

SPECIES PROFILE

Osprey

Pandion haliaetus

Federal Listing: Not listed
State Listing: Threatened
Global Rank: G5
State Rank: S2B
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ELEMENT 1: DISTRIBUTION AND HABITAT

1.1 Habitat Description

The osprey has a cosmopolitan distribution, occurring nearly everywhere in the world except Polar Regions during various portions of their annual cycle (Poole et al. 2002). Most ospreys in North America are long-distance migrants, traveling up to 5,000 mi (8,000 km) to and from their wintering areas in the Caribbean, Central America, and South America (Henny and Van Velzen 1972, Environment Canada 2001). Satellite tracking studies (Martell et al. 2001) show that ospreys that breed on the east coast of the United States winter primarily in northern South America and sometimes in Cuba and in Florida. Ospreys breeding in Florida, California, and other southern U. S. locations are essentially non-migratory (Poole et al. 2002). Female ospreys from most North American breeding populations usually winter farther south than do their male counterparts, and individuals of both sexes display strong fidelity to wintering and breeding sites.

Osprey do not make their first northward spring migrations from the tropics until they are nearly 2 years old, and generally do not establish breeding territories until they are at least 3 years old (Poole et al. 2002). When attempting to establish a breeding territory, young ospreys often settle within 32 mi (50 km) of natal areas, which contributes to the species' slow rate of colonizing vacant territory.

When ospreys return to New Hampshire from

the tropics, they usually arrive in coastal areas first. Dispersal inland often involves travel upstream on the Connecticut, Merrimack, Piscataqua, Saco, and Androscoggin rivers. Local breeding territories are reoccupied beginning in late March and early April; early arrival dates reported for New Hampshire nest sites include March 24 at Great Bay, March 26 in the lower Merrimack River valley, March 29 in the Lakes Region, and April 6 in Pittsburg (Evans 1994, Martin et al. 2004). From April to mid-May, many individuals pass through the state en route to breeding areas far north of the state's border with Canada. During this spring migratory interval, ospreys are seen on all of the state's major rivers and lakes, as well as on many smaller streams and minor ponds, where they are able to obtain prey to fuel their migration.

Ospreys breed from Newfoundland across to Alaska up to and even beyond the tree limit, and they occur in every province in Canada and across the entire U. S. In northern New England and the Canadian Maritimes, ospreys typically establish breeding territories near large lakes, major rivers, and coastal estuaries. For example, a habitat model developed for the Gulf of Maine watershed (USFWS 2000) found that 90% of 200 osprey nests examined in Maine were located within 0.6 miles of major rivers or lakes of greater than 100 acres in size. Another key breeding habitat is wetland ponds, where flooding by beavers produces dead snags for nesting and shallow waters for fishing. Shallow water is preferred because it offers better access to aquatic prey. Suitable breeding habitat (Poole et al. 2002) included the following:

- Areas with dependable fishing sources located within 2 to 3 miles (Poole 1989), but occasionally as far as 8 miles (Prevost 1979, Hagan and Walters 1990) from potential nesting sites,
- Standing trees or other structures located in wetlands,

- An ice-free period of no less than 20 weeks, long enough to permit egg-laying (3 weeks), incubation (5 weeks), raising young (8 weeks), and post-fledging foraging skill development (4 weeks).

Breeding ospreys generally defend their nest site only (typically a perimeter of 50 to 100 m), rather than a much larger feeding territory. Spacing between adjacent nesting pairs is highly variable and is dependant upon regional prey abundance and distribution and upon availability and type of nest substrate (Poole et al. 2002). For example, mean distance reported between neighboring nests for a tree-nesting population in New York State averaged 410 m, whereas a platform-nesting population in salt marshes in southeastern Massachusetts nests averaged only 140 m apart. A boreal forest population in New Brunswick averaged a much more diffuse one pair per 51 ha (Stocek and Pearce 1983).

1.2 Justification

Ospreys have been closely monitored in the United States ever since severe population declines were first documented both in North America and elsewhere between the 1950s and the 1970s (Henny and Ogden 1970, Poole et al. 2002). The number of pairs nesting in coastal areas of southern New England declined about 90% during this period, Chesapeake Bay area pairs declined by about 50%, and populations in the Great Lakes region also dropped significantly. Research demonstrated that population losses during that period resulted primarily from presence of high levels of DDT and other persistent organochlorine pesticides in the aquatic food web, which caused severe eggshell thinning and extremely poor hatching success (Spitzer et al. 1978, Wiemeyer et al. 1988).

Ospreys can serve as valuable bio-indicators of general environmental quality in aquatic systems because they rapidly accumulate chemical contaminants, such as the organochlorine pesticide DDT and its metabolite DDE, contained in fish. A dramatic osprey population decline, caused by DDT contamination, occurred across much of North America beginning in the 1940s and continued until 1970 (Ogden 1977). Osprey populations have rebounded strongly since the banning of the use of DDT, with the most dramatic increases occurring in traditional or historical nesting areas rather than in newly colonized areas

(Houghton and Rymon 1997).

1.3 Protection and Regulatory Status

Ospreys are protected in the United States under the Migratory Bird Treaty Act of 1918, which prohibits the possession or killing of most non-game birds and the collection of their eggs or nests. The species was first listed as threatened by the State of New Hampshire in 1979 (R.S.A. 212-A: 1 et seq.), and is still so classified. Other federal measures that indirectly provide protection include the Federal Insecticide, Fungicide, and Rodenticide Act (7 U.S.C. 136) for new and existing pesticide registration and use, the National Forest Management Act (16 U.S.C. 1600), and the Federal Land Management and Policy Act (43 U.S.C. 1701). Ospreys are also protected from unregulated international trade by an agreement of the 1975 Convention on International Trade in Endangered Species of Wild Flora and Fauna.

