / 35
Woods Island easement	Penobscot	20 - area	0 / 35
Damariscotta River Association: ***Fee Ownership***			
Hodgson Island	South Bristol	217A	10 / 11
Forest Society of Maine: ***Fee Ownership***			
Attean Pond shore & islands	Attean Twp.	309A-B	4 / 4
West Branch Project – Seboomook Lk.	Plymouth	182A	14 / 14
Forest Society of Maine: ***Easements***			
WBP easement – Canada Falls Lake	Pittston Academy	320A	4 / 4
Nicatous Lake easement	T40 MD	76 - area	0 / 34
Freeport Conservation Trust: ***Easements***			
p/o Williams Island easement	Freeport	202C	1 / 11
Frenchman Bay Conservancy: ***Fee Ownership***			
Sullivan Falls parcel	Hancock	36 - area	0 / 26
Frenchman Bay Conservancy: ***Easements***			
p/o Egypt Bay shoreline easement	Hancock	33 - area	0 / 23
Hills Island easement	Hancock	31E-F	16 / 16

Conservation Organization Parcel Name[a]	Township(s)	Nest Site(s)[b]	Years of Eagle Residency[c]
Friends of Merrymeeting Bay: ***Easements***			
Abagdasset Point easement	Bowdoinham	9B, E	5 / 16
Bald Head easement	Bowdoinham	10A-B, E	22 / 24
Page Farm easement	Dresden	192 - area	0 / 14
Friends of Nature: ***Fee Ownership***			
McGlathery Island	Stonington	147 - area	0 / 19
Great Auk Land Trust: ***Fee Ownership***			
Browney Island	Beals	265A	1 / 1
Great Auk Land Trust: ***Easements***			
Bowline Head easement	Harrington	373A	2 / 2
p/o Crowley Island easement	Addison	52 - area;	0 / 24
		128 - area	0 / 0
Eagle Island easement	Addison	167A-C	14 / 14
Greater Lovell Land Trust: ***Fee Ownership***			
Kezar Lake outlet	Lovell	230A	2 / 2
Harpswell Heritage Trust: ***Fee Ownership***			
Doughty Island	Harpswell	257A	9 / 9
Doughty Point	Harpswell	257 - area	0 / 9
Long Reach Preserve	Harpswell	257 - area	0 / 9
Island Heritage Trust: ***Fee Ownership***			
p/o Carney Island	Deer Isle	394 - area	0 / 1
Polypod Island	Deer Isle	374 - area	0 / 2
Round Island	Stonington	147 - area	0 / 19
Wreck Island	Stonington	147 - area	0 / 19
Island Institute: ***Fee Ownership***			
Campbell Island	Deer Isle	229A	1 / 9
Islesboro Islands Trust: ***Easements***			
Bonne Farm easement	Islesboro	340A	1 / 2
Kennebec Land Trust: ***Fee Ownership***			
Hodgdon Island	Winthrop	3 - area	0 / 8
Horseshoe Island	Winthrop	3 - area	0 / 8
Norris Island	Winthrop	2 - area	0 / 17
Perry Island	Winthrop	3 - area	0 / 8
Kennebec Land Trust: ***Easements***			
Bearnstow easement	Mount Vernon	341 - area	0 / 3
Cobbosseecontee Stream easement	Gardiner	397 - area	0 / 1
Parker Pond tract easement	Vienna	341 - area	0 / 3
Vaughan Woods easement	Hallowell	4B-C	5 / 6

