Vermont Bald Eagle

Recovery Plan

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EXECUTIVE SUMMARY

The bald eagle (*Haliaeetus leucocephalus*) has returned to many parts of its former range, and its re-establishment as a breeding species in the northeastern United States appears secure. Efforts to restore bald eagle populations to North America have been extremely successful, thanks to the ban on dichlorodiphenyltrichloroethane (DDT), extensive reintroduction programs, and the protection of critical breeding and wintering habitat.

Bald eagles were proposed for delisting from the federal Endangered Species Act on July 6, 1999, and officially removed on July 9, 2007. Presently, the species has continued protection under the Bald and Golden Eagle Protection Act (1940), the Lacey Act (1900), and the Migratory Bird Treaty Act (1918).

The state of Vermont lists the bald eagle as a state-endangered species under the protection of the Vermont Endangered Species Law. Historical information on bald eagles in Vermont is limited; however, eagles were considered rare summer residents in the early 1900s (Fichtel 1985). A pair was known to have nested on Lake Bomoseen in the central part of the state in the 1940s. In August 2008, a successful nest and fledging was confirmed in Concord, VT for the first time since the 1940s, and two more nests were confirmed in 2009. Currently, bald eagles are also known to nest in every state and Canadian province bordering Vermont. Increases in breeding populations of eagles in states neighboring Vermont bode well for the future establishment of more breeding eagles in the state.

Through its development of numeric recovery objectives and management guidelines, the Vermont Fish and Wildlife Department's (VFWD) *Bald Eagle Recovery Plan* will guide the establishment and management of breeding populations of bald eagles in the state. The plan outlines the following recovery objectives described in the plan:

Downlisting Objectives

To meet the recovery goals and move to down-list from current state endangered status, the following objectives must be achieved over the course of five consecutive years:

1. There is an average of at least 19 occupied nests or breeding pairs within Vermont or within 1.5 kilometers of its border that produce an average of at least 19 fledglings; and

2. Of the successful pairs at least 10 of which must have their nest established within Vermont's state boundary.

Delisting Objectives

Delisting (removal from the state's endangered and threatened species list) will occur if the following objectives are met over the course of five consecutive years:

1. There is an average of at least 28 occupied nests or breeding pairs within Vermont or within 1.5 kilometers of its border that produce an average of at least 28 fledglings; and

2. Of the successful pairs at least 14 of which must have their nest established within Vermont's state boundary.

NATURAL HISTORY AND ECOLOGY

Taxonomy

Bald Eagles are in the family Accipitridae and the genus *Haliaeetus* for "fish" or "sea" eagles. It is one of two eagle species known to occur in North America. Two subspecies were once debated: *H.l. alascanus* for populations north of the 40-degree North latitude, and *H.l. leucocephalus* for the generally smaller southern subspecies (Buehler 2000). However, the subspecies are no longer distinguished (Stalmaster 1987).

Life History

Bald eagles range in size from 76 to 102 cm (30 to 40 in), and adults in northern areas range in weight from four to six kilograms (eight to 14 pounds) with wingspans of 1.5 to 2.4 m (five to eight feet). Females are larger than the males (USFWS 1999, USFWS 2007a). Adult birds are distinguishable by their white heads and tails, and dark brown bodies. Young eagles retain their dark brown immature plumage for several years through a sub-adult phase until they eventually acquire the white head and tail in their fourth or fifth year. Sexual maturity is reached at four to six years of age (USFWS 1983, USFWS 1999, DeGraaf and Yamasaki 2001).

In flight, bald eagles have slow and powerful wing beats intermittent with soaring and gliding. Wings are held on a flat plane at a right angle to the body, making them distinguishable from the classic "v" of a soaring turkey vulture.

The bald eagle's range extends throughout most of North America with the largest population in Alaska. Bald eagles occupying northern parts of their range winter in coastal and inland areas where they can access open water to feed. Adult bald eagles are "opportunistic migrants", following food sources as they are needed and made available (Buehler 2000). Suitable wintering grounds offer an abundant food supply with well-protected night roosts (USFWS 1983, USFWS 1999).
Northeastern populations will migrate southward along the Atlantic coast or inland along the Appalachian Mountains (Bednaz et al. 1990). While fall migration occurs anytime between August and December, spring migration occurs between January and March, depending upon weather and food availability (Buehler 2000). Spring migration northward is shorter in duration and early arrival allows for advantages in nest site selection and breeding opportunities (Buehler 2000).

Home range sizes depend upon a number of biological variables such as season, food availability or breeding status. For instance, non-breeding adult eagles tend toward nomadic wandering as food availability changes, thus occupying huge areas throughout a region (Buehler 2000). Within each home range, defended territory size also varies depending upon nesting density and food supply (Buehler 2000). One method of estimating territory size is by measuring distance from nest to perching trees up to approximately 0.5 km (0.31 miles) from the nest (Johnsgard 1990).

The diet of bald eagles consists primarily of fish, but they will also eat waterfowl, shorebirds/colonial waterbirds, small mammals, carrion, and turtles (USFWS 2007a). Stalmaster (1987) averaged 20 studies from across the species range and determined that the diet of nesting bald eagles was comprised of 56% fish, 28% birds, 14% mammals, and 2% other. Feeding behavior and nest site selection influences which foraging areas are utilized by adult bald eagles, ultimately determining prey base (Lefranc and Cline 1983). Concomitantly, food availability may influence offspring survival, the proportion of active nests in an area, and timing of early egg-laying (Hanson 1987).

Wintering bald eagles will congregate near streams during salmon runs and below reservoirs where fish are particularly abundant (USFWS 2007a). Lefranc and Cline (1983) found that late winter and early spring diets of bald eagles include more bird species than in summer and fall, reflecting seasonal abundance of prey base, particularly migratory waterfowl. Landfills, shallow bays, and mouths of streams are also favorite feeding grounds for groups of young bald eagles looking for easy feeding opportunities (USFWS 2007a). Carrion, particularly birds and terrestrial mammals (Buehler 2000), serves as an important winter food source in inland areas where there is little open water where fish or waterfowl would be available (USFWS 1983, USFWS 1999, DeGraaf and Yamasaki 2001). In general, the opportunistic foraging of wintering bald eagles is indicative of flexibility in winter feeding behavior during periods of food scarcity (Ewins and Andress 1995).

Bald eagle pair formation is not well-documented but has been observed on breeding grounds and occasional copulation has been noted on wintering grounds (Stahlecker and Smith 1993). The subsequent activity of nest-building begins one to three months before actual egg-laying (Buehler 2000).

Bald eagles typically nest in tall trees with broad visibility and sturdy branches located near lakes, rivers, or seacoasts. Adults show a strong tendency for fidelity to their breeding areas, and will often use the same nest for many years (USFWS 1999, Watts 2000, DeGraaf and Yamasaki 2001). As a result, the nest tree requires sturdy branches to support the growing weight of the nest as materials are added each year. Nests are located approximately 15 to 18 m (50 to 60 ft) above the ground and two to nine meters (five to 30 ft) below the top of a live tree. Visibility of the surrounding area from these high posts facilitates easy flight access and serves as a possible sentinel post for defending territory (Buehler 2000).

Egg-laying generally begins from early March through as late as early May (USFWS 2007a) in northeastern states. Clutch sizes range from one to three eggs. Incubation lasts approximately 35 days and eggs hatch asynchronously. Competition for food in the nest can be fierce and the youngest chick often dies. Fledging occurs at 11 to12 weeks after hatching. Parental care may continue for up to three months after fledging. The entire breeding cycle, from courtship to fledgling independence, takes at least six to seven months (USFWS 1983, Green 1985, USFWS 1999, DeGraaf and Yamasaki 2001).

No longer focused on reproduction, wintering bald eagles congregate in large numbers in areas with adequate food availability, roost sites that protect from inclement weather, and an absence of human disturbance (Buehler 2000, Johnsgard 1990). Winter migration typically commences in October when concentrations of eagles start to build (Stalmaster 1987). Forced south by the freezing of lakes and rivers, and the migration of waterfowl, northern populations of bald eagles often migrate to areas where waters remain unfrozen in the winter (USFWS 2007a, Stalmaster 1987). The availability of food in a particular wintering area determines its attractiveness to migrating bald eagles, and these food sources are often located by eagles wandering over large areas (Stalmaster 1987).

According to Stalmaster (1987), wintering bald eagles spend 68% of a 24-hour day roosting, 30% loafing or perching, 1% foraging or feeding, and 1% flying.

Bald eagles are a relatively long-lived species, with the record age for a wild individual at 28 years in Alaska (Schempf 1997). As a high-trophic species, immature and adult bald eagles are less vulnerable to predation than eggs, nestlings, or fledglings (Buehler 2000). Although raptor survivorship is expected to be low in the first year with relative increases into adulthood (Beuhler 2000), research has documented 87%, 71%, and 100% first-year survival of bald eagles in recovering populations (Harmata et al. 1999, Bowman et al. 1995, and Beuhler et al. 1991b, respectively). Partially attributed to a winter supplemental feeding program, survival of bald eagles in Maine was approximately 73% for first year birds, 84% for second year birds, and 91% for older birds (McCullough 1986). Nye (1990) documented at least 24 of 150 (16%) eagles from New York's hacking project survived to adulthood through 1990. In Vermont, seven out of 29 birds released through the hacking project have been found injured or dead as of the writing of this document. Only three of those eagles were first year birds. The status of the remaining 22 birds is unknown.

