Coastal Ospreys between New York City and Boston: a decade of reproductive recovery 1969 - 1979

Devastated by pesticide-related eggshell thinning, this population is now making a gradual comeback

Paul Spitzer and Alan Poole

FEW BREEDING POPULATIONS of North American birds have attracted as much attention and concern in recent decades as the Osprey (*Pandion haliaetus*) nesting in the Northeastern coastal region between New York City and Boston. A drastic, organochlorine pesticide-induced reproductive failure and population decline during the 1950s and 1960s led workers then to predict that Osprey would soon be eliminated as a breeding species in this area (Peterson, 1969), and prompted more careful monitoring of this raptor's numbers not only in the Northeast, but elsewhere. What emerged from these studies, partially summarized in Ogden (1977) and Henny (1977), was the knowledge that while the New York-to-Boston population had suffered reductions more severe than others in the United States, this region nevertheless continued to retain significant Osprey nesting concentrations.

We report here the results of a yearly population survey during the past decade (1969-1979) of coastal Ospreys in New York, Connecticut, Rhode Island and Massachusetts. This survey has enabled us to trace a dramatic improvement in the bird's reproductive rate and the beginning of the first population increase in 30 years. We investigated changing patterns of distribution, reoccupation of former range, increased use of man-modified habitat, and factors influencing reproductive success. Comparisons are made with the region's historical population. Such analysis of this single population's dynamics is appropriate now when other depleted raptor populations are also beginning to recover.

METHODS

ALTHOUGH THE DATA on Osprey populations in the New York-to-Boston region prior to 1960 are not extensive, we have made use of banding records and general accounts of early naturalists to arrive at rough pre-DDT population figures. These estimates appear, nonetheless, more reliable than those for most other regions of the country. In 1969 Spitzer began systematic ground surveys to determine potential nest sites, active and inactive nest locations and the production of young; Poole carried on much of this survey work in 1974-1979. Throughout the surveys we relied on the aid of local naturalists familiar with various aspects of particular portions of the population. State conservation agencies in Connecticut, New York and Rhode Island started Osprey survey work in 1975, 1977 and 1978, respectively, and their data have proved useful in compiling and cross-checking the more recent yearly production totals.

Since Ospreys in this region often breed in loose colonies and usually occupy conspicuous, traditional nest sites, and as this region contains little inaccessible habitat, the survey was able to achieve nearly total nest coverage within its first few years.

All accessible nests were visited and their contents checked once during the incubation period (April 1 - May 15) to determine clutch size and at least once later to check their reproductive outcome. At inaccessible nests, telescope observations were usually adequate to reveal the activity and success of a nest

Although the study area consists of the entire coastline between New York City and Boston, in fact Osprey nests are clustered into relatively few portions of this region as shown in Figure 1. Centers of concentration include Suffolk County, N.Y. (east of Riverhead, Long Island) and its associated offshore islands: Shelter, Plum, Gardiner's, and Fisher's. Nests in Connecticut and Rhode Island are more scattered, but the Connecticut River estuary in Connecticut and the Westerly Cedar Swamp and the Great Swamp in Rhode Island currently hold the largest groupings. Two-thirds of the Massachusetts nests are in the Westport River estuaries, with most of the remaining third on the island of Martha's Vineyard. All known nests are within a few kilometers of the coast, 95% within sight of salt water. The likelihood of scattered nests undiscovered inland is low.

Long Island nesting concentrations are separated by a gap of nearly 150 km from New Jersey Ospreys to the south and west, while to the north there is a gap of over 250 km between nests in southeastern Massachusetts and those closest on the Maine coast. Such a nesting distribution, given the great regional fidelity of Ospreys, results in a discrete geographical population whose relative isolation has been confirmed by banding studies (Spitzer, 1978, 1979). Thus it is possible to consider the dynamics of this population as mainly dependent on local reproductive rates and relatively free from the influences of neighboring population fluctuations.