Conservation Organization Parcel Name[a]	Township(s)	Nest Site(s)[b]	Years of Eagle Residency[c]
Lower Kennebec Regional Land Trust: ***Fee Ownership***			
Back River parcel	Georgetown	13 - area	0 / 13
Chops Creek parcel	Woolwich	9 - area	0 / 16
Thorne Head	Bath	11 - area	0 / 17
Lower Kennebec Regional Land Trust: ***Easements***			
Ewe Island easement	Woolwich	13 - area	0 / 13
Hockomock Point easement	Woolwich	13C, E	9 / 13
Twing Point easement	Woolwich	9A, C	8 / 16
Maine Audubon Society*: Fee Ownership*			
Fields Pond Nature Center	Holden	319 - area	0 / 4
Hamilton Sanctuary	West Bath	316 - area	0 / 4
Hog Island	Bremen	155A, C-D	16 / 17
Little Duck Island	Frenchboro	138A	2 / 16
Northeast Creek parcel	Bar Harbor	28 - area	0 / 30
Maine Coast Heritage Trust*: Fee Ownership*			
Aldemere Farm	Camden	361 - area	0 / 2
Black Island	Bar Harbor	201A-B	12 / 12
Carlow Cove islets	Trescott	218D	1 / 11
Crow Island	Frenchboro	23C	5 / 17
Eastern Head	Cutler	211 - area	0 / 6
Eastern Mark Island	Stonington	326A	1 / 3
p/o Fog Island	Isle au Haut	215A-C	0 / 11
Inner Baker Island	Swans Island	198A-D	13 / 13
Marshall Island	Swans Island	152 - area	0 / 17
		402A	1 / 1
Nab Island	Brooksville	21 - area	0 / 24
Pond Island	Deer Isle	371 - area	0 / 2
Penobscot Island	Vinalhaven	108A	7 / 12
South Twinnie Island	Bar Harbor	28D	16 / 30
Southwest Point Preserve	Frenchboro	313A	4 / 4
p/o Tinker Island	Tremont	314 - area	0 / 4
Wescott's Island	Blue Hill	21 - area	0 / 24
Western Head	Cutler	211 - area	0 / 6
Maine Coast Heritage Trust: ***Easements***			
Babson Creek easement	Mount Desert	26 - area	0 / 28
p/o Bear Island easement	Phippsburg	396A	1 / 1
Fog Island easement	Isle au Haut	215A-C	11 / 11
Stone House Farm easement	Bar Harbor	28 - area	0 / 30
The Basin easement	Vinalhaven	15 - area	0 / 1
p/o Tinker Island easement	Tremont	314A-B	4 / 4

Conservation Organization Parcel Name[a]	Township(s)	Nest Site(s)[b]	Years of Eagle Residency[c]
Maine Coast Heritage Trust: ***Easements*** *(continued)*			
Western Island easement	Deer Isle	371A	2 / 2
Maine Department of Conservation: ***Fee Ownership***			
Allagash Waterway – Eagle Lake	T7 R12 WELS	90A-D	27 / 27
Allagash Waterway – Churchill Lake	T9 R12 WELS	173A-C	0 / 13
Allagash Waterway – Umsaskis Lake	T10 R13 WELS	216 - area	0 / 8
Allagash Waterway – Eagle Lake	Eagle Lake Twp.	349A	0 / 2
Allagash Waterway – Chamberlain Lk.	T7 R13 WELS	368A	2 / 2
Baxter State Park – Nesowadnehunk	T2 R10 WELS	88A, C-G	28 / 28
Baxter State Park – Abol Deadwater	T2 R10 WELS	388 - area	0 / 1
Bigelow Unit – Flagstaff Lake uplands	Bigelow Twp.	302A	4 / 4
Bigelow Unit – Flagstaff Lake island	Flagstaff Twp.	156A	1 / 12
Bigelow Unit – old Flagstaff Lake island	Flagstaff Twp.	281A	8 / 8
Bold Coast Unit – Eastern Head area	Cutler	211 - area	0 / 6
Burial Island	Eastport	165 - area	0 / 14
Chesuncook Unit – Gero Island	Chesuncook	186A-B	11 / 11
Cobscook Bay State Park	Edmunds	63 - area	0 / 21
Cold Stream Pond	Enfield	331 - area	0 / 1
Dodge Point – Damariscotta River	Newcastle	103 - area;	0 / 2
		335 - area	0 / 3
Donnell Pond Unit – Downing Bog	T10 SD	188A	8 / 8
Duck Lake Unit – p/o Nicatous Lake	T40 MD	76A-C	34 / 34
Duck Lake Unit – Gassabias Lake	T41MD	296A	2 / 2
Clark Cove tract	Harpswell	257 - area	0 / 9
Eagle Island State Park	Harpswell	99A	0 / 0
Eagle Lake Unit – Square Lake area	Square Lake	226A	1 / 9
Five Islands – East Grand Lake	Weston	137A, C	13 / 13
Fort Island – Damariscotta River	Boothbay	217 - area	0 / 11
Fort Point State Park	Stockton Springs	339 - area	0 / 3
p/o Fox Island – Brewer Lake	Orrington	319 - area	0 / 4
Holeb Unit – Attean Lake area	Attean Twp.	309 - area	0 / 4
Holbrook Island Sanctuary	Brooksville	210A-C, F	8 / 12
Kineo peninsula	Kineo	280 - area	0 / 6
Little Dram Island	Pembroke	381 - area	0 / 1
Otter Island – Harrington Bay	Harrington	48B	2 / 27
Parker Pond islands	Mount Vernon	341A	3 / 3
Ram Island – Kennebec River	Phippsburg	168 - area	0 / 15
Ram Island – Merchants Row	Isle au Haut	179C	3 / 14
Rangeley State Park	Rangeley	398A	1 / 1
Richardson Lake Unit	Adamstown &	225 - area	0 / 1
	Richardsontown	252 - area	0 / 8