HABITAT REQUIREMENTS AND STATUS

As their primary food source is fish, bald eagles are generally associated with aquatic systems. Despite varying seasonal behavior, bald eagles require similar habitats in summer and winter. Ample feeding opportunities and nesting, perching or roosting trees are important for breeding individuals. Similarly, wintering bald eagles require access to food sources and adequate perching and roosting trees. Wintering bald eagles are faced with environmental variables such as freezing waters which influences their migration.

Breeding and Nesting Habitat

Bald eagles have three habitat requirements in order to sustain themselves during the summer breeding season and in winter: 1) adequate tree canopy structure for perching, roosting, foraging, and nesting; 2) water for sources of food; and 3) ample foraging opportunities. The U.S. Fish and Wildlife Service (USFWS) defined essential breeding habitat for eagles as an area encompassing a minimum of 259 ha (640 a) that includes aquatic and terrestrial habitat (USFWS 1983). As 56% of their diet is comprised of fish (Stalmaster 1987), biologists can infer that water is an important component in suitable breeding habitat. Canopy-dominant trees that can support a significant nest structure and provide perching or roosting sites over wide open areas (such as water bodies) where prey can be killed and consumed are critical habitat features for bald eagles (Stalmaster 1987). Due to these general requirements, eagles have been documented in lacustrine, riverine, marine, and palustrine habitats.

Research indicates that the distance of a nest site from water varies: 1.6 km (1.0 miles) in Oregon (Anthony and Isaacs 1989), 1.06 km (0.7 miles) in Florida (McEwan and Hirth 1979), and 80 m (262 ft) in Minnesota (Mathisen 1983). Closeness to water and open, mature vegetation were the most important characteristics in nest site selection in Maryland (Andrew and Mosher 1982). Data from Maryland also suggested that eagle nests were built well within their optimal foraging range, which decidedly included aquatic habitat. In addition, it has been suggested that habitat discontinuity across the landscape may be important to allow for enhanced maneuverability from and around nest sites (Andrew and Mosher 1982)

Specific features of water bodies associated with nest sites vary as well. Haywood and Ohmart (1986) found that streams within proximity of inland nests included deep pools bounded by riffles and/or sandbars and pools deep on one side with broad shallows opposite. Shallow lakes in Nova Scotia served as optimal foraging areas for eagles and documented high concentrations of nests (MacDonald and Austin-Smith 1989). Such characteristics bring benthic feeders closer to the surface, thus increasing vulnerability and access for foraging eagles. According to Peterson (1986), bald eagles prefer large areas of open water for foraging because prey availability is a function of habitat productivity as well as the size of the foraging habitat. In Maine, riverine bald eagle nests were situated on stretches in a large basin area and were also built on lakes greater than or equal to 30 ha (74 a) (Livingston et al. 1990). By 2008, eagles nesting adjacent to smaller water bodies (approximately 14 hectares or 35 acres) in Maine were still within 1.6 km (1.0 miles) of larger aquatic systems that provided additional foraging habitat (C. Todd, pers. comm.).

Bald eagles prefer tall, sturdy, live trees that provide easy access in and out of the nest and have unobstructed flight path to the nest and views of surrounding areas (McEwan and Hirth 1979, Green 1985, USFWS 1999, Watts 2000, DeGraaf and Yamasaki 2001, USFWS 2007). Some breeding pairs will construct alternate nests in their breeding territory, thereby advertising territoriality, reducing overall nesting failure, and avoiding

parasites (Stalmaster 1987). In addition, sometimes alternate nests are used as feeding platforms (USFWS 1983). Reproductive conditions are considered optimal where mature timber exceeds 75% of the landscape (Peterson 1986). Once a nesting territory has been established by a breeding pair, it will be defended against other bald eagles. All resources, such as favored roost, perch and nest trees, within the breeding territory will be used exclusively by the pair (Stalmaster 1987). During the breeding season, tall snags near nest sites and adjacent to water are also preferred for perching and hunting (USFWS 1983, USFWS 1999). As bald eagles are "still hunters" with most fish strikes made within 100 m (30.5 ft) of shoreline, prominent perches with a wide field of view are important (Watts 2000). The preferred species of tree varies; however, bald eagles tend to utilize white pine (*Pinus strobus*) in northeastern regions (DeGraaf and Yamasaki 2001).

Nest trees are usually in relatively remote areas adjacent to or within range of large bodies of water. Shorelines of lakes, ponds and rivers with canopy-dominant trees are typically favored. Humans also favor shorelines for recreation as well as seasonal and year-round homes. Studies have shown that eagles avoid new nests in proximity to development (Fraser et al. 1985) and that land clearing and residential settlements impacts eagle nesting activity and success of individuals (Therres et al. 1993). However, some pairs exhibit greater tolerance for disturbance and will build a nest within close proximity to human activity, such as occurred in Barnet, Vermont in 2009. The average distance between a nest and human development is greater than 0.3 miles (483 m), but in some areas, nests are less than 0.06 miles (97 m) from development (Buehler 2000).

The Northern States Bald Eagle Recovery Plan (1983) suggests that management of breeding sites be configured based on factors such as prey base and habitat used for foraging. The plan also recommends that specific nests be managed for potential disturbance regimes under a tiered buffer zone system. Based on these federal recommendations and management experience, biologists in Maine have implemented a buffer zone radius of 100 m (330 ft) around the nest to be a designated sanctuary with extension of up to 201 m (660 ft) for pairs that are more sensitive to disturbance (MDIFW 2002). In addition, Maine's recommendation includes avoidance of major disturbance out to 402 m (1320 feet = 0.25 miles) from the nest. Outside of the nesting season, carefully managed development and tree removal has been allowed within the parameters of local and state regulations (C. Todd, pers. comm.). Other states have employed similar guidelines (see VDGIF 2000).

Wintering Habitat

Wintering bald eagles require abundant and available food sources with suitable habitat for day perches and night roosts. Such habitat includes large, sturdy trees, visibility of surrounding area, and a warmer microclimate to minimize energy expenditure (Green 1985). Quality winter roost sites provide thermal cover and a buffer from human disturbance. Large areas of undisturbed habitat with perching and roosting sites near feeding areas are essential for the survival of wintering bald eagles. Open water is also important, and in the Northeast, bald eagles often congregate near dams. Carrion and other scavenged food items are also important sources of food in winter (USFWS 1999,

Nickerson 1989). The presence of other bald eagles in an area can serve as a cue as to the presence of foraging or scavenging opportunities to other bald eagles in search of food (Knight and Knight 1983).

Habitat Status

A habitat suitability index model was created and published by the USFWS (see Patterson 1986) that included food, reproduction, and human disturbance components. Much of the data required to run this model is unavailable for Vermont and to date no research has been conducted on the full extent of suitable habitat in the state. However, based on advice from P. Nye (NYDEC) and C. Todd (MDGIF) as well as components of a habitat suitability index for bald eagles published through the US Fish and Wildlife Service (Peterson 1986) indicating that food supply appears to be a primary criterion for choosing nesting habitat, a crude habitat evaluation of potential bald eagle habitat in Vermont was conducted. A list of warm water lakes and ponds with abundant fish populations was derived using land use data from the Vermont Department of Environmental Conservation Water Quality Division's (VTDEC) lakes and ponds database, and fisheries (i.e., fish species) information from the annual Vermont Fish and Wildlife Department Guide to Hunting, Fishing and Trapping.

Based on the available literature indicating that land use influences habitat suitability of eagles, the list was then further narrowed by evaluating the level of development in the watershed and the size of the lake. Each lake was ranked according to its size and development level. Those that were 91-100% undeveloped were given a rank of 1, 76-90% a rank of 2, and less than 76% a rank of 3. Lakes that were greater than 100 acres were given a rank of 1, 51-100 acres a rank of 2, and less than 51% a rank of 3. All lakes and ponds with a combined rank of 2 (i.e., highest rank for both size of waterbody and level of development) were selected. As a result of this assessment, 58 out of 163 (36%) lakes and ponds in Vermont have been determined to provide suitable bald eagle nesting habitat (Table 1). An additional 15 sections of the Connecticut River (Wilder Dam, Williams River, Black River, West River, Vernon) and the Lake Champlain basin (Missisquoi Delta, Sandbar/St. Albans, Winooski Delta, Shelburne Bay, Dead Creek, Little Otter Creek, Otter Creek, Whitney Creek, Hospital Creek and Poultney River) also provide potentially suitable habitat, yielding a total of 73 sites that are likely to support breeding bald eagles. Although this assessment is based on available data, setting ranges for the ranking system may have inherently excluded important components of selected variables.

Based on annual mid-winter bald eagle surveys, there are three areas where wintering eagles congregate and are listed here in order of significance: (1) Lake Champlain: Charlotte Ferry south to the Champlain Bridge; (2) Lake Champlain: Charlotte Ferry north to Shelburne Point; and (3) Connecticut River: McIndoes Falls north to Moore Reservoir. Actual occurrences of eagles at these sites vary each year depending upon ice-over conditions.

Table 1. List of Vermont warm water lakes and ponds ranked as potentially suitable habitat for breeding bald eagles.