1.4 Population and Habitat Distribution

Osprey populations across much of North America have rebounded strongly since the banning of the use of DDT. Estimates in the mid-1980s indicated that North America then supported about 18,000 to 20,000 pairs of breeding ospreys (about 57 to 84% of the world population) and that about two thirds of those bred in Canada and Alaska (Poole 1989). Recent population estimates suggest that about one third of the world's breeding ospreys nest in Canada (Environment Canada 2001). There were an estimated 8,000 breeding pairs in the contiguous U. S. in 1981, but 14,200 pairs in 1994 (Houghton and Rymon 1997), an estimate that increased further to 16,000 to 19,000 pairs by 2001 (Poole et al. 2002). Annual population growth rates ranging from 6 to 15% have generally been reported across North America over the past 30 years (Ewins 1997). Specifically, average annual rates of population increase in northern Michigan, Wisconsin, southern Ontario, and upper New York State have been 7%, 8%, 10-15%, and 10%, respectively (Environment Canada 2001).

A summary of the recent population status of breeding ospreys in states adjacent to New Hampshire is summarized in Table 1. In New Hampshire, ospreys have been reported as migrants for more than a century, though they were historically documented

as common summer residents only in the Umbagog Lake area (Maynard 1871, Brewster 1925).

Aerial surveys of Coos County, New Hampshire, conducted by the USFWS in 1970 and 1971, located a total of 7 and 12 osprey nests, respectively, and the Umbagog area breeding population was believed to number only 3 or 4 pairs by 1977 (Smith 1979). There are relatively few historical references about ospreys breeding in other parts of the state (see Allen 1902, Dearborn 1898, Scott 1921), and there are no comprehensive estimates of statewide historical distribution or population size prior to fieldwork initiated by the New Hampshire Audubon (NHA) and New Hampshire Fish and Game (NHFG) beginning in 1980 (Smith and Ricardi 1983). Since 1980, these two organizations have partnered to conduct extensive annual field monitoring of the state's breeding osprey population (Martin et al. 2004).

Surprisingly, there is only one historical reference to nesting ospreys in New Hampshire's Great Bay area (Scott 1921). Early population declines in New Hampshire may have resulted in part from removal, by loggers, of large pines for nest sites, especially those located on river and lake shorelines and in wetlands. Logging-related population declines have been documented elsewhere in North America (Ewins 1997).

New Hampshire classified the osprey as state threatened in 1980 and soon began to conduct field monitoring and management of the breeding population. During the 1980s, nest sites were limited almost completely to the Androscoggin River watershed. The first nesting in New Hampshire's coastal watershed was documented near Great Bay in 1989, followed by first nesting in the Connecticut River watershed in 1993, and in the Merrimack River watershed in 1996. New Hampshire osprey productivity for the 25-year period from 1980 to 2004 is shown in Table 2. Known available, active, and successful osprey nests in New Hampshire from 1980 to 2002 are shown in figure 2. Osprey fledglings produced at successful nests in New Hampshire from 1980 to 2002 are shown in figure 3.

1.5 Distribution Map

1.6 Habitat Map

Several habitats were mapped that are relevant to ospreys, including marsh and shrub wetlands and

known great-blue heron rookeries. This information, along with new and available (e.g., rivers, lakes) data, will be used to map potential osprey habitat.

1.7 Sources of Information

General natural history information and some sources of original research discussed in this document were obtained primarily from *The Birds of North America*, No. 683: Osprey (Poole et al. 2002). Unless otherwise noted, New Hampshire specific data have been acquired by field monitoring and management activities conducted by NHA from 1980 to 2004 under several cooperative and/or contractual agreements and grants received from NHFG, Public Service Company of New Hampshire, and other funding sources (Martin et al. 2004).

1.8 Extent and Quality of Data

Since 1980, the osprey has been one of the most intensively monitored and managed species in New Hampshire. Breeding site and productivity data are derived from field monitoring conducted for 25 years by NHA staff and trained volunteer observers who use standardized monitoring techniques (Martin et al. 2004).

1.9 Distribution Research

The future distribution and abundance of ospreys in New Hampshire should be monitored by spring breeding surveys of recently active and potential breeding sites. Active breeding territories should be checked annually to determine nest occupancy status and reproductive outcome, and surveys of potential breeding territories should be conducted on a rotating basis, with annual survey intensity determined by available funding and human resources. For example, sites could be checked on a biennial or triennial rotating basis, covering 50% or 33% of potential sites annually.

ELEMENT 2: SPECIES/HABITAT CONDITION

2.1 Scale

New Hampshire's 5 major watersheds (Androscoggin, Coastal, Connecticut, Merrimack, and Saco wa-

tersheds) will be considered as separate conservation planning units because there are significant differences between watersheds in the physical characteristics, human land use patterns, population distribution, and nest sites utilized by ospreys (see figure 1).

2.2 Relative Health of Populations

2.1.1 Androscoggin River watershed

The Androscoggin River watershed is one of the most pristine and undeveloped major drainages in the state. Umbagog Lake at the Androscoggin's headwaters was the only part of the state that maintained breeding pairs of osprey through the region-wide period of decline in the 1950s through 1970s. The Umbagog Lake population may have been the source for the recolonization of much of the Androscoggin River watershed during early stages of population recovery in the 1980s and early 1990s. Presently, osprey pairs are clustered around two major water bodies, Umbagog Lake and Pontook Reservoir.

During the 2004 breeding season, the Androscoggin River watershed had the highest number of active nests of any major watershed; 14 young fledged from 12 active nests. The 14 young fledged represent 26% of the statewide number of young produced in 2004. Recently, there has been a shift in the distribution of the breeding population, with fewer pairs breeding near Umbagog Lake and more pairs breeding near Pontook Reservoir. The reasons for this shift are unclear, but may be influenced by changing availability of nest trees, forage base, interactions with aerial predators such as bald eagles, or other factors.

The population in this area should remain stable or continue to expand as long as nest tree availability remains high and the forage base remains in good condition. This area is characterized by spruce and fir forests and has high aquatic productivity. Many of the streams and lakes have good fish producing characteristics, such as high oxygen content and suitable substrate. Most of the lakes and streams are stocked annually and there are a high percentage of water bodies that contain warm water species. Land conservation initiatives, such as the establishment and expansion of the Lake Umbagog National Wildlife Refuge, and protection of shoreline by the State of New Hampshire, should protect foraging and nesting habitat in the long-term.

2.2.2 Coastal Watershed

The Coastal watershed in southeastern New Hampshire includes Great Bay and its tributary rivers and streams. Also included within this watershed are extensive coastal salt marshes along the state's immediate coastline and many isolated beaver ponds and wetlands in the headwaters of many of the river drainages mentioned above.