Conservation Organization Parcel Name[a]	Township(s)	Nest Site(s)[b]	Years of Eagle Residency[c]
Maine Department of Conservation: ***Fee Ownership*** *(continued)*			
Rocky Lake Unit	T18 ED BPP	59 - area;	0 / 20
		160A;	13 / 13
		222A-C	10 / 10
Roque Bluffs State Park	Roque Bluffs	111 - area	0 / 24
Seboeis Lake Unit	T4 R9 NWP	175A-B	10 / 10
Sol Seal Island	Pembroke	65 - area	0 / 32
Spednic Lake shoreland	Forest City	86 - area	0 / 11
Spednic Lake shoreland	Vanceboro	283 - area	0 / 3
Telos Unit	T6 R11 WELS	390A	1 / 1
Tomah Stream parcel	Codyville Plt.	83 - area	0 / 30
Maine Department of Conservation*: Easements*			
Eden tract easement	Bar Harbor	28 - area	0 / 30
Foster Island easement	Harrington	48D &	0 / 27
		315A-B	4 / 4
Nicatous Lake easement	T40 MD	76 - area	0 / 34
Seavey Island easement	Saint George	238 - area	0 / 9
Upper Dam easement	Richardsontown	252 - area	0 / 8
Maine Dept. of Inland Fisheries & Wildlife: ***Fee Ownership***			
Bog Brook WMA	Beddington	142A,C	18 / 19
Booming Ground WMA	Forest City	86A-B	8 / 11
p/o CoM WMA – Alden Island	Topsham	204 - area	0 / 11
p/o CoM WMA – Bellier Cove islet	Edmunds	171B	3 / 12
p/o CoM WMA – Burnt Island	North Haven	17A-B	17 / 30
p/o CoM WMA – Crotch Island	Bremen	155B	1 / 17
p/o CoM WMA – Crow Island	Deer Isle	157B	5 / 17
p/o CoM WMA – p/o Freyee Islands	Brunswick	204C	2 / 11
p/o CoM WMA – p/o Freyee Islands	Topsham	204 - area	0 / 11
p/o CoM WMA – p/o Great Duck Isl.	Frenchboro	138B-G	0 / 16
p/o CoM WMA – Hardwood Island	Isle au Haut	179A-B, D	11 / 14
p/o CoM WMA – Hog Island	Machiasport	232A-B	10 / 10
p/o CoM WMA – Inner Goose Island	Addison	52A,C-G	24 / 24
p/o CoM WMA – Inner Ram Island	Beals	148A-C	16 / 16
p/o CoM WMA – Lee Island	Phippsburg	168B-C	12 / 15
p/o CoM WMA – p/o Lines Island	Bath, Woolwich	11 - area	0 / 17
p/o CoM WMA – No Man's Island	Stonington	147B	3 / 19
p/o CoM WMA – Pope Folly Island	Lubec	194A-B	13 / 13
p/o CoM WMA – Ram Island	Stonington	147A,C	16 / 19
p/o CoM WMA – Salt Pond islet	Blue Hill	22A	24 / 24
p/o CoM WMA – p/o Salt Island	Machiasport	57A-C	18 / 20
p/o CoM WMA – Sheep Island	North Haven	17C-E	13 / 30