Waterbody	Town of Outlet	Acres	Mean Depth	%Undev	%Dev	Dev Rank	Acres Rank	Rank Total	Fishing	Boating	Swim	Perch	Walleye	N. Pike	Pickerel	LM Bass	SM Bass	Bullhead	Panfish	Black Crappie	Burbot
Arrowhead Mt Lk	Milton	760	11				1	2	x	x	x	x	x	x		x	x	x	x		
Beebe Pond	Hubbardton	111	26	97%	3%	1	1	2	x	x	x	x		x		x	x	x	x		
Lake Bomoseen	Castleton	2360	27	92%	8%	1	1	2	x	x	x	x	x	x	x	x	x	x	x	x	
Brownington Pond	Brownington	139	18	94%	6%	1	1	2	x	x	x	x			x		x	x			
Comerford Resv	Barnet	777		93%	7%	1	1	2	x	x	x	x		x	x	x	x	x	x		
Clyde Pond	Derby	186	11	92%	8%	1	1	2	x			x	x		x	x	x	x			
Coles Pond	Walden	125	8	99%	1%	1	1	2	x	x	x	x			x		x	x			
Lake Dunmore	Salisbury	985	28	98%	2%	1	1	2	x	x	x	x		x		x		x	x		
East Long Pond	Woodbury	188	47	98%	2%	1	1	2	x	x	x										
Echo Lake	Charleston	550	58	96%	4%	1	1	2	x	x	x	x					x				
Echo Lake	Plymouth	104	30	98%	2%	1	1	2	x	x	x	x			x	x	x	x	x		
Lake Eden	Eden	194	15	98%	2%	1	1	2	x	x	x	x			x		x	x	x		
Lake Elligo	Greensboro	174	29	97%	3%	1	1	2	x	x	x	x			x		x	x			
Lake Elmore	Elmore	219	11	95%	5%	1	1	2	x	x	x	x		x			x	x	x		
Fairfield Pond	Fairfield	446	23	92%	8%	1	1	2	x	x	x	x		x		x	x	x	x	x	
Lake Fairlee	Thetford	457	23	98%	2%	1	1	2	x	x	x	x			x	x	x		x		
Flagg Pond	Wheelock	111	3	100%	0%	1	1	2	x			x			x	x		x			
Forest Lake/Nelson Pond	Calais	133	49	99%	1%	1	1	2	x	x	x						x				
Gale Meadows Pond	Londonderry	195	8	96%	4%	1	1	2	x			x			x	x		x	x		
Glen Lake	Castleton	206	32	95%	5%	1	1	2	x		x	x		x		x	x	x	x		
Green River Resv	Hyde Park	554		98%	2%	1	1	2	x			x			x		x	x	x		
Lake Groton	Groton	422	13	99%	1%	1	1	2	x	x	x	x			x		x	x	x		
Harriman Resv	Whitingham	2040	34				1	2	x	x	x	x			x		x	x	x		
Holland Pond	Holland	325	17	98%	2%	1	1	2	x	x	x				x						
Lake Hortonia	Hubbardton	479	19	95%	5%	1	1	2	x		x	x		x		x	x	x	x	x	
Great Hosmer Pond	Craftsbury	140	20	95%	5%	1	1	2	x	x	x	x			x	x	x	x			
Island Pond	Brighton	626	31	90%	10%	1	1	2	x	x	x	x			x	x	x	x	x		x
Joes Pond	Danville	396	21	97%	3%	1	1	2	x	x	x	x			x		x	x	x		
Kettle Pond	Groton	109	6	99%	1%	1	1	2	x			x					x				
Lowell Lake	Londonderry	109		98%	2%	1	1	2	x	x	x	x			x	x		x	x		
May Pond	Barton	116	9	97%	3%	1	1	2	x		x								x		
Lake Memphremagog	Newport Town	5966	21				1	2	x	x	x	x	x		x	x	x	x	x		x
Miles Pond	Concord	215	20	99%	1%	1	1	2	x	x	x	x			x	x	x	x	x		
Mollys Falls Res	Cabot	397	18	98%	2%	1	1	2	x	x		x		x	x	x	x	x	x		
Moore Res	Waterford	1235		93%	7%	1	1	2	x	x	x	x		x	x	x	x	x	x		x
Lake Morey	Fairlee	547	24	98%	2%	1	1	2	x	x	x	x		x	x	x	x	x	x		
Neal Pond	Lunenburg	185	16	98%	2%	1	1	2	x	x	x	x		x	x		x	x			
Nichols Pond	Woodbury	171		98%	2%	1	1	2	x	x		x									
Lake Ninevah	Mt. Holly	171	6	97%	3%	1	1	2	x		x	x			x	x	x	x	x		
North Hartland Res	Hartland	215					1	2	x			x				x	x				
North Springfild Res	Springfield	290					1	2	x		x	x				x		x	x		
Old Marsh Pond	Fair Haven	131		91%	9%	1	1	2	x												
Pensioner Pond	Charleston	173	15	95%	5%	1	1	2	x	x	x	x			x		x	x			
Lake Raponda	Wilmington	121	8	100%	0%	1	1	2	x	x	x	x			x		x	x	x		
Rescue Lake	Ludlow	180	40	98%	2%	1	1	2	x	x	x	x			x	x	x		x		
Sabin Pond	Calais	142	18	97%	3%	1	1	2	x	x	x	x			x	x	x	x	x		
Sadawga Pond	Whitingham	194	6	99%	1%	1	1	2	x	x	x	x			x	x		x	x		
Lake Salem	Derby	764	20	93%	7%	1	1	2	x	x	x	x	x		x	x	x	x	x		x
Shadow Lake	Concord	128	14	99%	1%	1	1	2	x	x	x	x				x		x			
Sherman Res	Whitingham	160					1	2	x	x		x			x		x	x	x		
Silver Lake	Leicester	101	29	100%	0%	1	1	2	x			x						x	x		
Somerset Res	Somerset	1568	24				1	2	x	x		x			x		x	x	x		
Spectacle Pond	Brighton	103	8	93%	7%	1	1	2	x	x	x	x			x	x	x	x	x		
Lake St. Catherine	Wells	904	37	95%	5%	1	1	2	x		x	x		x		x	x	x	x	x	
Townshend Res	Townshend	108		94%	6%	1	1	2	x	x	x								x		
Wallace Pond	Canaan	532	27	96%	4%	1	1	2	x	x	x	x			x		x	x			
Waterbury Res	Waterbury	839					1	2	x		x	x					x	x			
Woodward Res	Plymouth	106	22	99%	1%	1	1	2	x		x	x			x	x	x		x		

POPULATION STATUS AND DISTRIBUTION

Population Status

Biologists estimate that there may have been as many as 100,000 bald eagles in the lower 48 states before Europeans first arrived. However, bald eagles suffered declines prior to enactment of the Bald Eagle and Golden Eagle Protection Act in 1940. Large-scale clear cutting operations and development in Canada and the United States destroyed bald eagle nesting habitat. Trophy and feather collection and shooting extirpated some eagle populations, and hunting of game reduced the amount of carrion available to wintering bald eagles. Through the mid-1900s, persecution and reductions in prey availability caused eagle population declines (Nickerson 1989, USFWS 1999).

The most drastic eagle population declines occurred from the 1950s to the 1970s due to the widespread use of DDT and other organochlorine chemicals. DDT slowed calcium metabolism thus causing reproductive failure in bald eagles (Stalmaster 1987). By the early 1960s, fewer than 100 bald eagles were nesting in the northeastern U.S. (Nickerson 1989). Maine's bald eagles alone were reduced from a population estimated in the thousands at its peak to 29 pairs by 1972 (MDIFW 2001).

In response to this decline the bald eagle was listed in the lower 48 states as an endangered species in 1967 under the Endangered Species Preservation Act of 1966. In 1978, the species was listed as endangered under the Endangered Species Act of 1973 in all lower 48 states except Michigan, Minnesota, Wisconsin, Washington, and Oregon, where it was federally listed as threatened.

Efforts to restore bald eagles to North America have proven extremely successful. The banning of DDT, an extensive reintroduction program, and protection of critical breeding and wintering habitat has contributed to the bald eagle's recovery. The current breeding population in the lower 48 states is approximately 10,000 pairs (USFWS 2007b). The bald eagle was federally down-listed to threatened status in all lower 48 states in July of 1995, and was proposed to be delisted in the lower 48 in 1999. In 2007, the bird was officially removed from the federal list of threatened and endangered species.

The bald eagle was first listed as endangered in Vermont in April 1987. The species remains listed as state-endangered in Vermont and Massachusetts, and state-threatened in Maine, New York, and New Hampshire.

Vermont reached a milestone in 2008 with the successful fledging of at least one eagle at a new nest in the Northeast Kingdom, and subsequent successfully fledged birds in 2009. None of the breeding individuals are known to be birds released from the Vermont hacking project (see Vermont Bald Eagle Restoration Initiative section). Table 2 shows recently documented nesting attempts through 2009.

Table 2. Status of bald eagles breeding in Vermont and within 1.5 km of Vermont border 2002-2010

	2002	2003	2004	2005	2006	2007	2008	2009	2010
Vermont									
Barnet	-	-	-	-	-	-	-	1	B
Concord	-	-	-	-	-	-	1	1	1
New Haven	-	-	-	-	-	-			O
Panton	-	-	-	-	-	-	-		1
Rockingham	-	-	-	O	B[3]	O[4]	B	B	1
Springfield	O[1]	-	-	O[2]	-	-	T	O	O
Waterford	-	-	-	-	-	-	-	O	B
West Haven	-	-	-	-	-	-	O	O	2
Windsor									O
VT Occupied Pairs	1			2	1	1	2	3	3
VT Breeding Pairs	0	0	0	0	0	0	2	3	6
VT Young fledged	0	0	0	0	0	0	1	2	5
New York									
Fort Ticonderoga	-	-	-	-	-	-	-	-	O
Port Kent	-	-	-	-	-	-	-	-	2
Putnam	-	-	-	-	-	-	-	-	2
NY Occupied Pairs	-	-	-	-	-	-	-	-	1
NY Breeding Pairs	-	-	-	-	-	-	-	-	2
NY Young fledged	-	-	-	-	-	-	-	-	4
New Hampshire									
Hinsdale	-	-	-	-	-	-	-	-	B
Northumberland	-	-	-	-	-	-	-	-	2
Orford	-	-	-	-	-	-	-	-	2
Plainfield	-	-	-	-	-	-	-	-	2
NH Occupied Pairs	1	1	2	2	2	2	2	2	0
NH Breeding Pairs	0	0	2	2	2	2	1	2	4
NH Young fledged	0	0	3	3	5	3	1	4	6
Recovery Plan Totals									
Occupied or Breeding Pairs									16
Young fledged									15

T = Territorial Pair; O = Occupied; B = Breeding; # = Number of Young Fledged
[1]Nest taken over by great-horned owls in 2003.
[2]Nest taken over by great-horned owls in 2006.
[3]Chick (1+) hatched, lost to weather/inexperienced adults; nest tree later blown down.
[4]Artifical nest erected, returning eagles built own nest.