This area has been highly productive for ospreys since breeding pairs began to recolonize the area in 1989. Since the 2000 breeding season, more than 90% of all active nests located in this watershed have been successful. During the 2004 breeding season, this watershed had the highest number of successful nests of any major watershed; 14 young fledged from 9 active nests, 8 of which were successful. The 14 young fledged represent 26% of the statewide total number of young produced in 2004. Ospreys show an affinity for nests within great blue heron rookeries in this watershed. Nesting platforms erected in the coastal watershed have also been successful.

There is high potential for further breeding population expansion in the Coastal watershed due to the numerous lakes and ponds, an abundance of heron rookeries, and a focused effort to install additional platforms and replica nests. Currently there are 4 unoccupied platforms and 1 unoccupied replica nest in the coastal watershed.

2.2.3 Connecticut River Watershed

The Connecticut River watershed extends from the northernmost tip of New Hampshire to the state's southern border with Massachusetts. The Connecticut River flows through several ecoregions and includes several diverse habitats. Northern New Hampshire, characterized by soft and hardwood forests, has a long history of industrial ownership and uses. Agricultural uses are common within the drainage, especially in northern and central sections.

The osprey population in the Connecticut River watershed is in the early stages of recovery. During the 2004 nesting season, 8 young fledged from 5 active nests. The 8 young fledged represent 15% of the statewide total number of young produced in 2004. No active nesting attempts have been documented in the southern two thirds of this watershed, though there are 6 unoccupied platforms available along the

southern two thirds of the Connecticut River in New Hampshire.

Foraging areas are plentiful in the northern Connecticut River watershed. The area is a popular destination for fishermen, and NHFG heavily stocks local water bodies with trout. The area also has a high number of low-lying shallow ponds oxbows and streams ideal for osprey hunting. The Connecticut River watershed contains some of the more rural areas left in New Hampshire. Recently, industrial landowners have sold large parcels of land in the northern region, including lands comprising the headwaters of the Connecticut River. As a result, a large portion of the watershed will be conservation land. Incentives are also being provided to farm owners throughout the watershed in an attempt to conserve some of New Hampshire's open field habitats and farms.

Nest site availability is potentially a limiting factor for osprey population expansion in the Connecticut River watershed. In northern areas, supercanopy pines are uncommon due in part to historical logging practices and due to elevation and predominating soil characteristics. The practice of retaining snags during timber harvests is a relatively new management consideration; snag retention became common only within the past 20 years. Therefore, the lack of larger diameter snags in the Pittsburg area may be a result of harvesting that occurred prior to their identification as desired wildlife retention species. Furthermore, soils in the northern extent of the state are not especially suited for white pine production, and spruce and fir characterize much of this area. Agricultural areas found within the northern, central, and southern sections of the Connecticut Watershed contain very few large diameter trees and are managed as fields.

2.2.4 Merrimack River Watershed

The Merrimack River watershed, including the Lakes Region, the upper Merrimack valley, and the lower Merrimack valley, drains an extensive portion of central and southern New Hampshire. Starting at Franconia Notch, the drainage continues south to the Massachusetts border. Water bodies within this area range from deep, cold lakes and ponds to shallow marshes. The Merrimack River is large, includes many oxbow ponds, and provides a substantial amount of potential osprey foraging and nesting habitat.

During the 2004 breeding season, this watershed

had the highest number of young fledged; 17 young fledged from 8 active nests. The 17 young fledged represent 32% of the statewide total number of young produced in 2004. A majority of these active nests was located within heron rookeries, which are commonly found in beaver ponds throughout the watershed. There is high potential for ospreys to establish new nesting sites in heron rookeries scattered throughout the watershed, especially within the Lakes Region.

2.2.5 Saco River Watershed

The Saco River watershed located in the east-central portion of New Hampshire is mountainous. Water bodies within this area are typically clear, cold, and deep. Each of these characteristics is less than ideal foraging habitat for ospreys. Warmer, shallow water bodies tend to produce more foraging opportunities for ospreys. However, the sandy soils of the region are also characterized by an abundance of white pine, which are preferred by osprey as nesting trees. Through the 2004 breeding season, there were no known osprey nests located within this watershed.

The Saco River watershed has an abundant growth of supercanopy pine, yet the lack of white pine snags may be a limiting factor. Shallow water bodies and areas historically selected by great blue herons may offer potential osprey nest areas. Deep, oligotrophic lakes in the watershed have limited productivity due to the high abundance of granite and sand and, as a result, these water bodies are deficient in the correct characteristics to produce preferred forage species such as perch and pickerel.

2.3 Population Management Status

Management strategies for ospreys in New Hampshire fall into 3 categories:

1) Locate territorial pairs

From 1980 to 2004, NHA staff biologists solicited and evaluated public reports of ospreys in areas of potential breeding habitat and followed up with field surveys by staff or trained volunteer observers to identify occupied territories. The number of occupied nest sites has risen from 6 in 1980 to a recent high of 44 in 2003, and from presence in only 1 major watershed in 1988 to 4 of the state's 5 major watersheds by

1996 (Martin et al. 2004).

2) Monitor and manage nesting attempts

Nesting attempts have been monitored by trained volunteers observers and NHA staff biologists from 1980 to 2004, resulting in the documentation of 472 active nesting attempts, 296 successful nesting attempts, 613 young fledged (1.30 young/nesting attempt), and 176 nest failures (37% failure rate). The NHA staff installed sheet metal predator guards around the bases of nest trees to deter tree-climbing mammalian nest predators.

3) Augment natural nest sites by installing nesting platforms and replica nests

The NHA and NHFG began installing nest structures in 1977 around Umbagog Lake, but such activity did not begin in earnest until 1994 in the coastal watershed, when cooperation with Public Service Company of New Hampshire began. The primary objectives were to hasten colonization by ospreys of unoccupied areas of the state and to provide additional nesting opportunities for new osprey pairs within already occupied areas. As of the end of 2004, there were a total of 28 human-built structures (22 platforms and 6 replica nests) in place in New Hampshire for ospreys.