Conservation Organization Parcel Name[a]	Township(s)	Nest Site(s)[b]	Years of Eagle Residency[c]
Maine Dept. of Inland Fisheries & Wildlife: ***Fee Ownership*** *(continued)*			
p/o CoM WMA – Smalls Island	Pembroke	67 - area	0 / 22
p/o CoM WMA – Upper Goose Island	Harpswell	202 - area	0 / 11
p/o CoM WMA – Wreck Island	Bristol	237A	10 / 10
p/o Cobscook WMA – Carlow Cove isls.	Trescott	218C	1 / 11
p/o Cobscook WMA – Commissary Point	Trescott	62B; 263 - area	3 / 30 0 / 13
p/o Cobscook WMA – Fred's Islands	Edmunds	263A	13 / 13
p/o Cobscook WMA – Horan Head	Lubec	70B-D	3 / 25
p/o Cobscook WMA – Inner Talbot Isl.	Trescott	218A	4 / 11
p/o Cobscook WMA – Morong Cove	Lubec	218 - area	0 / 11
p/o Cobscook WMA – p/o Race Point	Trescott	68 - area	0 / 27
p/o Cobscook WMA – Wilbur Neck	Pembroke	65B-C	20 / 32
Egypt Bay parcel	Hancock	33E,G	15 / 23
Great Works WMA	Edmunds	118A-B	20 / 20
Frost WMA	Eastbrook	170A-B	7 / 10
Garcelon WMA	Augusta	317 - area	0 / 2
Manuel WMA	Hodgdon	372A	2 / 2
Mattawamkeag WMA	Drew Plantation	350A	2 / 2
Mendall Marsh W.M.A	Prospect	94 - area	0 / 22
Merrymeeting Bay WMA – Abby River	Bowdoinham	9 - area	0 / 16
Merrymeeting Bay WMA – Center Point	Bowdoinham	10 - area	0 / 24
Merrymeeting Bay WMA – Green Point	Dresden	8 - area	0 / 37
Merrymeeting Bay WMA – p/o Pleasant Point	Topsham	178 - area; 204 - area	0 / 6 0 / 11
Messalonskee Marsh parcel	Belgrade	244 - area	0 / 9
Mill River parcel	Milbridge	242 - area	0 / 8
Muddy River WMA	Topsham	204A	1 / 11
Orange River WMA	Whiting	62 - area	0 / 30
Powell WMA – Little Swan Island	Perkins	7A, C	20 / 23
Powell WMA – Swan Island	Perkins	7B, D; 8A-B, D-I	3 / 23 36 / 37
Maine Department of Inland Fisheries & Wildlife: ***Easements***			
Bowden Point easement	Prospect	94 - area	0 / 22
Burying Island easement	Hancock	197C, G-H	10 / 17
Butler Island easement	Franklin	33 - area	0 / 23
Butler Point easements	Franklin	33B, I-J	8 / 23
Center Point easement	Bowdoinham	10 - area	0 / 24
Clark Island easement	Saint George	238 - area	0 / 9
Eastern Bay easements	Bar Harbor	286 - area	0 / 6
Eastern Nubble easement	Cutler	211 - area	0 / 6

Conservation Organization Parcel Name[a]	Township(s)	Nest Site(s)[b]	Years of Eagle Residency[c]
Maine Dept. of Inland Fisheries & Wildlife: ***Easements*** *(continued)*			
East Plummer Island easement	Addison	51A-D	26 / 34
Green Point easement	Dresden	8 - area	0 / 37
Hyde Point easement	Hancock	31 - area;	0 / 16
		32 - area	0 / 14
Mill River easement	Milbridge	242 - area	0 / 8
Monroe Island easement	Owls Head	253 - area	0 / 2
Oar Island easement	Bremen	155 - area	0 / 17
Pleasant Point easement	Topsham	178A, C	6 / 6
Rapid River easement	Upton	365 - area	0 / 1
Reachwood Peninsula easement	Newcastle	212 - area	0 / 11
Spednik Lake easement	T11 R3 NBPP	283A	3 / 3
Thorne Head easement	Bath	11 - area	0 / 17
Tide Mill Farms easement	Edmunds Twp.	62 - area;	0 / 30
		63A-C &	21 / 21
		263 - area	0 / 13
Tomah Stream lease	Codyville Plt.	83 - area	0 / 30
Trafton Island easement	Harrington	401A	1 / 1
p/o Verona Island easement	Verona	166 - area	0 / 14
Municipal Lands: ***Fee Ownership***			
Eaton Brook (City of Brewer)	Brewer	199A	7 / 11
Devil's Head (City of Calais)	Calais	129B	1 / 17
Curtis Island (City of Camden)	Camden	361A	2 / 2
Falls Point (Town of Pembroke)	Pembroke	68 - area	0 / 27
Municipal Lands: ***Easements***			
p/o Bartlett Island easement	Mount Desert	27A	24 / 24
National Audubon Society: ***Fee Ownership***			
Medomak River parcels	Waldoboro	400 - area	0 / 1
New England Forestry Foundation: ***Fee Ownership***			
Arnold Family Tract	Freeport	268 - area	0 / 7
New England Forestry Foundation: ***Easements***			
p/o Pingree easement – Big Machias L.	T12 R8 WELS	348 - area	0 / 2
p/o Pingree easement – Chamberlain L.	T7 R13 WELS	368A	0 / 2
p/o Pingree easement – Churchill Lake	T9 R12 WELS	173A-C	13 / 13
p/o Pingree easement – Daggett Pond	T7 R14 WELS	181B-E	8 / 9
p/o Pingree easement – Eagle Lake	Eagle Lake	349A	2 / 2
p/o Pingree easement – Eagle Lake	Soper Mountain	90 - area	0 / 27
p/o Pingree easement – LaPomkeag L.	T8 R7 WELS	284A	5 / 5
p/o Pingree easement – Leadbetter Pd.	T9 R11 WELS	235A	1 / 9
p/o Pingree easement – Mooseleuk Lk.	T10 R9 WELS	343A	3 / 3