For this table and purposes of this recovery plan, the following definitions apply:

1. A *territorial pair* indicates the presence of two adult birds within suitable nesting habitat during the breeding season where some sign of pair bonding is evident.

2. A*n occupied nest* indicates the presence of a recently decorated nest and two adult birds during the breeding season.

3. A *breeding pair* indicates an adult pair of birds with evidence of egg-laying (e.g., eggs or fragments, young, incubation)

4. The number of fledglings indicates the number of hatchlings that reach fledgling stage.

Bordering states such as New Hampshire, Massachusetts, and New York have all seen increases in breeding bald eagle populations (Figure 2). For instance, Maine has seen an 8% average annual growth since 1991 (Todd 2004).

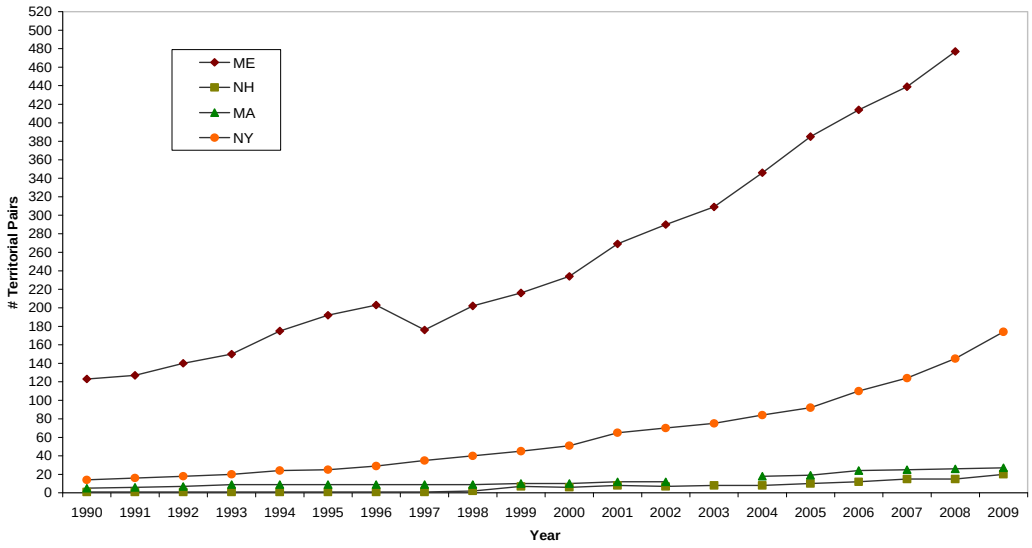

Figure 1. Northeastern territorial bald eagle populations, 1990-2009.

In addition, steady increases in the number of wintering eagles in Vermont have become evident in recent years (Figure 2).

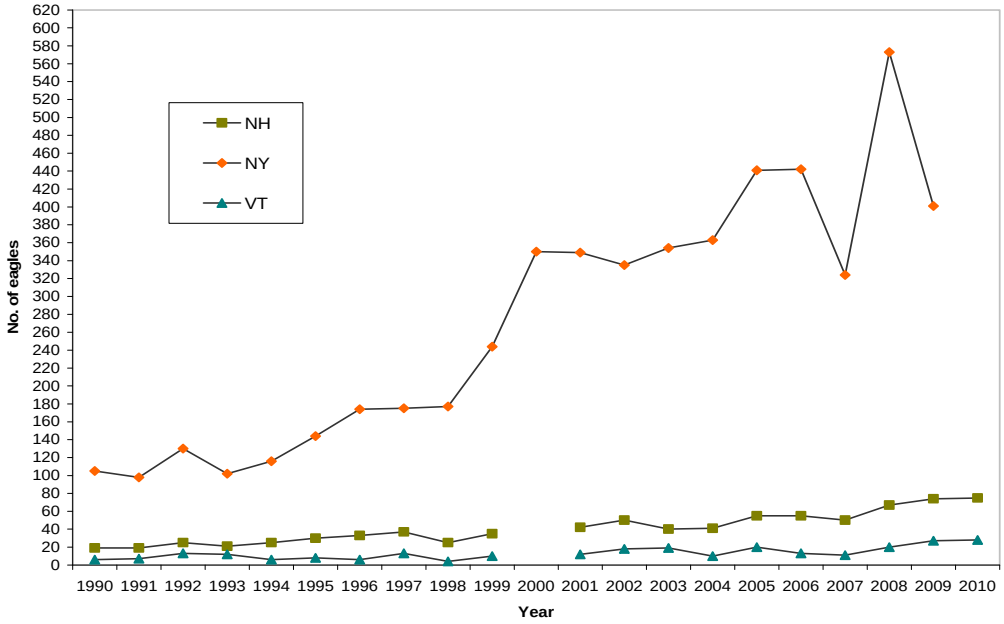

Figure 2. Northeastern bald eagle winter survey results, 1990-2009 (no Maine winter survey; Massachusetts data unavailable; Vermont Lake Champlain and Connecticut River only surveyed every other year starting 2001).

Distribution

Little information exists on bald eagle population levels prior to the mid-1900s for the northeastern United States (Nickerson 1988). Historic records of bald eagles (*Haliaeetus leucocephalus*) in Vermont are scant. Vermont's Breeding Bird Atlas (1985) reported that bald eagles were very rare breeders in Vermont, but that breeding bald eagles were noted in Vermont bird lists from the late 1800s and early 1900s near Castleton (Fichtel 1985). However, the only known breeding record is from the 1940s on Lake Bomoseen. In addition, there are a handful of unconfirmed verbal reports of eagles having nested in the past in Vermont. There is no historic information suggesting that bald eagles ever wintered in Vermont (Fichtel 1985). Based on available current and historic scientific information of breeding habitat criteria, it seems unlikely that the absence of records is indicative of the bald eagle's historic breeding status. Suitable nesting habitat exists in Vermont, and all surrounding states and provinces have breeding populations.

Historic records are also scarce for nesting ospreys (*Pandion haliaetus*) in Vermont which occupy similar breeding habitat. However, by 2008, recovery efforts have resulted in a breeding population of 119 pairs.

The neighboring states of New York, New Hampshire and Maine have similarly scant records of historic bald eagle nest locations. However, Nye (1979) estimated that up to 40 pairs simultaneously nested in New York at some point between the 1800s and 1979. Of the 72 known nesting locations in New York, seven were located in the Lake Champlain

Basin, three of which were on the shores of Lake Champlain (Nye 1979). Distributions in New York in 2006 showed concentrations of nests along the southern Hudson River and Delaware River. Prior to a confirmed nest in 1989, the last verified record of a bald eagle nest in New Hampshire was at Lake Umbagog in 1949 (Smith and Ricardi 1983; Smith 1984). Of the 10 known breeding areas in New Hampshire, at least two were near the Connecticut River (Smith 1984). In 2008, 80% (12) of New Hampshire's bald eagle nests were located on lakes throughout the state and 20% (3) were along rivers (Martin 2008). Maine's historic accounts were likely incomplete and a poor representation of that state's population at the time (Todd 2004). More recent distribution of eagle nests in Maine include 23% estuarine, 25% marine, 41% lacustrine, and 11% riverine (Todd 2004).

The current known locations of bald eagles in Vermont is limited to successful nesting attempts at two sites in Barnet and Concord, several failed or abandoned nests in Springfield, Waterford, and Rockingham, as well as a potential alternate nest site for a confirmed New York breeding pair in West Haven. While bald eagles have been sighted across all regions of Vermont by biologists, volunteer monitors, and residents, they continue to nest on the New Hampshire side of the Connecticut River and the New York side of Lake Champlain. New Hampshire pairs along the Connecticut River have territories that extend into Vermont. Congregations of wintering bald eagles continue to be observed at specific regions of the Connecticut River and Lake Champlain. In addition, deceased birds have been recovered in the Champlain Valley.

Vermont Bald Eagle Restoration Initiative

In the spring of 2003, the USFWS, through an appropriations bill sponsored by Vermont's U.S. Senator James Jeffords, was given funding for a bald eagle recovery initiative in the Lake Champlain region of Vermont. The VFWD received the bulk of these funds as part of a cooperative agreement, and the National Wildlife Federation (NWF) was contracted by VFWD to coordinate a three year translocation project with the help of Central Vermont Public Service (CVPS), Outreach for Earth Stewardship (OFES), and VFWD staff.

The goals of the project were to aid in the establishment of breeding pairs along the Lake, and through its educational efforts, set the stage for necessary habitat protection for bald eagles on Lake Champlain. Increased public awareness about endangered species and the role of top predators in aquatic habitats of Vermont was an important component as well. As a high profile endangered species restoration program, this project was symbolic of other endangered species restoration efforts occurring in the state.