4) Public outreach and education

Information on the goals and status of osprey conservation efforts in New Hampshire has been disseminated in a variety of ways and has involved many different audiences. Extensive efforts have been made to educate the public on accurate identification and reporting of osprey. Articles and media news releases on the state's osprey recovery efforts and opportunities for direct public volunteer involvement appear annually in newspapers, on radio, and in newsletters of various natural resource agencies and conservation groups. The NHA staff offers public lectures and conduct volunteer training sessions annually to effective public participation in osprey conservation. Outreach to landowners, developers, and recreationists concerning osprey habitat needs are ongoing and essential.

2.4 Relative Quality of Habitat Patches

Currently occupied breeding habitat appears to pro-

vide the key ecological attributes required to support a healthy, expanding breeding population. Ospreys are generalist feeders that catch fish that linger near the water's surface (Poole et al 2002). The state's lakes and ponds, reservoirs, and rivers are well stocked and will likely provide foraging resources to support additional breeding pairs over the coming decade. The state's beaver and great blue heron population are at healthy levels; thus, the future development of new nest site habitat appears secure. Suitable nesting substrate does not appear to be a limiting factor, except perhaps in the Connecticut Lakes area where there are very few supercanopy pines available. The greatest ongoing habitat quality concerns include the following:

- Additional shoreline development near wetlands and on rivers and lakes, especially in the Merrimack River and the Coastal watersheds
- Increasing use of motorized watercraft and growing popularity of kayaks and canoes, especially in the Androscoggin River watershed
- Additional wetland losses, especially in the Merrimack River and the Coastal watersheds

2.5 Habitat Patch Protection Status

Of the 73 known osprey nests and human-built nest sites in 2004, 33 (45%) were located on public lands (16 federal, 12 state, 5 county or municipal government) and 40 (55%) were located on private land. Conservation easements or other formal conservation measures applied to 40 (55%) of the state's nest sites.

2.6 Habitat Management Status

Nest sites on public land are generally managed to promote productive breeding attempts, but few actual zone closures are in effect. Nest sites on private land are subject to landowner decisions, but outreach and education with landowners have usually resulted in land use practices that benefit osprey nesting success. No formal management agreements are currently in effect in the state.

2.7 Sources of Information

Information on the state's breeding osprey population is derived directly from summary reports and

field data on monitoring and management activities conducted by ANSH from 1980 to 2004 under annual contracts and grants received from the NHFG, from Public Service Company of New Hampshire and other funding sources (Martin et al. 2004).

2.8 Extent and Quality of Data

Because ospreys have been state-listed as threatened since the late 1970s, few New Hampshire wildlife species have a more complete data set on occurrence, productivity, and nest site condition. Annual summaries of this information are on file at NHA.

2.9 Condition Assessment Research

Long-term baseline monitoring of breeding ospreys in New Hampshire remains an important task in order to detect future threats to a stable or growing population in the state. Formal adoption of the existing draft recovery plan, including specific targets for delisting, should be a priority. Additional research to determine contaminant loads present in New Hampshire osprey chicks should be encouraged and facilitated by NHFG in order to determine the potential impact on statewide productivity and population recovery.

ELEMENT 3: SPECIES AND HABITAT THREAT ASSESSMENT

3.1.1 Mercury and Non-point Source Pollution

(A) Exposure Pathway

There are many types of anthropogenic pollutants whose toxic residues are known to biomagnify, particularly in aquatic systems, as they reach species that occupy higher trophic levels, such as ospreys. While only infrequently resulting in direct mortality, these pollutants have a range of more common sub-lethal effects, especially in long-lived predators such as ospreys that accumulate toxins over a long period. These various neurotoxins produce reproductive, behavioral, neurological, and physiological changes that can result in reduced vigor and breeding success (Wiemeyer et al. 1988, Steidl et al. 1991, Evers 2005).

Ospreys continue to be exposed to toxic contaminants through the fish they eat. Although industrial discharge to surface waters has been significantly curtailed, toxic chemicals are transported long distances

by air currents, and these chemicals enter aquatic systems via atmospheric deposition. Although the use of PCBs and dioxins has received much attention in North America, mercury has become an increasing problem in aquatic systems. One recent study conducted in Ontario and New Jersey found that mercury levels did not reach a level associated with toxic effects (Hughes et al. 1997), though another determined that high levels of mercury are present in adult and nestling ospreys in northern Quebec (Desgranges et al. 1998). Additionally, new pesticides continue to be developed that may have undetermined impacts on osprey and other wildlife.

(B) Evidence

Mercury levels are high and pervasive in northeastern North America in aquatic food webs (Hughes et al. 1997, Desgranges et al. 1998, Evers 2005). Brominated fire retardants, commonly known as PBDEs, are similar in chemical structure to PCBs, and are used in a wide range of synthetic household and consumer products. PBDEs have recently been shown to be accumulating in wildlife populations worldwide, including in raptors (Sharp and Lunder 2004). PCBs and many other organic compounds are also commonly detected in ospreys (Wiemeyer et al. 1998).

3.1.2 Recreation (Lead shot and sinkers)

(A) Exposure Pathway:

In a manner similar to what has been well documented in bald eagles, ospreys may be subject to lead poisoning by consuming lead sinkers associated within living or dead fish that they consume. This could potentially be an important source of anthropogenic morbidity and mortality. Continued use of lead fishing tackle (in violation of state laws) could threaten ospreys in certain areas.

(B) Evidence:

Lead poisoning of bald eagles has been documented in at least 34 states (Buehler 2000). Similar exposure in ospreys is far less well documented, however ospreys utilize a similar prey base of living and dead fish, and therefore would be expected to experience similar exposure. One difference is that ospreys are likely not exposed to lead shot because they do not typically feed on non-piscivorous prey and carrion (Poole et al. 2002).

3.1.3 Recreation (Boats and Jet Skis)

(A) Exposure Pathway

Recreational boating can modify osprey foraging patterns by reducing use of perching and foraging areas, potentially altering food delivery and productivity.

(B) Evidence

Motorized boat traffic on New Hampshire water bodies is increasing, as are the size of vessels and their top speed. Improved access to public waters has the potential to further increase the number of boats on the water. The growing popularity of small personal watercraft (motorized jet skis as well as self-propelled canoes and kayaks) has the added effect of bringing increased human traffic volume into the shallow coves and other areas where ospreys feed, perch, and rest.