Conservation Organization Parcel Name[a]	Township(s)	Nest Site(s)[b]	Years of Eagle Residency[c]
New England Forestry Foundation: ***Easements*** *(continued)*			
p/o Pingree easement – Pond in River	C Surplus	365 - area	0 / 1
p/o Pingree easement – Richardson L.	Richardsontown	252A-B	2 / 8
p/o Pingree easement – Round Pond	T7 R14 WELS	181A	1 / 9
p/o Pingree easement – Rowe Lake	T11 R8 WELS	367 - area	0 / 2
p/o Pingree easement – p/o Rowe Pd.	T7 R14 WELS	163A-D	11 / 11
p/o Pingree easement – Soper Pond	Soper Mountain	322A	3 / 3
p/o Pingree easement – p/o Spider Lk.	T9 R11 WELS	235B	8 / 9
Orono Land Trust: ***Fee Ownership***			
Penobscot River tract	Orono	277 - area	0 / 6
Pleasant River Wildlife Foundation: ***Fee Ownership***			
p/o Crowley Island	Addison	52 - area; 128 - area	0 / 24 0 / 0
Quoddy Regional Land Trust: ***Fee Ownership***			
Denbow Point	Trescott	68 - area	0 / 27
Quoddy Regional Land Trust: ***Easements***			
Falls Island easement	Trescott	68A-B	27 / 27
p/o Race Point easement	Trescott	68 - area	0 / 27
Rangeley Regional Land Trust: ***Fee Ownership***			
Mooselookmeguntic Lake shoreline	Adamstown	225A	1 / 1
Sheepscott Valley Conservation Association: ***Fee Ownership***			
Guptil Island – Marsh River	Newcastle	103 - area 212 - area	0 / 2 0 / 11
Sheepscott Valley Conservation Association: ***Easements***			
Cunningham Island easement	Newcastle	212 - area	0 / 11
Marsh River easements	Newcastle	212 - area	0 / 11
Somes / Meynell Wildlife Sanctuary: ***Fee Ownership***			
Somes Pond parcel	Mount Desert	26C	10 / 28
Somes / Meynell Wildlife Sanctuary: ***Easements***			
p/o Somes Pond easement	Mount Desert	26 - area	0 / 28
The Nature Conservancy – Maine Chapter: ***Fee Ownership***			
Abagdasset River tract	Bowdoinham	9 - area	0 / 16
Back River tract	Georgetown	290 - area	0 / 5
Bald Head Preserve	Arrowsic	290 - area	0 / 5
Barred Island Preserve	Deer Isle	375A	2 / 2
Big Garden Island Preserve	Vinalhaven	107 - area	0 / 18
Big White Island Preserve	Vinalhaven	107 - area	0 / 18
Blagden Point Preserve	Bar Harbor	201 - area	0 / 12
Bradbury Island Preserve	Deer Isle	157A, C	12 / 17

Conservation Organization Parcel Name[a]	Township(s)	Nest Site(s)[b]	Years of Eagle Residency[c]
The Nature Conservancy – Maine Chapter: ***Fee Ownership*** *(continued)*			
Chops Creek tract	Woolwich	9 - area	0 / 16
Dayton Island – Nicatous Lake	T40 MD	76 - area	0 / 34
Dram Island Preserve	Sorrento	37 - area	0 / 32
East Plummer Island Preserve	Addison	51A-D	26 / 34
p/o Falls Island Preserve	Trescott Twp.	68A-B	27 / 27
Fernald Neck Preserve	Camden	306 - area	0 / 4
Flint Island Preserve	Harrington	47B	5 / 32
Flying Point Preserve	Georgetown	13E	1 / 13
p/o Great Duck Island Preserve	Frenchboro	138B-G	14 / 16
Great Wass area – Great Wass I.	Beals	119D	6 / 21
Great Wass area – Great Wass I.	Beals	265 - area	0 / 1
Great Wass area – Great Wass I.	Beals	342A	3 / 3
Great Wass area – Little Hardwood Isl.	Jonesport	53A-C	25 / 25
Great Wass area – Mark Island	Jonesport	54A-B	12 / 12
Hersey Cove Preserve	Pembroke	67D, F-H	21 / 22
Hog Island Preserve	Lubec	70A	22 / 25
Katahdin FP – Debsconeag Deadwater	T1 R9 WELS; T1 R10 WELS; T2 R10 WELS	89A-E	23 / 23
Katahdin FP – Ltl. Ambejackwockamus	T3 R11 WELS	120 - area	0 / 4
Katahdin FP – Sourdnehunk Deadwater	Rainbow; T2 R10 WELS; T3 R11 WELS	88 - area	0 / 28
Long Island Preserve	Lubec	70 - area	0 / 25
Long Porcupine Island Preserve	Gouldsboro	40B-E	21 / 22
Mark Island Preserve	North Haven	16A-D	20 / 20
Moose River tract	Rockwood Strip	280 - area	0 / 6
Mustard Island	Topsham	204 - area	0 / 11
Placentia Island Preserve	Frenchboro	24A, C	26 / 27
Plummer Point	South Bristol	217 - area	0 / 11
Preble Island Preserve	Sorrento	37A-B, H	2 / 32
Sheep Island	Deer Isle	324 - area	0 / 2
Shipstern Island Preserve	Harrington	47A, C-D	27 / 32
Stone Island Preserve	Machiasport	162A-B	15 / 15
Sucker Brook Preserve	Lovell	230 - area	0 / 2
Turtle Island Preserve	Winter Harbor	297A-B	4 / 4
Upper Birch Island Preserve	Addison	49A, D-F	22 / 23
The Nature Conservancy – Maine Chapter: ***Easements***			
Big Coombs Island easement	Stonington	147 - area	0 / 19
Great Spruce Head Island easement	Deer Isle	193 - area	0 / 13