Dead Creek Wildlife Management Area in Addison, Vermont was selected as the most appropriate site for the translocation project due to its accessibility to water, security, and high visibility to the public. Eaglets from Maine, Maryland, and a rehabilitation facility in Massachusetts were transported to Dead Creek for "hacking", the proven conservation practice of temporarily housing birds in a hack-box and provisioning them with food until they gradually become independent enough to be released into the wild. Twenty-nine

eaglets were fledged during the three-year span of the project. For detailed information about the project see Alfieri 2006 and Fowle 2007.

Since the end of the hacking project, there have been seven confirmed deaths of the released birds: four of unknown causes, one hit by a train, and another hit by a vehicle. The eagles have been observed wintering as far south as Forestburgh, New York and have also been observed in other parts of Addison County of Vermont, not far from Dead Creek WMA. Table 3 highlights the known status of the birds fledged through the hacking project.

Table 3. Recovery of bald eagles fledged from Dead Creek WMA.

Year Fledged (expected breeding year)	# fledged birds	Recovery Status (band #)
2004 (2008)	8	3 deceased (7C, 7D, 7H)
2005 (2009)	11	3 deceased (7K, 7N, 6D)
2006 (2010)	10	1 deceased (DN)

LEGAL PROTECTION OF BALD EAGLES

There are four primary federal laws and one state law that provide direct protection to bald eagles. Each has or continues to serve as a mechanism for protection of the species and its habitat.

Lacey Act

The Lacey Act, passed in 1900, was the first national law to protect wildlife. This act regulates the trade of wildlife across state or international borders. The Lacey Act makes it a violation of federal law if wildlife, taken in violation of state law, is then transported across state, foreign, or tribal boundaries.

Migratory Bird Treaty Act

This 1918 law prohibits the possession, taking, selling, transporting, and importing of native migratory birds (including bald eagles), their eggs, nests, parts, or products, without specific authorization. “Take” is defined as pursue, hunt, take, capture, kill, possess, sell, barter, purchase, ship, export, or import protected species. Exceptions are made for the lawful hunting of waterfowl and game birds, falconry, raptor propagation, and education.

Bald Eagle and Golden Eagle Protection Act

This act, also called the Eagle Act, which was passed in 1940, prohibits the take, sale, possession, purchase, barter, offer to sell, transport, export or import of any bald or golden eagle, dead or alive, including any part, nest, or egg, unless allowed by permit. The act defines “take” as “pursue, shoot at, poison, wound, kill, capture, trap, collect,

molest, or disturb." The act also prohibits the use of bald eagles for falconry. Exceptions to this law are scientific and educational permits, and traditional use by Native Americans. The act was amended in 2009 to better define terms and to address the need to protect eagle habitat. The National Bald Eagle Management Guidelines (USFWS 2007a) were developed to advise various entities on where and when provisions of this act would be applicable. In addition, a strategy for implementation has been developed through a web-based, step-by-step guide for the upper Midwest (USFWS 2007c).

Endangered Species Act (ESA)

The ESA's was enacted to protect endangered species and the ecosystems upon which they depend. Under the ESA, endangered and threatened species are protected from "take," which includes harm, harass, pursue, hunt, shoot, wound, kill, trap, capture, collect, and the adverse modification of critical habitat. The bald eagle was officially listed as endangered in 1978 and removed from the list in 2007. Recovery of the species throughout the United States is attributed in large part to the ban on DDT and active management of critical habitat. Once an avian species is removed from the protection of the ESA, individuals may continue to be protected by one or more of the other federal laws above or individual state laws. The ESA, however, provides more protection for a species' habitat than the other statutes. Although no longer listed under the ESA, bald eagles are required to be monitored after delisting. A draft monitoring plan has been written (see Millar et al. 2007) and a Final Rule is pending. The plan proposes monitoring every five years over a 20-year span to detect percent changes in occupied bald eagle nests. In addition, the USFWS maintains management jurisdiction of the species with passing of the National Bald Eagle Management Guidelines.

Vermont Endangered Species Law

In the state of Vermont, the Vermont Endangered Species law (V.S.A. Title 10, Chapter 123) protects all species listed as threatened or endangered in the state from take, possession or transfer. There is a lack, however, of habitat-specific protection measures in the Vermont Endangered Species law. Exceptions are granted for scientific purposes, enhancement or propagation of a species, educational purposes, zoological exhibition or economic hardship. Currently, the bald eagle is listed as a state-endangered species.

Criteria under Vermont's Act 250 and new Current Use Program guidelines may also be used to protect and manage for endangered and threatened species and necessary wildlife habitat.

THREATS AND LIMITING FACTORS

According to Wood et al. (1990), approximately 68% of 1,428 individual bald eagles necropsied at the National Wildlife Health Center over a 19 year period died as a direct or indirect result of humans. Due to the relatively low number of bald eagle sightings in Vermont, the recovery of the population could be more sensitive to various threats or

limiting factors. The following describes potential causes of mortality that may serve as threats or limiting factors to the Vermont population of bald eagles based on nationwide research on the species.

Physical

Collisions

As human development continues to encroach on bald eagle habitat, mortality from collisions with cars, trains, power lines, wind turbines, and other structures is likely to increase. Twenty-three percent of bald eagles necropsied over a 30-year period by the Department of the Interior starting in the early 1960s died from impact injuries (Fronson et al. 1995). Bald eagles are vulnerable to vehicle collisions, including trains, when scavenging near roadways and train tracks (Stone et al. 2001, Buehler 2000) and electrocution (Harmata et al. 1990, Beuhler 2000).

Habitat Loss

As discussed earlier in this document, preferred bald eagle habitat includes water, foraging opportunities and an open forest canopy structure for flight and nesting. There are conflicting reports on the extent to which habitat loss limits the breeding and wintering habitat available for bald eagles. Most habitats are lost through development of shorelines which are critical areas for nesting, foraging, and roosting. Such development may limit the expansion of breeding populations and may reduce the carrying capacity of some areas (Buehler 2000). For example, Fraser et al. (1985) report that eagles avoid building new nests in the vicinity of human structures while Buehler et al. (1991a) determined that the density of human structures was the primary factor in predicting bald eagle shoreline use in the northern Chesapeake Bay region. This population of bald eagles nested in areas isolated from human activity, and rarely used areas with more than one building per hectare. In addition, increasing development density resulted in a need to retain perch trees and forest cover to provide suitable habitat for bald eagles in the same region (Chandler et al. 1995). With the increased urbanization of this region, there is evidence that the carrying capacity for bald eagles has decreased (Watts 2000).

Recent increases in North American populations may indicate that available habitat will not significantly limit future populations (USFWS 1999) at the national level. However, some local populations may still be at risk (USFWS 2006). Although some land use changes such as hydroelectric dams that provide open water areas for winter feeding have increased the availability of wintering habitat (USFWS 1999, NYSDEC 1993), these changes do not appear to have positive long-term effects for eagles. Hydroelectric dams can cause an increase in mercury levels (N. Kamman, pers. comm.) in flooded areas, as well as increased PCB levels (Anthony et al. 1993), resulting in bioaccumulation in native fish populations. Based on a calculated index, concentrations of PCBs in anadromous fishes below dams in the Great Lakes regions could present a hazard to bald eagles in the area (Bowerman et al. 1995).

Weather

Severe weather may affect productivity of bald eagles in some climates. Inclement weather has been associated with low bald eagle productivity in the Greater Yellowstone Ecosystem (Harmata et al. 1999, Swenson et al 1986) and Voyageurs National Park (Grim and Kallemeyn 1995) where years with cold, wet springs have resulted in reduced numbers of young produced. Generally, bald eagles appear to be resistant to cold and extreme weather as long as food sources remain available (Buehler 2000). Adverse weather events, such as prolonged wet snowfalls or cold rains when eagle eggs are about to hatch are suspected of having caused nest failure at several northeastern sites (M. Amaral, pers. comm.).

Chemical

Persistent contamination from and bioaccumulation of toxic chemicals, lead tackle and shot, and acid rain deposition may affect the overall health of bald eagles in Vermont and could limit their reproductive potential as well as be significant sources of mortality in the state.

Toxic Chemicals

Although the overall impact of harmful chemicals has been reduced since federal recovery efforts began, various environmental contaminants continue to threaten the survival and productivity of bald eagle populations. Poisoning from various agricultural pesticides sources caused the death of 16% of all eagles necropsied at the USGS National Wildlife Health Center beginning in 1963 (Fronson et al. 1995). Starting after World War II, DDT was used to control insects nationwide and associated declines in bald eagle populations were documented. The chemical disrupted calcium metabolism, thus resulting in thinning of egg shells and unsuccessful hatchings (Stalmaster 1987). The elimination of DDT from the U.S. in 1972 was a significant factor in the recovery of the species. However, bald eagles occasionally prey on avian species that migrate to regions of the world where DDT is still in use today (Anthony et al. 1993).

Some coastal areas such as California and Maine still have high concentrations of DDE, a metabolite of DDT. DDE and PCB's have been found in high concentrations in bald eagle eggs in the Delaware Bay drainage (Clark et al. 1998) as well as Lake Michigan area (Dykstra et al. 2001). A 75% reduction in productivity associated with DDE was calculated in areas of the Great Lakes where PCBs were estimated to have lowered reproductive success from the rate accepted for a viable population (1.0 fledgling/occupied nest) to 0.67 (Bowerman et al. 1995). Oil spills, pesticides, and other toxins all pose threats to bald eagle populations (Buehler 2000, USFWS 1999).