3.1.4 Development (Shoreline Development)

(A) Exposure Pathway

Shoreline development and increased recreational on water bodies may disturb nesting adults and reduce availability of perching and feeding sites. Development can limit the future expansion of a recovering population and act to reduce future carrying capacity. New Hampshire is among the fastest growing states in the northeastern U.S. Shoreline real estate development contributes to secondary problems such as increased pollution and water-based recreation, which also have the potential to negatively impact ospreys.

(B) Evidence

Some osprey pairs have been documented to acclimate to frequent human activity at nesting sites, especially where the presence of human activity precedes nest establishment (Ewins 1996, Poole et al. 2002). However, many New Hampshire pairs do not appear to exhibit this high degree of tolerance. Shoreline development affects perching and foraging by ospreys, with possible direct and indirect effects on reproductive success. In Ontario, shoreline development has been suggested as a leading source of reduction in nest site availability (Ewins 1997).

3.1.5 Energy and Communication Infrastructure

(A) Exposure Pathway

Ospreys are attracted to high-tension electricity trans-

mission towers and to smaller wooden utility poles as potential nest sites, and this exposes ospreys to the risk of electrocution (Ewins 1995). Although this is not considered the most significant risk to the state's osprey population, it can be managed through monitoring and collaboration with utility companies.

(B) Evidence

During the past decade, the number of power line osprey nests in New Hampshire has increased from 1 to 7 sites. Although there are no documented instances of electrocution of ospreys in the state, there have been cases where power interruptions have been caused by nest structures.

3.1.6 Development (Habitat Loss and Conversion)

(A) Exposure Pathway

Availability of suitable nest sites appears frequently to limit some local breeding populations of osprey (Ewins 1997). Supercanopy pines near wetland edges and dead standing trees located in flooded beaver ponds are both highly attractive to ospreys as nesting sites. Flooded areas reduce the vulnerability of osprey nests to mammalian predators (Poole et al. 2002), and draining or filling of wetlands reduces the ability of these areas to support viable osprey nests.

(B) Evidence

Researchers working in certain parts of Europe have reported that some forestry practices have severely reduced or eliminated suitable supercanopy nesting trees, which resulted in fewer available nest sites for ospreys (Meyburg et al. 1996). In Ontario, timber extraction has been suggested as a leading cause of reduction in nest site availability (Ewins 1997).

3.1.7 Non-point Source Pollution (Pesticides and Herbicides)

(A) Exposure Pathway

Ospreys are exposed to DDT and other organochlorines in the fish they consume. These chemicals may be transported long distances by air and may enter aquatic systems via atmospheric deposition and precipitation. Although the use of DDT and other organochlorines has been much reduced in North America, ospreys may still be exposed on the wintering grounds and in migration.

(B) Evidence

The use of DDT has been greatly reduced in North America, but ospreys are long-distance migrants and are exposed to DDT and other organochlorine compounds in prey species on the wintering grounds and in migration (Elliott et al. 2000).

3.2 Sources of Information

Information on various threats to ospreys was obtained from literature review, from NHA field data, and from consultation with specialists employed by the USFWS, NHFG, and the NHA, all located in Concord, New Hampshire, and from BioDiversity Research Institute in Gorham, Maine.

3.3 Extent and Quality of Data

Most of the threats described above have been examined carefully by researchers working outside of New Hampshire. The negative effects of mercury, PBDEs, PCBs, and DDT on aquatic species are well known and are well documented by researchers nationwide. There are sufficient data on the threat posed by lead to piscivorous bird species in New Hampshire that legislation has recently been passed that prohibits the use of certain size lead sinkers and jigs. There is no substantial New Hampshire specific data set on effects on ospreys of motorized and self-propelled boating activity. There is sufficient concern about shoreline and wetland habitat loss to justify strengthening land use policies and investing in more land protection efforts by federal and state agencies, and by non-profit conservation groups. Electrocutation issues are currently being addressed in collaboration with local utility companies.

3.4 Threat Assessment Research

There are several areas where additional threat assessment research is warranted, including:

- Investigation into the likely future extent of wetland and shoreline development on water bodies in New Hampshire, and development of a pro-active plan that would better protect wildlife values associated with shorelines and wetlands.
- Investigation of the tolerance of osprey for recreational boating activity in the vicinity of nest

sites and foraging areas

- Additional investigation of current levels of mercury, PCBs, DDE, and other bioaccumulative pollutants in New Hampshire ospreys.

ELEMENT 4: CONSERVATION ACTIONS**4.1.1 Document breeding status, Restoration and Management**

To determine occupancy status and reproductive outcome, distribution and abundance of breeding ospreys should be documented by nest site visits. Data on annual osprey productivity are needed to determine when recovery goals are achieved. This can be accomplished largely by training and coordinating a statewide network of volunteer nest site monitors. Direct threats addressed under this conservation action include mercury, PBDEs, PCBs, lead, motorized and self-propelled watercraft, shoreline development, electrocution, wetland loss, DDT, and organochlorines.

4.1.2 Finalize and adopt state recovery plan for ospreys, Regulation and Policy

Formally adopt an existing draft state recovery plan for ospreys (Martin et al. 2004) that includes specific targets for delisting. This conservation action builds on 25 years of ongoing management activities to insure population viability and establish clear targets for population recovery. Direct threats addressed under this conservation action include mercury, PBDEs, PCBs, lead, motorized and self-propelled watercraft, shoreline development, electrocution, wetland loss, DDT, and organochlorines.

4.1.3 DETERMINE CONTAMINANT LOADS, RESTORATION AND MANAGEMENT

Conduct more extensive monitoring of contaminant loads present in New Hampshire osprey chicks to determine the potential impact of toxics on statewide productivity and population recovery. This conservation action builds on 25 years of ongoing management activities to insure population viability and understand the effects of environmental contaminants. Direct threats addressed under this conservation ac-

tion include mercury, PBDEs, PCBs, lead, DDT, and organochlorines.

4.1.4 Nest site management, Restoration and Management

Install predator guards on nest sites and selectively place additional nesting platforms to disperse the breeding population. To minimize predation by mammalian predators such as raccoons and to increase productivity rates, the NHA and NHFG have installed predator guards on all new nest poles since 1994 and have installed predator guards on a majority of existing natural nest trees since 1985. Consult with local landowners and collaborate with utility companies to install additional nest poles and platforms to encourage colonization by ospreys of unoccupied areas of the state and to provide additional nesting opportunities for new osprey pairs in already occupied parts of the state. Direct threats addressed under this conservation action include motorized and self-propelled watercraft, shoreline development, electrocution, and wetland loss.