Conservation Organization Parcel Name[a]	Township(s)	Nest Site(s)[b]	Years of Eagle Residency[c]
The Nature Conservancy – Maine Chapter: ***Easements*** *(continued)*			
p/o Head Harbor Island easement	Jonesport	53 - area;	0 / 25
		54 - area;	0 / 12
		153 - area	0 / 18
Hog Island easement	Harrington	48 - area;	0 / 27
		373 - area	0 / 2
Ingalls Island easement	Sorrento	35A	3 / 13
Katahdin FP easement – Abol Falls	T2 R10 WELS	388A	1 / 1
Katahdin FP easement – Caribou Pt.	T3 R12 WELS	357A;	1 / 1
		134 - area	0 / 13
Katahdin FP easement – Eagle Lake	T7 R12 WELS	90 - area	0 / 27
Katahdin FP easement – Little "A"	T3 R11 WELS	120A	4 / 4
Katahdin FP easement– Pemadumcook	T1 R9 WELS	285A-B	6 / 6
Katahdin FP easement – Ripogenus	T3 R12 WELS	264 - area	0 / 8
Katahdin FP easement – South Twin	T4 Indian Purch.	245A	3 / 3
Katahdin FP easement – Umbazookus	Chesuncook	186 - area	0 / 11
Little Eaton Island easement	Deer Isle	324 - area	0 / 2
Mink Island easement	Addison	49 - area	0 / 23
Narrows Island easement	Harrington	48 - area;	0 / 27
		373 - area	0 / 2
Outer Scott Island easement	Deer Isle	324A-B	2 / 2
p/o Steele Harbor Island easement	Jonesport	53 - area	0 / 25
p/o Upper Goose Island easement	Harpswell	202 - area	0 / 11
Pickering Island easement	Deer Isle	324 - area	0 / 2
Plummer Point easement	South Bristol	217 - area	0 / 11
Race Point easement	Trescott	68 - area	0 / 27
Raspberry Island easement	Harrington	48 - area	0 / 27
Seguin Island easement	Jonesport	54 - area	0 / 12
Shingle Island easement	Stonington	326B	2 / 3
Willard Point easement	Harrington	48 - area;	0 / 27
		49 - area;	0 / 23
		373 - area	0 / 2
University of Maine Foundation: ***Fee Ownership***			
Holt Research Forest	Arrowsic	13 - area	0 / 13
p/o Marsh Island	Orono	277 - area	0 / 6
Penobscot Experimental Forest	Eddington	305A	4 / 4
U.S. Fish & Wildlife Service: ***Fee Ownership***			
Moosehorn N.W.R. – Bellier Cove	Edmunds Twp.	66 - area;	0 / 27
		171 - area	0 / 12
Moosehorn N.W.R. – Birch Island	Edmunds Twp.	64A,C	16 / 16
Conservation Organization		Nest	Years of