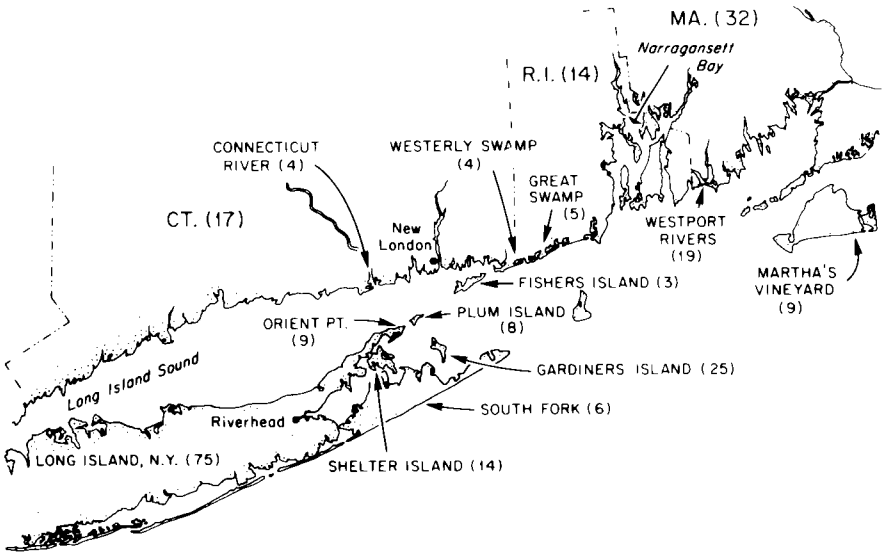

Figure 1. *Locations of major Osprey nesting colonies in the New York City to Boston region 1969-1979. Numbers in parentheses represent total nesting pairs for a colony or a state during the 1979 breeding season.*

HISTORICAL NUMBERS AND POPULATION DECLINE

DURING THIS CENTURY and the last, the largest known concentrations of nesting Ospreys in the world occurred in the northeast coastal United States between Virginia and Massachusetts, including many portions of the New York to Boston study area. This region is characterized by extensive shallow-water bays and estuaries, supporting rich anadromous and near-shore fish populations. Such predictable and readily available supplies of food encourage the formation of loose nesting aggregations that make up the "colonies" of this semi-social raptor. Within the study area, as in locations throughout the world, islands substantially free of men and other mammalian predators are favored nesting areas and frequently support the densest nesting aggregations.

Table 1. Change in number of active Osprey nests in areas between New York City and Boston that were censused around 1940, and then in 1970 by Spitzer.

Area	*Year of census*	*Source of data*	*Active nest count*	*1970 active nest count*
Gardiner's Island, N.Y.	1940	S. LeRoy Wilcox (Wilcox, 1944)	306	38
"North Fork" of Long Island, N.Y. (Orient to Riverhead)	1940	Roy Latham, S. LeRoy Wilcox (Wilcox, 1944)	79	10
Shelter Island, N.Y.	1940	S. LeRoy Wilcox (Wilcox, 1944)	41	16
"South Fork" of Long Island, N.Y. (Montauk to East Moriches)	1940	S. LeRoy Wilcox (Wilcox, 1944)	68	10
Rhode Island	1941	Carlos Wright and the R.I. Ornithological Club (Emerson and Davenport, 1963)	120	8
Connecticut River estuary and surrounding areas, Conn.	1938	John Chadwick (Ames and Mersereau, 1964)	200+	8
		Totals	814	90

Several breeding areas in New York, Connecticut and Rhode Island sampled during the early 1940s had a total of over 800 active nests (Table 1). Foremost among these was the famous Gardiner's Island colony whose already large numbers built up tremendously in the early 1900s owing to an influx of Ospreys displaced during construction and clearing on nearby Plum Island (Allen, 1892) Wilcox carried out enthusiastic and extensive banding of Gardiner's Island Ospreys during the 1930s and 1940s and estimated, with others (Knight, 1932, Puleston, 1977), over 300 active nests clustered in certain portions of the 3300-acre island, probably making Gardiner's at that time the largest and densest Osprey nesting colony in the world. Reproduction appeared excellent during those years; brood sizes in nests visited by Wilcox averaged 2.2 and he noted no significant population fluctuations during the 15+ years of his banding studies (Wilcox, 1944).