Lead

Bald eagles are extremely susceptible to lead poisoning and can ingest lead from contaminated or poisoned waterfowl and deer carcasses, or from fish that have swallowed leaded hooks, lines or sinkers. Based on a review of published data, Sanborn (2002) reported that discharged ammunition and fishing tackle were the primary sources of lead poisoning for wildlife. Twenty-two percent of the 634 bald eagles admitted to the Raptor Center at the University of Minnesota from 1980-1995 had lead poisoning, which has been reported in bald eagles from at least 34 states (Franson et al 1995, Buehler 2000). The relative frequency of lead poisoning admissions did not change significantly after the USFWS' 1991 ban on lead shot for waterfowl hunting (Kramer and Redig 1997). Eagle deaths in Iowa from January 2004 to January 2010 confirm this trend with 74.3% of tested eagles (78 out of 105) showing abnormal lead levels (Neumann, unpubl. data). In addition, a rehabilitation center in Minnesota indicated 37.5% of admitted eagles had acute lead poisoning in 2009, which was a significant increase over the past 30 years (P. Redig, pers. comm.)

Wintering bald eagles are susceptible to secondary toxicity from ingestion of lead-poisoned or contaminated prey or carrion (Kramer and Redig 1997). This was confirmed by peak numbers of eagle poisonings in late fall and early winter in Iowa (Neumann 2008), Wisconsin (Strom et al. 2008), and Minnesota and Wisconsin combined (Redig at al. 2008), which coincided with regulated hunting seasons and the congregating of wintering bald eagles in these areas. In addition, large caliber bullets used on ungulates were ingested by bald eagles in the Greater Yellowstone Ecosystem, resulting in lead poisoning (Harmata et al. 1999). Hunt et al. (2006) suggested that scavenging birds such as bald eagles are at risk for high exposure to lead based on 92% of hunter-killed deer and 90% of offal piles containing lead-based bullet fragments. Even with existing bans on lead shot, eagles have exhibited chronic exposure as opposed to acute, predisposing them to other traumatic injuries (Kramer and Redig 1997, Sanborn 2002, Neumann 2008).

Mercury

Due to their long lifespan, high trophic level, and piscivorous diet, bald eagles are at risk from mercury exposure. Although, national mercury levels decreased from 1969 to 1974, they have held stable since. Atmospheric deposition of mercury in the northeastern United States, where levels are thought to be the highest in the country, is primarily from waste incineration and coal burning power plants (DeSorbo et al. 2008).

An examination of mercury levels throughout the Northeast identified the upper Connecticut River as a hotspot associated with water level manipulations at reservoirs (Evers et al. 2007) and recent findings have shown total mercury levels were in excess of those recommended by the United States and Canada in 44% of waters in the Northeast (Kamman et al. 2005b). Mercury concentrations in certain fish species were also elevated at reservoirs across the Northeast (Kamman et al 2005a).

The effects of mercury on bald eagles vary regionally. For instance, productivity was negatively correlated to mercury exposure in Maine eagles, particularly in lacustrine habitats as published in studies conducted yearly since 2005 (DeSorbo and Evers 2005, 2006, 2007). However, there was no relationship between productivity and mercury levels in British Columbia (Weech et al. 2006). Due to the identified mercury hotspot in the upper Connecticut River, particular attention should be paid during the recovery process to mercury in bald eagles utilizing this area.

Biological

Intentional Takings

Shooting, trapping, and poisoning had significant impacts on bald eagles through the early part of the 20th century, and at one time, bald eagles were killed for bounties (USFWS 1999, Buehler 2000). With the passage of the Migratory Bird Treaty Act and Bald Eagle Protection Act, the mortality rate of bald eagles from shooting and other forms of persecution decreased. However, Wood et al. (1990) studied the necropsies of 1,428 bald eagles from 1963-1984, of which 38% died from intentional takings: 22% from gunshot; 11% from poisoning; and 5% from trapping. Even as recently as 2001, one bald eagle was shot in Vermont (S. Parren, pers. comm.), and one adult was shot and another died from complications from a trap injury in Maine (C. Todd, pers. comm.). Moreover, it is not uncommon for necropsies of bald eagles to uncover shotgun pellets in bald eagles that died from other causes (C. Todd, pers. comm.). While no longer considered a significant threat to the overall survival of the population (USFWS 1999), intentional takings, especially shootings, continue.

Human Disturbance

Eagles may be disturbed by a variety of human activities, including, but not limited to, human presence, recreational activities, research activities, and construction. Eagle responses to disturbance vary depending upon season, status of breeding cycle, environmental conditions as well as type, proximity and frequency of disturbance (USFWS 1983, Steidl and Anthony 2000). Other variables may simply be undetectable by species managers (Fraser et al. 1985). Habituation of eagles to human disturbance has been suggested in some studies (Stalmaster and Newman 1978, Knight and Knight 1984, Grubb et al. 2002), but food availability, particularly in winter feeding areas, has been suggested as a cause of reduced escape flights associated with disturbance (Knight and Knight 1984).

As a result of confounding variables, recommendations for buffer distances vary in the literature. In areas where human presence is not pre-existing and disturbance is not a regular occurrence, excessive human activity (regardless of type) can result in changes to normal behavior and ultimately lead to nesting failure (Grubb and King 1991). This in turn can result in decreased long-term population viability (Steidl and Anthony 2000).

Ultimately, it is necessary to evaluate locally important factors for the success of breeding pairs.

As the nesting population of eagles in Vermont expands, the implementation of nest site protection measures will become more important to reduce the severity of human encroachment on these areas (Buehler 2000, USFWS 1999).

In addition, negative perceptions toward bald eagles and endangered species in general may inhibit recovery efforts on private lands. Private landowners may be unwilling or unable to cooperate to minimize disturbance when bald eagles are nesting on their land.

Disease

Relatively little is known about the impact of diseases such as avian cholera, avian pox, and aspergillosis on bald eagle populations. Most of the effects appear to be localized, however, and therefore disease is not considered to be a significant threat (USFWS 1999). Only 2% of bald eagles submitted to the USGS National Wildlife Health Center during a 20-year period died of disease. Between 1995 and 1999, 58 bald eagles died at artificial reservoirs in Arkansas from avian brain lesion syndrome, a poorly understood disease that is present in other avian species in the Southeast (Buehler 2000, USFWS 1999).

Recently, the threat of West Nile Virus has been indicated in birds of prey. Various news articles and press releases in late 2002 revealed that there were confirmed cases of West Nile Virus causing the death of raptors in many mid-western states. The virus appears to have caused the death of some bald eagles reported to the Center for Disease Control's West Nile Virus avian mortality database (M. Amaral, pers. comm.). The overall effect of this disease on bald eagles remains unknown, but it will be something to monitor closely in the future.

Highly pathogenic avian influenza (HP H5N1 or "Asian Bird Flu") is an emerging virus that continues to be monitored nationwide by the United States Department of Agriculture. Samples are taken from waterfowl throughout Vermont to determine the status of the virus in wild populations. Although HP H5N1 has not yet been detected in Vermont, a positive finding may place bald eagles at risk. Other raptorial species including northern goshawk and peregrine falcon have tested positive for the virus, resulting in mortalities (USGS 2007). Potential population-level impacts on bald eagles are not known at this time.

Predation

Eggs and young are vulnerable to predators, but predation does not appear to be a significant source of mortality for bald eagles. Little information exists on nest predation of bald eagles, but gulls (*Larus* spp.), common ravens (*Corvus corax*), American crows (*Corvus brachyrhynchos*), and raccoons (*Procyon lotor*) may prey upon eggs in tree nests, and black bears (*Ursus americanus*), raccoons, great-horned owls *(Bubo*

virginianus), and bobcats (*Lynx rufus*) may prey upon nestlings. Furthermore, fledglings may be vulnerable to mammalian predators when on the ground (Buehler 2000). Adults are rarely vulnerable to non-human predators (Buehler 2000), but eagles fight over territories, sometimes resulting in mortality (USFWS 1999).

Conflicts and Competition with Other Species

Eagles may compete with osprey and great blue herons for nest sites and food. This competition may affect local distributions of these species once bald eagles become established as breeders in Vermont. Biologists in Maine have recorded nest site and food competition with osprey as well as nest takeovers and predation with great blue herons (*Ardea herodias*) (C. Todd, pers. comm.). In Maine, the interaction between osprey and bald eagles has not always been predictable, but eagles have generally tended to out-compete osprey over time and eventually displace osprey from their nests. These species occur sympatrically throughout their range in North America. Nonetheless, mammalian scavengers often chase off bald eagles when they are feeding on carcasses (Buehler 2000).

Limited Food Supply

Selecting breeding areas with a stable food sources can be the most important factor for nesting success (Swenson et al. 1986). Consequently, food availability can be a significant limiting factor for sustaining breeding populations of bald eagles. Variations in reproductive success (Hansen and Hodges 1985, Hansen 1987, Steidl et al. 1997, Elliot et al. 1998), nest distribution (Steidl et al. 1997), and density of breeding and non-breeding bald eagles (Dzus and Gerrard 1993) have resulted from limited food supplies.

MANAGEMENT, MONITORING, AND RESEARCH

The purpose of this section is to describe practices related to bald eagle management, monitoring, and research that are currently being implemented or may need to be implemented for the recovery of the species.

Management

Managing Nesting Activity

Reports of new nests in Vermont have been investigated by VFWD particularly by use of visual aids such as spotting scopes. Previous efforts have also included cooperation with the Vermont Electric Company (VELCO) and CVPS for post nesting season climbing to confirm eagle use. With confirmation of new nesting activity in Vermont, Department biologists have worked cooperatively with landowners to protect and monitor nest sites during the nesting season. In some cases, public relations through media events have been necessary due to the high visibility of certain nests and breeding pairs. As a result, viewing areas have also been established where tolerance for human activity is high.