Conservation Organization Parcel Name[a]	Township(s)	Site(s)[b]	Years of Eagle Residency[c]
U.S. Fish & Wildlife Service: ***Fee Ownership*** *(continued)*			
Moosehorn N.W.R. – Dram Island	Pembroke	381A	1 / 1
Moosehorn N.W.R. – p/o Edmunds Unit	Edmunds Twp.	171 - area	0 / 12
Moosehorn N.W.R. – Hallowell Island	Edmunds Twp.	64B	0 / 16
Moosehorn N.W.R. – Liza Dunn Point	Pembroke	101C	7 / 24
Moosehorn N.W.R. – Magurrewock	Calais	72E-F;	3 / 15
		73A, C-F	28 / 28
Moosehorn N.W.R. – Mile Brook Flwg.	Baring Plt.	132A-B	20 / 20
Petit Manan N.W.R. – Bois Bubert Isl.	Milbridge	267A;	6 / 6
		46 - area	0 / 22
Petit Manan N.W.R. – Cross Island	Cutler	121A	9 / 19
Petit Manan N.W.R. – Double Shot Isl.	Cutler	121B,D	2 / 19
Petit Manan N.W.R. – Metinic Island	Matinicus Isle	395A	1 / 1
Petit Manan N.W.R. – Mink Island	Cutler	121C	8 / 19
Petit Manan N.W.R. – Outer Heron Isl.	Boothbay	292A-B	5 / 5
Petit Manan N.W.R. – Outer White Isl.	Boothbay	292 - area	0 / 5
Petit Manan N.W.R. – Petit Manan Pt.	Steuben	144 - area	0 / 9
Petit Manan N.W.R. – Sally Island	Steuben	144A	7 / 9
Petit Manan N.W.R. – Shoppee Island	Roque Bluffs	111A-C	2 / 24
Petit Manan N.W.R. – Ringtown Island	Swans Island	152B-E	17 / 17
Petit Manan N.W.R. – Williams Point	Gouldsboro	145D	3 / 18
Umbagog N.W.R.	NH / Magalloway	219A	13 / 14
	& Upton	311 - area	0 / 4
U.S. Fish & Wildlife Service: ***Easements***			
Kennebec River uplands easement	Benton	278 - area	0 / 6
Sandy River easement	Starks	291A	4 / 4
Vinalhaven Land Trust: ***Fee Ownership***			
Bluff Head	Vinalhaven	108C	2 / 12
Neck Island	Vinalhaven	108D	0 / 12
Perry Creek parcels - Vinalhaven	Vinalhaven	294 - area	0 / 5
Vinalhaven Land Trust: ***Easements***			
Burnt Island easement	Vinalhaven	108 - area	0 / 12
Hay Island easement	Vinalhaven	108 - area	0 / 12
p/o Green Island easements	Vinalhaven	276 - area	0 / 6
p/o Perry Creek uplands easement	Vinalhaven	294 - area	0 / 5
Starboard Rock easement	Vinalhaven	108 - area	0 / 12
The Basin easements	Vinalhaven	15 - area	0 / 1
Winter Harbor easements	Vinalhaven	108 - area	0 / 12

[a] Abbreviations: "CoM" = Coast of Maine, "KF" = Katahdin Forest, "N.W.R." = National Wildlife Refuge, "p/o" = part of, "WBP" = West Branch Project, and "WMA" = Wildlife Management Area.

[b] Individual nest sites (*e.g.,* “#41A-B”) on a conservation parcel are listed in this column. Other conservation lands within 1.5 miles of a nest (*e.g.,* “108 - area”) are also identified.

[c] Years of eagle residency (cumulative during the period 1962 – 2002) is expressed as a ratio: # years of pair residency on the conservation parcel / # years of pair residency in the nesting territory. This summary does not include instances of territorial behavior by single adults.

Appendix 4. Models described by discriminate function analysis for predicting bald eagle nesting habitat in Maine (Livingston 1987, Livingston *et al.* 1990).[a]

Habitat Type Variable[b]	Model Coefficient	Transformation	Coefficient Of Variance
Rivers			
Basin area (m^2)	14.90	$\log_{10}(X + 1)$	15.53
Forest edge (m)	- 0.000868	none	22.37
Distance to shore (m)	- 0.267	$(X + 0.5)^{1/2}$	45.78
Constant	- 78.75		
Lakes			
Distance to shore (m)	- 0.266	$(X + 0.5)^{1/2}$	19.17
Disturbed area (ha)	- 1.34	$X^{1/2}$	19.59
Superdominant trees (#)	1.90	$\log_{10}(X + 1)$	28.80
Forest harvests (ha)	- 0.315	$(X + 0.5)^{1/2}$	20.74
Constant	4.57		
Inshore estuaries			
Diadromous fish (#)	0.783	none	27.08
Roadways (m)	- 0.00129	none	24.87
Shallow waters (m^2)	0.00511	$X^{1/2}$	14.62
Constant	- 2.65		
Offshore marine			
Forest openings (m^2)	0.00000621	none	46.07
Forest edge (m)	- 0.0658	$X^{1/2}$	31.08
Shallow & tidal waters (m)	- 6.08	$\log_{10}(X + 1)$	37.24
Constant	34.79		

[a] Model functions with an output >0 indicate potential nesting habitats, and those <0 forecast that a site is not suitable habitat for nesting eagles.