Other major breeding concentrations known from the 1940s included the large numbers of nesting pairs found at the mouth of the Connecticut River and environs, estimated by local naturalists at over 200 (Ames and Mersereau, 1964) The center of this concentration was the colony at Great Island, near Old Lyme, Connecticut, where, as on Gardiner's Island, a number of pairs adapted to the open, probably predator-free island habitat by nesting on the ground (Fig 2). The eastern end of Long Island harbored somewhat smaller but nonetheless important colonies, particularly along the edges of the extensive coastal marshes at Orient Point on the North Fork, along the shores of Shelter Island and along Gardiner's Bay on the South Fork; each of these clusters held 40-70 active nests (Wilcox, 1944; Table 1) In Rhode Island, a large majority of the 120 nests estimated before population declines, were found on Narragansett Bay, others being clustered in certain of the coastal freshwater cedar swamps at the western end of the state (Emerson and Davenport, 1963). If one assumes that areas not sampled in the region during the 1940s held relatively small numbers of active nests that have declined at a rate roughly equivalent to known population centers, the projected total of nests active in the region at that time is very close to 1000.

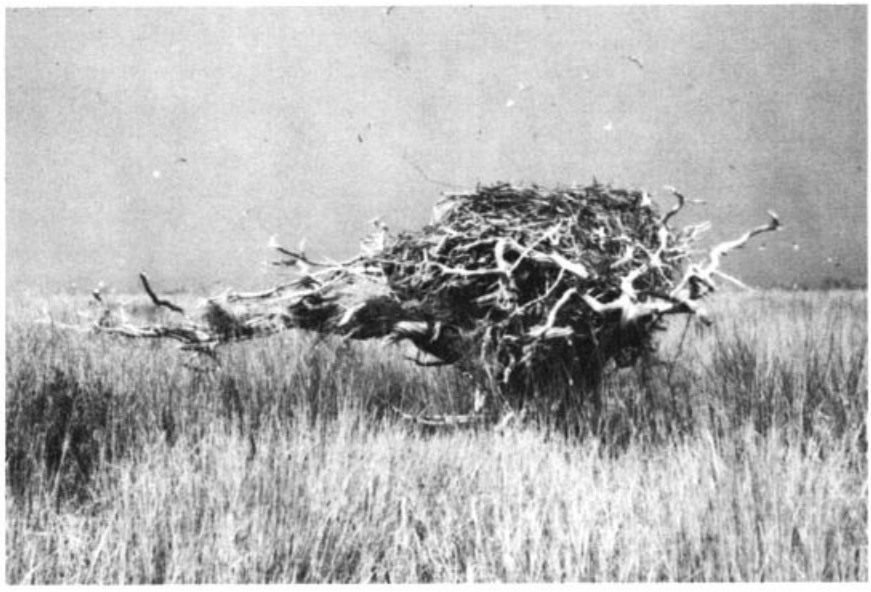

Figure 2. *One of the several Osprey ground nests found on Gardiner's Is., N.Y., an adaption to a habitat free of mammalian predators.*

Typical regional reproductive rates in the 1930s and early 1940s ranged from 1 0 to 2.0 young fledged per active nest (Wilcox 1944; Peterson 1969; Spitzer *et al.* 1978; Spitzer, unpubl.).