Department biologists continue to be responsible for determining suitable buffer distances and employing restrictions as necessary. Vermont has applied Maine's buffer guidelines as outlined in *Living with Maine's Endangered and Threatened Species: Bald Eagles* (see MDIFW 2002) in managing activity near nest sites. Monitoring of nesting activity has been conducted by VFWD staff and volunteer efforts. Information regarding the disposition of all eagle nests in Vermont has been sent to VFWD staff and memorialized in annual reports and press releases. These efforts will continue through the recovery process.

Centralized Database

An information clearinghouse for all bald eagle sightings was established in the winter of 2001 and 2002 and is now maintained by the VFWD. Updates will be regularly sent to Vermont partners and neighboring states.

Rehabilitation Efforts

The Vermont Raptor Center has received five injured bald eagles since 1994. One received in 2001 was the victim of a gunshot wound; in 1996, one eagle was hit by a car; another suffered from an unknown trauma; an adult received in 1994 collided with a power line; and an eagle died of starvation in 2002. In addition, one eagle from the Vermont hacking project was recovered and died of unknown causes in 2009 while under rehabilitation. Bald eagles requiring surgery and/or special treatment are usually transferred to Tufts Veterinary Clinic in Grafton, MA.

Law Enforcement

Department game wardens and the USFWS Special Agent for Vermont assist with the transport of injured eagles and investigate illegal shootings and other suspicious deaths. Any illegal activity is investigated. The existing program, Operation Game Thief, provides an opportunity for citizens to report and provide information on taking violations of bald eagles.

Education

VFWD developed an outreach strategy with NWF and OFES which included the completion of an Eagle Education Box, available to the public for use in programs related to bald eagles. Eagles have received regular media coverage and have been included in VFWD's overall endangered and threatened species outreach efforts.

Monitoring

Surveys are the primary method for monitoring bald eagles in Vermont. Prior to confirmed bald eagle nesting in the state, aerial surveys were conducted on two different occasions; one survey in 1993 was funded by the USFWS and contracted by VFWD, and the second was a one-day survey of Somerset Reservoir in 1994. VFWD, Vermont

Institute of Natural Science (VINS), and Audubon Vermont have received periodic reports of nesting activity in recent years, and Vermont's first nesting pair was documented in 2002. No eagles were fledged from this site and the nest was taken over by great-horned owls in 2003. Since then, several other nests have been identified around the state, with the first successful fledging in 2008. In 2009, six nests were identified throughout the state. To date, monitoring of bald eagles in Vermont during the breeding season has resulted in the protection of active nests that have been discovered over time and identified by VFWD biologists.

Midwinter Survey

NWF initiated a Midwinter Bald Eagle Survey in the lower 48 states in 1979, and the annual survey is now coordinated through the U.S. Army Corps of Engineers. VINS coordinated this survey in Vermont with VFWD from 1979-1999 and Audubon Vermont began coordinating the survey in 2001 under contract with VFWD. No survey was conducted in 2000. The survey consists of 15 standardized survey routes (SSR's) across the state. In 2002, VFWD staff determined that the full 15 SSR survey should be run every other year, with only 5 SSR's being surveyed in the alternate years. Alternate year surveys focused solely on Lake Champlain and the Connecticut River The most recent official survey was conducted in 2009.

Early Spring Survey

NWF and Audubon Vermont conducted a spring bald eagle survey on Lake Champlain in late April of 2007 followed by limited survey of the Winooski River in 2008 where birds had been sighted. The purpose of these surveys was to look for possible nesting activity. Funding for such surveys currently does not exist. However, cooperative organizations may have limited monies to contribute to some survey work.

GOALS, OBJECTIVES AND STRATEGIES FOR BALD EAGLE RECOVERY

Aside from the preliminary habitat evaluation presented earlier in this document, there is limited information on habitat suitability in Vermont for bald eagles. VFWD's primary conservation goal is to recover breeding populations of bald eagles to sustainable levels.

Downlisting Goals

1. Establish a breeding assemblage of bald eagles distributed throughout Vermont; and

2. Remove bald eagles from the Vermont list of endangered and threatened species.

Downlisting Objectives

To meet the recovery goals and move to down-list from current state endangered status to state-threatened status, the following objectives must be achieved over the course of five consecutive years:

1. There is an average of at least 19 occupied nests or breeding pairs within Vermont or within 1.5 kilometers of its border that produce an average of at least 19 fledglings; and

2. Of the successful pairs at least 10 of which must have their nest established within Vermont's state boundary.

Delisting Objectives

Delisting (removal from the state's endangered and threatened species list) will occur if the following objectives are met over the course of five consecutive years:

1. There is an average of at least 28 occupied nests or breeding pairs within Vermont or within 1.5 kilometers of its border that produce an average of at least 28 fledglings; and

2. Of the successful pairs at least 14 of which must have their nest established within Vermont's state boundary.

Relisting Criteria

After the species has been delisted, the bald eagle in Vermont should be relisted to state-threatened status if the following criteria are met over the course of five consecutive years:

1. There is an average of between 19 and 27 occupied nests or breeding pairs within Vermont and within 1.5 kilometers of its border that produce an average of between 19 and 27 fledglings; or

2. Of the successful pairs, less than 14 of which must have their nest established within Vermont's state boundary.

Relist the bald eagle in Vermont as a state-endangered species if the following criteria are met over the course of five consecutive years:

1. There is an average of less than 19 occupied nests or breeding pairs within Vermont and within 1.5 kilometers of its border that produce an average of less than 19 fledglings; or

2. Of the successful pairs, less than 10 of which must have their nest established within Vermont's state boundary.

Justification for Objectives

Although there is limited information about bald eagle populations in Vermont, experience in other states indicates that there is habitat to support as many as 37 nesting pairs within the state. This figure is based on an evaluation of available habitat throughout Vermont (see Habitat Status section) and represents successful nesting at 50% (37 of 73) of potentially suitable habitats. The downlisting and delisting objectives have been set at 19 territorial pairs (50% of the 37 potentially suitable habitats) and 28 territorial pairs (75% of the 37 potentially suitable habitats), respectively. Population models indicate that such objectives are achievable as a result of a steady increase in the number of breeding pairs starting in year 5 of recovery based on the existing 6 breeding pairs in Vermont (2009 season), mortality rates established in the literature, as well as increased recruitment of breeding-aged individuals.

Vermont's experience with the recovery of peregrine falcons demonstrates that setting recovery objectives at 50% of potential suitable habitat is appropriate. The historic peregrine falcon population estimate of approximately 32 pairs was never as high as the potential habitat of approximately 60 nesting cliffs. Furthermore, the current potential habitat continues to remain higher than the number of occupied territories. For peregrine falcons, downlisting and delisting objectives were based on the historic number of occupied territories (32), instead of the amount of suitable historic habitat (60), or 53% of the potential habitat (Fowle et al. 2000). Similarly for bald eagles, numeric downlisting and delisting objectives have been established to correspond with a similar estimate of total statewide occupancy, or 37 pairs (50% of the estimated 73 areas of potential habitat). This estimate is based on the assumption that each waterbody area would support only one pair of eagles.

The bald eagle downlisting objective is set at approximately 50% (19) of the possible occupied habitat in all regions and the delisting goal at 75% (28). Given the scarcity of historic information, these numeric goals could change with future knowledge, especially as bald eagles continue to reestablish themselves in Vermont. The goal of 1.0 fledgling per occupied breeding area is based on the federal recovery plan's similar goal for Northeastern States (USFWS 1983) and the recent average productivity rates of bald eagles breeding in other northeastern states, including Maine, New Hampshire, Massachusetts, and New York.

Given that Lake Champlain, the Connecticut River, and some interior lakes extend beyond Vermont into New York, New Hampshire, Massachusetts, and Canada, it is expected that bald eagles with territories on these waterbodies will use the adjacent states and province for foraging, nesting, and roosting, or even alternate nest sites. It is not possible to predict which side of the border pairs will use each year, and therefore expect that each waterbody will share pairs across states or the province. Using parameters from

a Maine eagle habitat model (Livingston et al. 1990), it is expected that pairs nesting up to 1.5 km (0.93 mile) outside of Vermont may use the State's water bodies for foraging sites. Due to an eagle's ability to travel from a neighboring state or province to support its chicks, at least 50% of successful pairs foraging in Vermont must have their nest located within Vermont's boundary to quantify them as Vermont nesters.

Recovery Strategies

As bald eagles are a long-lived species with high trophic level, strategies for recovery should include steps to protect adult and sub-adult populations as well as nesting and wintering habitats. Historic declines in bald eagle populations were believed to be the result of intentional takings such as bounties and later, environmental contaminants.

Strategies that direct recruitment of breeding eagles to the state have been employed through the Vermont Bald Eagle Restoration Initiative. Future recruitment will likely occur from surrounding populations, and therefore protection of new and existing nest sites is fundamental to the future of a breeding population of bald eagles in Vermont. Strategies that include outreach to public constituents will increase identification, awareness, and respect for the species through modified behavior and community involvement in conservation where appropriate.

Until bald eagle populations become more established in Vermont, monitoring and management strategies may need to be directed at both non-breeding individual eagles and established/potential breeding pairs. For purposes of this recovery plan, non-breeding individuals include juvenile and sub-adult birds not yet at breeding age, as well as all birds outside the breeding season.