4.1.5 Encourage cooperative research, Restoration and Management

There is a need for more information on the effects of certain contaminants, osprey migration, and nest site fidelity. Migration should be studied using satellite tracking of a subset of the New Hampshire population. Current and proposed blood sampling will provide information on environmental contamination of New Hampshire osprey. Banding studies should also be conducted to assess nest site fidelity. In total, this research will improve our understanding of risk factors and will guide future conservation efforts. Direct threats addressed under this conservation action include mercury, PBDEs, PCBs, DDT, and organochlorines.

4.1.6 Provide public outreach materials, Education and Outreach

Enhance educational efforts about osprey biology, habitat, and land conservation issues to promote better local stewardship, reduce nest disturbance, and provide public support for wildlife protection efforts in general. Direct threats addressed under this

conservation action include mercury, PBDEs, PCBs, lead, motorized and self-propelled watercraft, shoreline development, electrocution, wetland loss, DDT, and organochlorines.

4.1.7 Promote conservation of great blue heron colonies and healthy beaver populations, Restoration and Management

Particularly in the southern part of New Hampshire, ospreys commonly select great blue heron rookeries located in flooded wetlands as nest sites. To maintain and encourage a self-sustaining population of osprey, heron rookeries, and the beaver populations that produce dead standing trees in wetlands, should be maintained and protected from disturbance. Direct threats addressed under this conservation action include shoreline development and wetland loss.

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ELEMENT 6: LIST OF FIGURES

Figure 1. Number of known available, active, and successful osprey nests in New Hampshire from 1980-2002.

Figure 2. Number of osprey fledglings produced at successful nests in New Hampshire from 1980 to 2002.

Figure 3. Distribution of known active osprey nests within five major watersheds in New Hampshire during 1980-1989, 1990-1994, 1995-1999, and 2000-2003.

Figure 4. Number of known active osprey nests within four major watersheds of New Hampshire from 1980-2003.

Table 1. New Hampshire osprey productivity summary: 1980-2004.

5.2 Data Sources:

Osprey nest and productivity surveys from 1981-

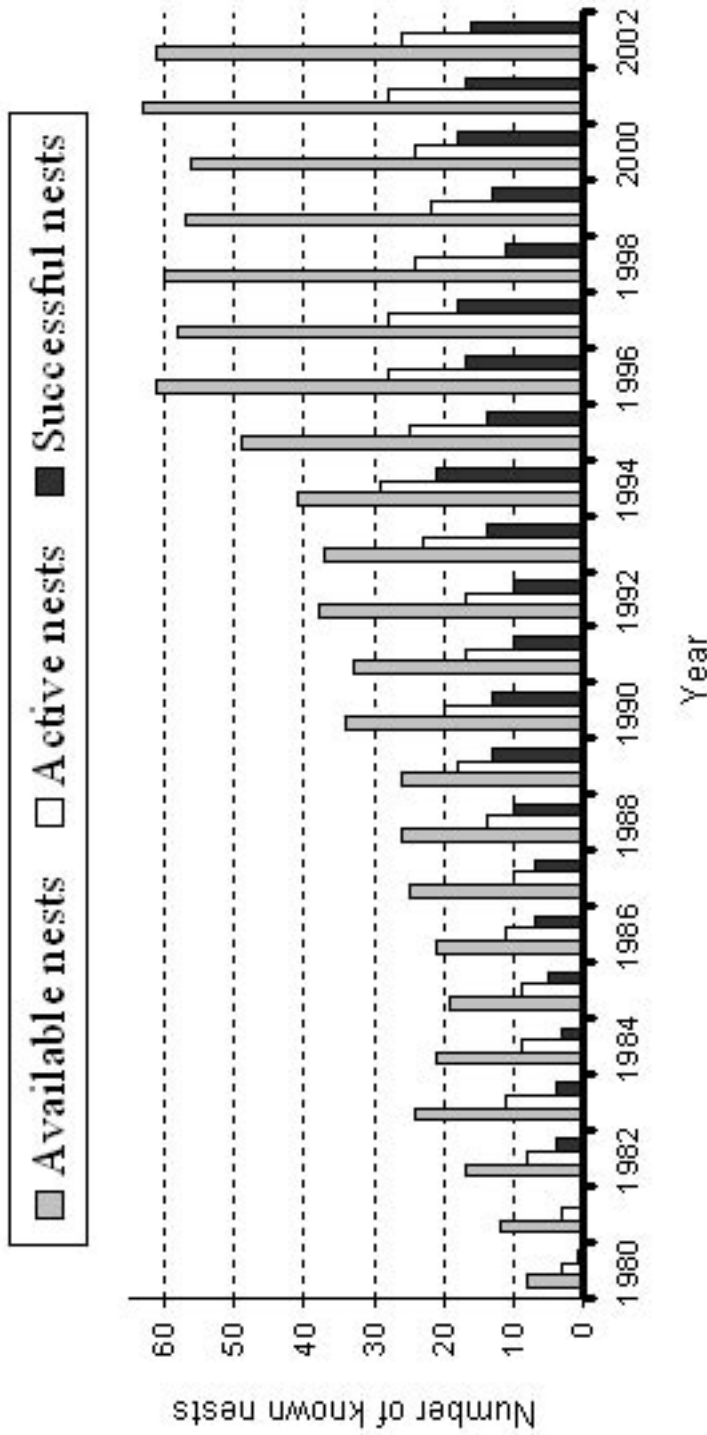


Figure 1. Number of known available, active, and successful osprey nests in New Hampshire from 1980-2002.