Beginning in the 1950s and following the introduction of the organochlorine pesticide DDT in 1948, naturalists aware of Osprey populations began to note serious reproductive failure and significant declines in nest numbers. This attention sparked the pioneering study by Ames and Mersereau (1964) of Osprey reproduction in the Connecticut River estuary where, during the period they were observing (1960-1963), reproduction was only 5-40% of the pre-DDT figure and the population was declining at the catastophic rate of 31% annually. Only 24 of the original 200 nests remained in 1963 and the colony continued to decline thereafter (Peterson, 1969). Their research showed that the poor nesting success of these birds was not due to either predation or human disturbance. Nests failed because a high percentage of the eggs did not hatch. Significant amounts of DDT metabolites were found in the food fish and eggs of these Ospreys (Ames and Mersereau, 1964; Ames 1966).

EVIDENCE FROM CONTINUED Osprey studies in this area (Wiemeyer *et al.*, 1975; Spitzer *et al.*, 1977) as well as from numerous field studies on other raptors in the Northern Hemisphere, soon made it clear that the Osprey's ecological position at the end of the long food chain made it vulnerable to the now well-known process of "biological magnification" whereby organochloride pesticides, here originally applied in salt marsh mosquito control programs and local agriculture, may increase their residue concentrations by as much as an order of magnitude with each trophic level sampled in a given ecosystem (Woodwell *et al.*, 1967). Like other avian predators, the Osprey suffered eggshell thinning. Many eggs broke during incubation, leaving shell fragments, or disappeared entirely between nest visits (Ames and Mersereau, 1964; Wiemeyer *et al.*, 1975). Spitzer *et al.* (1977) examined the relationship between shell thinning and DDE concentrations in Osprey eggs from throughout North America and found a positive correlation; eggs from Gardiner's Island and the Connecticut River, as well as from New Jersey, showed the highest DDE concentrations and the greatest amount of shell thinning (averaging 15-22% below pre-DDT norm) of any in North America at that time. Further studies by Spitzer (1978) involved the exchanges of eggs and young between osprey nests in the heavily contaminated Long Island Sound region and nests in the less polluted Chesapeake Bay area. Chesapeake eggs continued to hatch well in their Long Island foster nests, while the Long Island and Connecticut eggs showed no increased viability in Chesapeake nests. This experiment demonstrated that the problem was one inherent to the egg and helped to bolster the region's faltering population during a particularly critical time.

By 1970, the first year of the complete survey, it was obvious that the poor hatching rates of the previous 20 years had severely affected recruitment into the population with drastic consequences for breeding colonies throughout the area. Only 90 of the 800+ nests censused around 1940 remained active in 1970, a decline of roughly 90% (Table 1).

Because the application of DDT was so widespread in this coastal zone, and because East Coast Ospreys have a common South American wintering ground and, possibly, winter contamination (Henny and Van Velzen, 1977), the effects of this pesticide on Osprey breeding colonies within the region were generally uniform, although a few locales suffered especially severely. Particularly hard hit was the Connecticut River colony, perhaps due to the extensive agricultural areas with their accompanying DDT loads that this river drains. In addition, a local discharge of industrial pollutants, including dieldrin, compounded the problem (Spitzer *et al.*, 1978). By 1974, this colony had dwindled to a single pair of actively nesting birds. Equally dramatic was the total loss of breeding Ospreys from the Narragansett Bay region. This heavily industrialized portion of the New York City to Boston coastline contains some of its most severely modified habitat, which could have contributed additional stresses to this already faltering subpopulation.

REPRODUCTIVE RECOVERY AND POPULATION INCREASES— 1969-1979

WHILE THE TOTAL NUMBERS of nesting Ospreys in the region continued to fall until the mid-1970s, their reproduction was showing a distinct improvement during the early years of the survey (Table 2, Fig. 3). This rise in hatching rate coincided with a gradual decline in the use of DDT in the region brought about by an effective Environmental Defense Fund lawsuit against Long Island's Suffolk County Mosquito Control Commission in 1967, as well as the eventual Federal ban on the pesticide in 1972. Spitzer *et al.* (1978) measured organochloride residues in Connecticut and Long Island Osprey eggs and found a five-fold decrease in average DDE

Table 2. A summary of New York-to-Boston Osprey reproductive data, 1969-1979.