Monitoring

Non-breeding Individuals

Monitoring efforts for non-breeding individuals will focus on winter surveys, maintaining a centralized database of bald eagle sightings, and following up on any reports of potential breeding behavior. Monitoring action items are listed in order of priority.

1. Conduct statewide winter survey every other year and annual early spring survey of potential nest sites on large waterbodies, with a focus on Lake Champlain and the Connecticut River.

2. Regularly update statewide database of sightings in Vermont and surrounding regions. Send regular updates to partners in Vermont and neighboring states. VFWD will manage, update, and distribute the database.

3. Follow up on any observations of possible nest sites or nesting behavior. If staff resources are available, begin regular (weekly) monitoring of resident bald eagles (if necessary). Utilize the volunteer network to supplement monitoring events.

Established and Potential Breeding Pairs (long-term recovery strategy)

Continued annual monitoring of the statewide existing and potential breeding population will be necessary to determine population size and annual trends. Proposed monitoring actions are listed in order of priority.

1. Monitoring of existing and potential breeding bald eagles will include the following actions per VFWD draft protocols:

- Locate territorial pairs and potential new pairs exhibiting breeding behavior through sighting reports and encourage reporting of nesting activity by the public;
- Determine which pairs are nesting and locate each pair's primary nest site, determine onset of incubation, hatching and fledging dates, and number and sex (when possible) of young fledged;
- Record and report banded status of birds at nesting sites;
- Monitor human disturbance at nesting sites;
- When possible, photograph nest site and nesting activity;
- When possible, determine causes for nesting failure and identify factors limiting reproductive success.

2. Collect data on contaminant levels by analyzing eggshells and feathers;

3. Conduct statewide annual early spring survey of potential nest sites on large waterbodies throughout Vermont.

4. Continue to update statewide database of sightings and send annual updates to partners in Vermont and neighboring states.

5. Designate a coordinator of site monitoring efforts to work with partner organizations, volunteers, and state biologists, manage sighting database, compile field data, and produce an annual technical report of the status of Vermont bald eagles.

6. Develop volunteer network to share in monitoring of active nest sites.

7. Band downed or injured birds, or other birds as opportunity arises;

8. Collect prey remains from nests when opportunities arise.

9. Monitoring of existing and potential breeding bald eagles will include the following actions per VFWD draft protocols:

- Locate territorial pairs and potential new pairs exhibiting breeding behavior through sighting reports and encourage reporting of nesting activity by the public;

- Determine which pairs are nesting and locate each pair's primary nest site, determine onset of incubation, hatching and fledging dates, and number and sex (when possible) of young fledged;
- Record and report banded status of birds at nesting sites;
- Monitor human disturbance at nesting sites;
- When possible, photograph nest site and nesting activity;
- When possible, determine causes for nesting failure and identify factors limiting reproductive success.

10. Collect data on contaminant levels by analyzing eggshells and feathers;

11. Conduct statewide winter survey every other year and annual early spring survey of potential nest sites on large waterbodies throughout Vermont.

12. Continue to update statewide database of sightings and send annual updates to partners in Vermont and neighboring states.

13. Designate a coordinator of site monitoring efforts to work with partner organizations, volunteers, and state biologists, manage sighting database, compile field data, and produce an annual technical report of the status of Vermont bald eagles.

14. Develop volunteer network to share in monitoring of active nest sites.

15. Band downed or injured birds, or other birds as opportunity arises;

16. Collect prey remains from nests when opportunities arise.

Management

Management efforts will focus on enhancing bald eagle nesting success by reducing human impacts near nest sites. Longer term goals include securing the conservation of bald eagle nesting habitat in Vermont. Management actions are listed in order of priority.

1. Work with private landowners, municipalities, and other State departments/agencies where necessary to cooperatively implement nest site protection measures that include a nest sanctuary buffer of 100 m (330 ft) radius, with extension up to 201 m (660 ft) if isolation, woodlands, or terrain don't adequately buffer nests. Extend further seasonal restrictions out to 402 m (1320 ft) with timing, setbacks, and other concerns customized to each site, pair, or existing land use practices. As breeding populations increase across the state and adjacent breeding pairs must coexist, maintain habitat components such as perches, sentry lookouts, potential nest trees, roosts, and flight corridors within the buffer area. Post closure and informational signs (including water-based where/when necessary), and erect predator guards if disturbance to birds can be minimized.

2. Department game wardens and wildlife biologists will work USFWS Law Enforcement Division to implement law enforcement measures that limit harassment/killing of bald eagles according to state and federal law. Develop a program to regularly patrol nest sites to prevent disturbance, harassment or destruction of an eagle or nest site, in accordance with state and federal law. Department game wardens will also assist with outreach efforts while providing law enforcement.

3. Work with private landowners to develop appropriate agreements for long-term conservation of breeding sites. Whenever possible, protect bald eagle nesting habitat through the Landowner Incentive Program (LIP), Wildlife Habitat Incentive Program (WHIP), or habitat protection through the Use Value Appraisal program (Current Use). Protection of necessary wildlife habitat through Act 250, management agreements with private landowners, and conservation easements may also be utilized where necessary.

4. The Bald and Golden Eagle Protection Act penalizes for the "taking" of eagles which includes poisoning. The potential for lead shot ingestion by bald eagles feeding on carcasses has recently surfaced as an issue in Vermont where eagles have been observed feeding at carcass pits. In an effort to monitor the exposure of raptors such as bald eagles to lead ingestion, VFWD will develop practical strategies for the assessment, monitoring, and management of lead in carcass pits on state lands. As the potential for regional efforts in lead management evolves, monitoring lead levels in bald eagles may be helpful in monitoring the significance of this threat to recovering Vermont's population.

Education and Outreach

VFWD and partners will develop an outreach strategy focusing on educating the public about bald eagles and their role as a top predator in Vermont's ecosystems. Through public education efforts, the stage will be set for habitat conservation for bald eagles nesting in Vermont. Education action items are listed in order of priority.

1. Conduct regular outreach and educational events, including slide show and live raptor presentations, school and community-based programs, news releases, newsletter articles, and media coverage. VFWD, OFES and NWF developed an Eagle Education Box, to be available for schools to borrow.

2. Conduct regular events with the media, to be spearheaded by VFWD. VFWD will hold press conferences to publicize the bald eagle's return to Vermont throughout its recovery.

3. Distribute education materials to adults and children participating in education programs, lakeshore landowners, and recreationists that promote eagle habitat protection and enhancement.

4. If possible, set up remote video camera on active nest site that can be accessed on the internet (24 hr coverage of activity on nest) as done in other states such as Maine and Maryland.

Partnerships

As bald eagle numbers increase in Vermont, sharing information, coordinating monitoring efforts and surveying bordering waterbodies will continue with existing partners throughout the state and region.

Existing local partners include:

- VINS and OFES – injured bird rehabilitation
- Audubon Vermont – winter bird surveys and field reports
- Lake Champlain Basin Program – potential nest monitoring and reporting
- VELCO, CVPS, and Green Mountain Power (GMP) – potential nest reporting, monitoring, and management

Existing regional partners include:

- USFWS – management/monitoring reporting and refinement, regional population assessments;
- New Hampshire Audubon – nest reports and cooperative monitoring along Connecticut River, regional population assessments;
- Maine Department of Inland Fisheries and Wildlife (MDIFW) – monitoring/management reporting and refinement, regional population assessments;
- New York State Department of Environmental Conservation (NYSDEC) – monitoring/management reporting and refinement, cooperative monitoring along Lake Champlain, regional population assessments.

Once a substantial bald eagle population is established, it may be useful to recruit additional partners. Recovery partnerships are essential to enhance monitoring and management efforts where resources may be limited. Increased outreach efforts and media coverage resulting from partnerships fosters a stewardship paradigm throughout the recovery process. Partnerships with private landowners, local conservation and outreach organizations, and state and federal agencies will help ensure the long-term protection of nest sites. Actions are listed in order of priority.

1. Continue to establish and expand partnerships with government and non-government organizations in Vermont and the region, with focus on New Hampshire, Massachusetts, and New York. Potential partners and their roles include the following:
    - Land trusts – habitat conservation through easements, monitoring
    - Landowners – implementation of management strategies
    - Shelburne Farms – event organization and outreach

- ECHO Lake Aquarium and Science Center – education and outreach
- Vermont Center for Ecostudies – research and monitoring
- University of Vermont – research and monitoring
- Missisquoi National Wildlife Refuge – monitoring and management
- Northwoods Stewardship Center – research and monitoring
- Friends of the Winooski River – habitat conservation and monitoring
- The Nature Conservancy – habitat conservation through easements and land acquisition
- Audubon Vermont and its regional chapters – research and monitoring
- Vermont River Conservancy – habitat conservation
- Other numerous Vermont natural resource-based organizations
- Vermont-based corporations interested in the stewardship of natural resources

2. Work closely with USFWS to ensure the sustained recovery of bald eagles after delisting. Develop a post-delisting monitoring and management plan when eagles are proposed to be removed from the state list of endangered and threatened species.

<u>Fundraising</u>

1. Increase fundraising efforts to secure funds for annual monitoring, management, research and educational efforts. The costs of monitoring and managing nesting sites are expected to increase as the size of the breeding population increases and as recovery goals are approached. The following funding opportunities can be explored:

    - State Wildlife Grants
    - Nongame Fund
    - Lake Champlain Management Funds
    - Lintilhac Foundation
    - Lake Champlain Basin Program
    - Landowner Incentives Program
    - Partners for Fish and Wildlife Program
    - Wildlife Forever
    - Acorn Foundation
    - USFWS Conservation Grants
    - USFWS Cooperative Conservation Initiative
    - Doris Duke Charitable Foundation

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