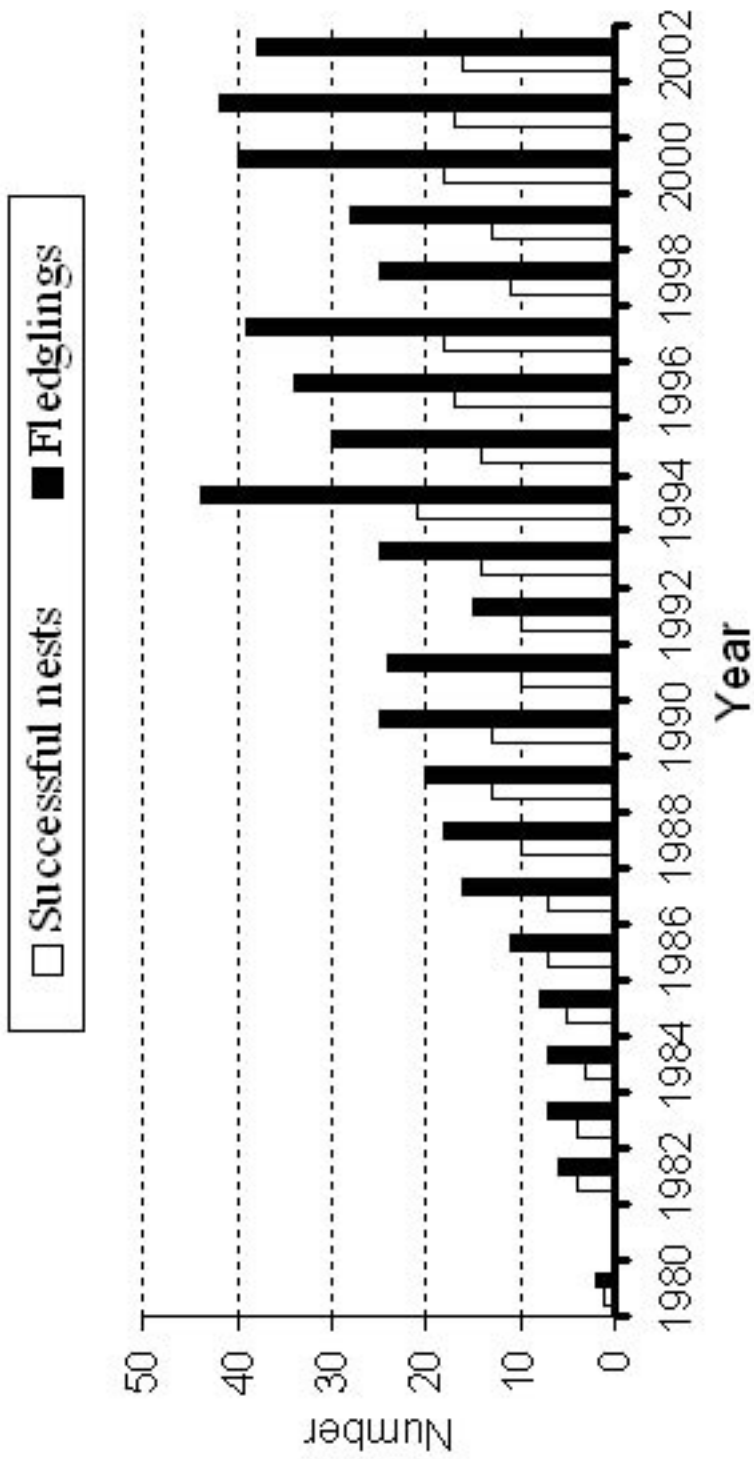


Figure 2. Number of osprey fledglings produced at successful nests in New Hampshire from 1980 to 2002.