Year	Total known active nests[a]	Total nests with known outcome	Total successful nests[b]	Per cent successful nests	Young fledged	Young per successful nest	Young per active nest
1969	137	127	46	36.2	67	1.46	0.528
1970	136	129	42	32.6	79	1.88	0.612
1971	122	117	41	35.0	75	1.83	0.641
1972	120	118	36	30.5	67	1.86	0.568
1973	115	114	51	44.7	88	1.73	0.772
1974	116	115	56	48.7	102	1.82	0.887
1975	109	108	59	55.1	96	1.63	0.889
1976	109	109	72	66.1	147	2.04	1.35
1977	120	117	62	53.0	121	1.95	1.03
1978	130	128	74	57.8	136	1.84	1.06
1979	138	130	81	62.3	148	1.82	1.08

[a]defined as nest in which eggs are laid; [b]defined as nest which fledges young.

levels in 1969-1976, while levels of PCBs (poly-chlorinated biphenyls—an industrial pollutant) remained virtually unchanged, indicating that the contribution of the latter to the reproductive failure of Ospreys has probably been negligible.

The first noticeable reproductive improvement within the survey period, measured both by young/successful nest and young/active nest, appeared in 1970 (Table 2). By 1973, the number of young/active nest had increased to 0.77, very near the point (0.79) that Spitzer (1979) has determined is the productivity needed to balance yearly mortality and thus maintain the stability of the population at least at its current density (Fig. 3) A dramatic surge in reproduction took place in 1976, doubling the 1973 output of young/active nest, an indication that contamination levels were falling low enough to allow the population to approach the range of its pre-DDT productivity. The fact that the number of young/active nest dropped somewhat in the following 3 years seems due to a combination of factors, including poor weather and the increasing recruitment of young, inexperienced nesters with lower success rates (Spitzer, 1978; Poole, unpub. data). Brood sizes have remained little changed since 1970, proof that hatching failures were the main cause of limited production; we note that the increasing percentage of successful nests has been quite well reflected in the number of young produced/active nest (Table 2).

Geographically the reproductive recovery of the region's Ospreys has been fairly uniform. However, one area showing a significant lag has been the Gardiner's Island colony whose productivity has consistently remained below the regional average (Fig. 4), a phenomenon of considerable interest since ideal nesting conditions seem to prevail there (Puleston, 1977). Recent field work (Poole, in prep.) shows considerable loss of young in this colony due to starvation. Male ospreys supply all the food for the female and nestlings; on Gardiner's Island the males must make long foraging trips to marshes on the South Fork of Long Island, the closest place where predictable supplies of fish are readily available (Spitzer 1978; Poole, in prep.). We hypothesize that formerly this colony depended to a greater extent on migratory schools of menhaden (*Brevoortia tyrannus*), surface schooling fish that appeared during the first half of the 20th century in vast numbers in the waters of Gardiner's Bay but whose populations have been severely reduced in recent decades by an intensive, highly mechanized, and poorly regulated fishing industry to the south (McHugh, 1972). It should be noted, however, that despite this situation the Gardiner's colony has nonetheless managed to produce sufficient young in some years to offset the annual mortality.

IMPORTANT CONSEQUENCES of the improved reproduction of Ospreys in the region have been the increasing recruitment of new breeders with resulting population stabilization and the gradual increase in breeding pairs. We have also noted a steady rise in the numbers of non-laying pairs in the region: 0 in 1970, 5 in 1974; 17 in 1978. These are typically young, inexperienced adults that take up residence at a nest site even if they do not produce eggs. These "housekeeping" pairs often do incubate eggs the following year, and it appears to be such new recruits that are beginning to swell the ranks of the region's Osprey breeding population. While its numbers were