[b] The following descriptions provide further detail of model variables:

“Basin area” = area of the primary water body basin (including open water and dense aquatic herbaceous vegetation) within 1500 m of inland sites; measured in square meters.

“Diadromous fish” = number of diadromous fish species (alewives, blueback herring, American eels) present within 1500 m of inland sites and those in coastal estuaries.

“Distance to shore” = distance to the primary water body within 1500 m of all sites; measured in 50-meter increments.

“Disturbed area” = land area within 500 m of all sites altered and maintained by humans; measured in hectares.

“Forest edge” = length of edge between forests and any other terrestrial or aquatic cover type within 500 m of all sites (includes only vertical differences between cover types > 5 m); measured in meters.

“Forest harvests” = land area within 1500 m of all sites subjected to timber harvests (as evidenced by cut boundaries, slash, regeneration, bare ground or haul roads; measured in hectares.

“Forest openings” = area of all breaks (terrestrial + aquatic) in the forest canopy > 1/4 hectare within 500 m of all sites; measured in hectares.

“Shallow & tidal waters” = area of intertidal zone + area of waters < 1.8 m deep at low tide within 1500 m of coastal sites; measured in meters^2.

“Shallow waters” = area of waters < 1.8 m deep at low tide within 1500 m of coastal sites; measured in meters^2.

“Superdominant trees” = number of superdominant trees within 500 m of all sites.

Appendix 5. Bald eagle nesting and productivity in Maine, 1962 – 2003.[a]

Year	Occupied Nests[b]	Successful Nests[c]		Nests Fledging # of eaglets				Eaglets Fledged	Fledglings / Nest[d]	
		#	%	0	1	2	3		Success.	Occup.
1962	27	8	27	19	8	0	0	8	1.00	0.30
1963	32	9	32	23	6	3	0	12	1.33	0.38
1964	28	6	21	22	6	0	0	6	1.00	0.21
1965	33	4	12	29	4	0	0	4	1.00	0.12
1966	28	7	25	21	3	4	0	11	1.57	0.39
1967	21	4	19	17	2	2	0	6	1.50	0.29
1968	23	9	39	14	7	2	0	11	1.22	0.48
1969	29	11	38	18	7	4	0	15	1.36	0.52
1970	32	8	25	24	5	3	0	11	1.38	0.34
1972	29	8	28	21	8	0	0	8	1.00	0.28
1973	31	6	19	25	6	0	0	6	1.00	0.19
1974	36	13	33	23	13	0	0	13[e]	1.00	0.33
1975	31	10	32	21	8	2	0	12[e]	1.20	0.39
1976	41	13	31	28	6	6	1	21[e]	1.62	0.51
1977	50	24	48	26	16	5	3	35	1.46	0.70
1978	62	20	32	42	9	10	1	32	1.60	0.52
1979	52	28	54	24	18	10	0	38[e]	1.36	0.73
1980	56	29	52	27	19	9	1	40	1.38	0.71
1981	63	34	54	29	20	14	0	48	1.41	0.76
1982	73	38	52	35	19	18	1	58	1.53	0.79
1983	76	40	53	36	20	20	0	60	1.50	0.79
1984	66	35	53	31	24	11	0	46	1.31	0.70
1985	86	52	60	34	29	23	0	75	1.44	0.87
1986	90	50	56	40	25	24	1	76[e]	1.52	0.84
1987	90	47	52	43	23	23	1	72	1.53	0.80
1988	[83]									
1989	109	44	40	65	19	25	0	69	1.57	0.63
1990	124	69	56	55	40	29	0	98	1.42	0.79
1991	127	79	62	48	44	32	3	117	1.48	0.92
1992	140	77	55	63	43	32	2	113	1.47	0.81
1993	151	86	57	65	56	30	0	116	1.35	0.77
1994	175	99	57	76	61	37	1	138	1.39	0.79
1995	192	118	61	74	62	54	2	176	1.49	0.92
1996	203	95	47	108	50	44	1	141	1.48	0.69
1997	176	108	61	68	42	61	5	179	1.66	1.02
1998	202	127	63	75	68	56	3	189	1.49	0.94
1999	216	133	62	83	66	60	7	207	1.56	0.96
2000	234	140	60	94	79	57	4	205	1.46	0.88
2001	269	174	65	95	88	80	6	266	1.53	0.99
2002	290	184	63	106	95	82	7	280	1.52	0.97
2003	309	190	61	109	108	81	1	273	1.44	0.88