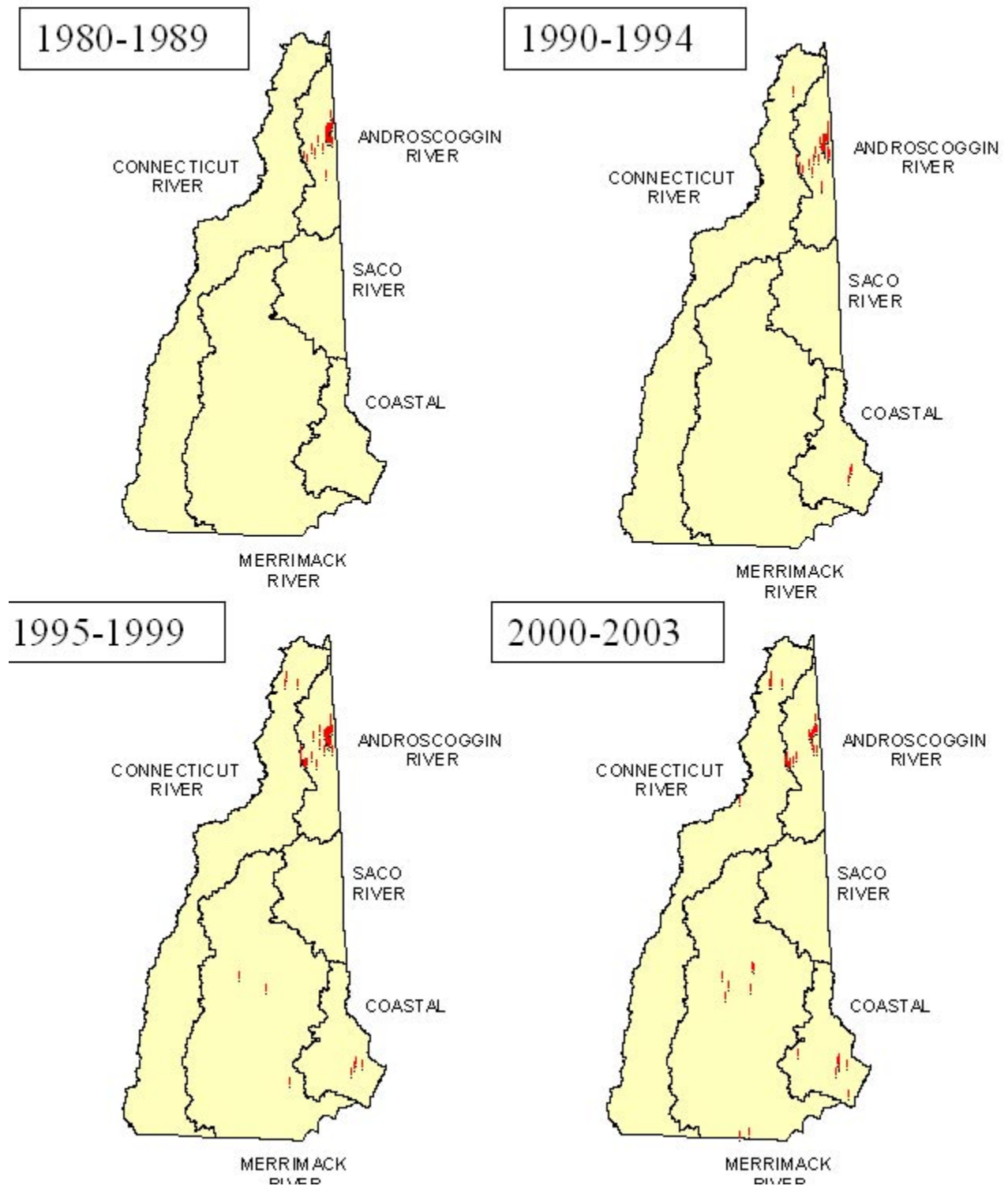


Figure 3. Distribution of known active osprey nests within five major watersheds in New Hampshire during 1980-1989, 1990-1994, 1995-1999, and 2000-2003.

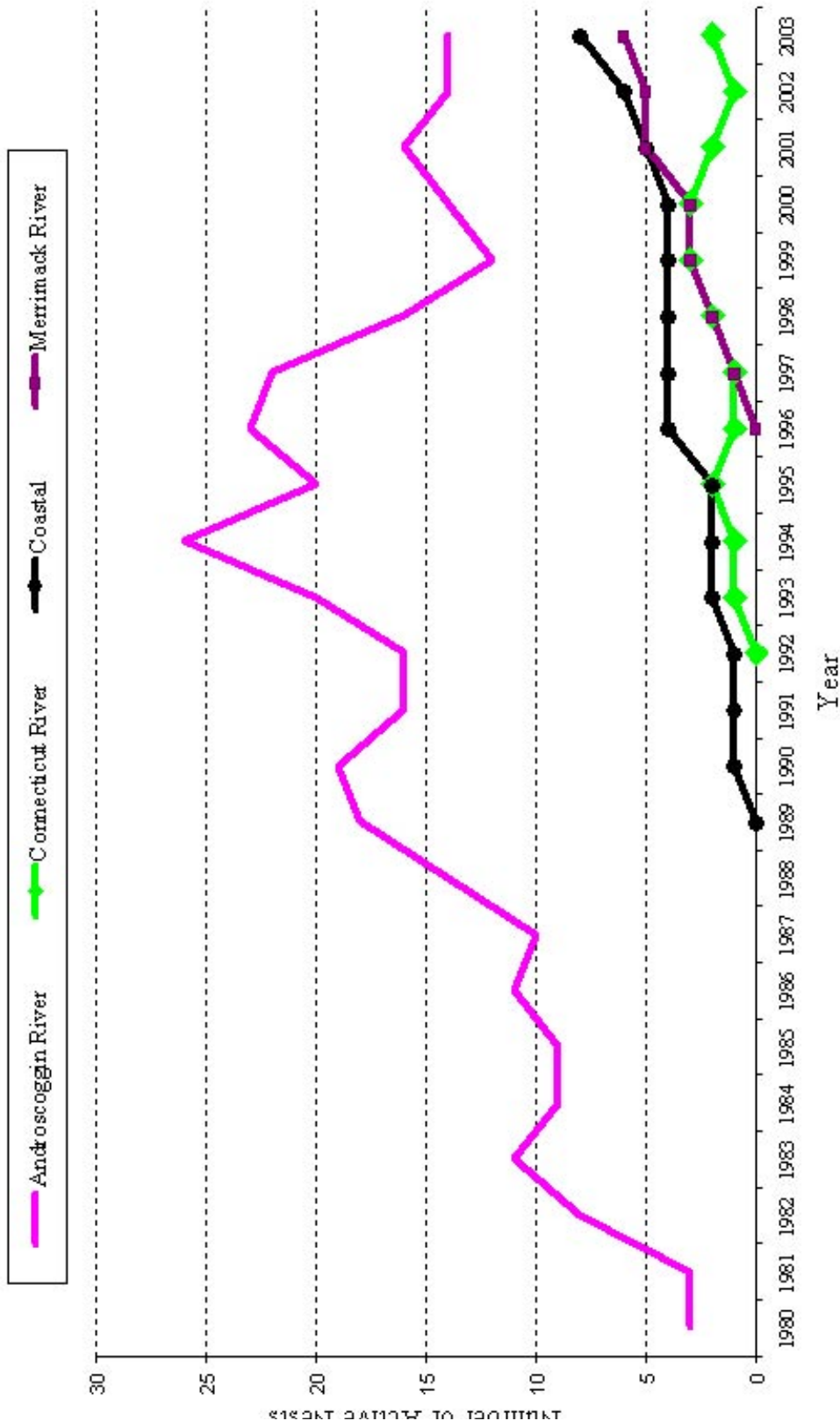


Figure 4. Number of known active osprey nests within four major watersheds of New Hampshire from 1980-2003.

Year	Occupied Nests	Active Nests	Successful Fledged	Young	Young per Nesting Pair
1980	6	3	1	2	0.67
1981	9	3	0	0	0
1982	14	8	4	6	0.75
1983	20	11	4	7	0.64
1984	15	9	3	7	0.77
1985	14	9	5	8	0.89
1986	15	11	7	11	1
1987	18	10	7	16	1.6
1988	21	14	10	18	1.29
1989	23	18	13	20	1.11
1990	26	20	13	25	1.25
1991	21	17	10	24	1.49
1992	33	17	10	15	0.88
1993	37	23	14	25	1.09
1994	32	29	21	44	1.52
1995	33	25	14	30	1.2
1996	43	28	17	34	1.21
1997	39	28	18	39	1.39
1998	36	24	11	25	1.04
1999	34	22	13	28	1.27
2000	39	24	18	40	1.67
2001	39	28	17	42	1.5
2002	32	27	17	40	1.48
2003	44**	30	23	54**	1.80**
2004	43	34**	26**	53	1.56
Totals for 1980-2004	472	296	613		1.3

Table 1. New Hampshire osprey productivity summary: 1980-2004.

Distribution of Osprey in New Hampshire

Distribution
■ Known



0 10 20 40 Miles

Known = verified nesting areas as reported
by Audubon Society of New Hampshire.