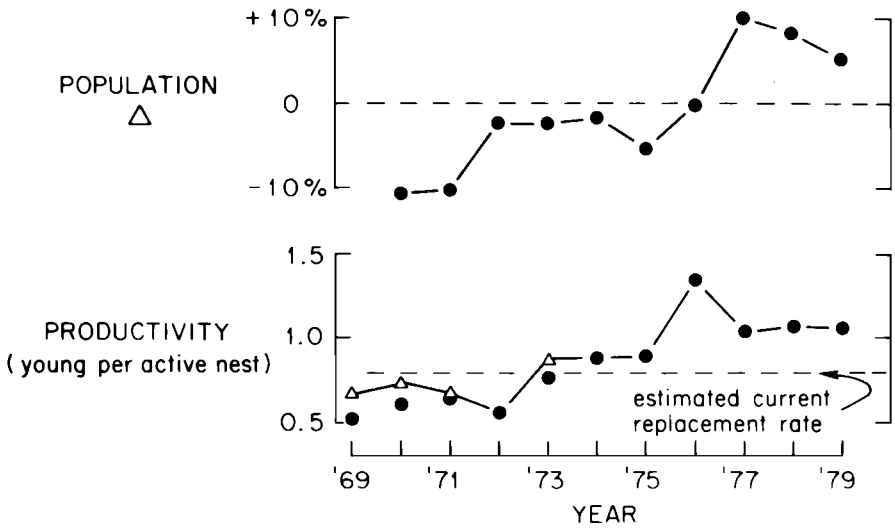

Figure 3. *A comparison of Osprey reproductive rate and change in population size in the New York City-to-Boston region, 1969-1979. Open triangles on lower graph are productivity values which include young introduced from Maryland by Spitzer.*

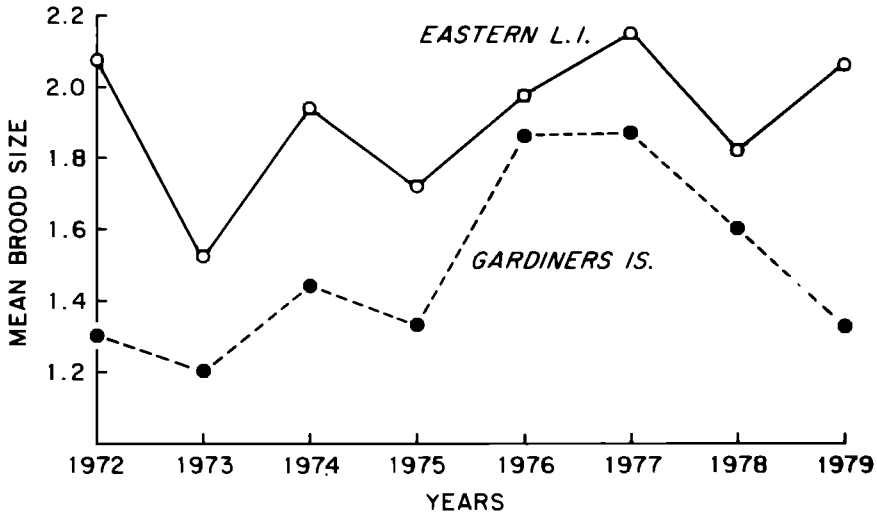

Figure 4. *An eight-year comparison of Osprey mean brood sizes on Gardiner's Island and in surrounding regions. Lower Gardiner's figures presumably reflect the poor feeding conditions found in that colony.*

stabilized by the mid-1970s, the population showed its first increase, roughly 10%, in 1977 (Table 2, Fig. 3). This encouraging trend has continued over the past 2 years and there now seems no reason to expect such increases to subside given the improved reproduction in the past half decade.

Newly settling Osprey pairs appear to be attracted to sites that have other Ospreys nesting nearby. During the past 3 years established colonies have gained more than twice as many new nests as isolated locations. We have noted a similar trend among non-laying pairs, the large majority of which first appeared in the vicinity of existing colonies. This continuing concentration of Ospreys could, of course, be a response to environmental factors as well as reflecting the semi-social nature of the bird; proximity to locally dense prey sources as well as to suitable nest sites are also factors. The two large Massachusetts colonies on Martha's Vineyard and in the Westport River estuaries have both doubled in size in the past 5 years, partly the result, it appears, of their increased reproductive success and also owing to intensive efforts on the part of local naturalists to build up surplus artificial nesting platforms in appropriate locations. In Connecticut, the Connecticut River colony on Great Island, which barely escaped temporary extirpation, has shown regained strength (4-5 pairs) in recent years. Significant numbers of non-laying pairs have appeared in the past 2 years on Fisher's Island, New York and in the extensive coastal marshes of the Mashomack Forest on Shelter Island, New York. While most other colonies have made steady gains in the past 3 years, only the Gardiner's Island colony has continued to decline in numbers (1969: 38 nests; 1975: 31 nests; 1979, 25 nests). We have noted few non-laying pairs on Gardiner's during the study, an indication that the colony is failing to attract and hold returning young birds despite its large size.

Although Ospreys have historically shown a tolerance for rural man (Bent, 1937), their recent population expansion in the heavily settled New York City-to-Boston region has increasingly indicated their ability to co-exist with suburban and urban man as well. Only Shelter Island and Gardiner's Island currently hold significant concentrations of Ospreys nesting in natural (tree) sites (Fig. 5); in most other areas nests are on platforms built specifically for them (Fig. 6) or on man-made structures that satisfy the Osprey's criteria for a predator-proof, unobstructed nest site. Most often the latter is a pole supporting telephone or power lines (Fig. 7), which often places the nesting pair close to intense human activity. In Connecticut, for example, there are successful pole nests in a variety of locations: along the main New York-to-Boston Amtrak line; on the outskirts of the nuclear power plant at Millstone Neck (Waterford); within 100 yds of a commercial airport; and an equal distance from a major four-lane divided highway. A nest perhaps most indicative of the Osprey's ability to settle successfully despite human disturbance is one that was built in 1978 on a 27 m light tower in the parking lot at a large coastal amusement park. Visiting this nest after dark is a bizarre experience; hundreds of cars disgorge passengers directly below the nest while the nearby midway is awash in a sea of music and neon lights, and city sirens wail in neighboring streets. Yet this nest

Figure 5. *A tree nest on Shelter Island, N.Y.. Only one-third of the region's Ospreys currently nest in natural sites like this.*

has successfully fledged at least one young in each of its 2 years of existence.

ALTHOUGH SUCH TOLERANCE of man may be of some help as the Osprey continues its regional expansion, there is no indication that suburban or urban locations will ever support large nesting concentrations. The growth of major colonies will continue to depend on extensive areas of undisturbed coastal land for nesting. In addition, close association with man is not without its hazards for breeding Ospreys. We have records of eleven birds that were electrocuted on power lines over the past decade, many of them fledglings out of nearby pole nests. Power companies in the past have often removed Osprey nests from electrical poles, but recently there has been more extensive cooperation between researchers and these companies, most of which are now willing to modify existing poles to accommodate more safely the nests, or to put up nearby nesting platforms. Additional sources of mortality include collisions with cars and trains, tangling in kite strings, and increasingly with unfledged young: angling in monofilament fishing line, discarded skeins of which adults often seem to use in nest building. Poole discovered one young late in the 1978 season with a severed wing, the result of its constriction by monofilament during growth. These types of losses are minimal, however; overall it seems that the Osprey's ability to use a man-modified coastal environment will be to its long-term advantage as the population increasingly competes with people for space.

Figure 6. *Artificial nesting platform built for Ospreys in the Westport, MA. River marshes. Nearly one-third of the region's Ospreys now nest on such platforms.*

THE FUTURE

A MAJOR BENEFIT OF the 1969-1979 New York City-to-Boston Osprey survey has been the encouraging realization that this population has not only regained the ability to sustain itself in this region, but has the potential for significant growth as well. A question of great interest at the moment is the extent to which these birds will be able to recover their former numbers over the next few decades.

Henny (1977) has suggested that loss of nesting habitat in the region will preclude any return to pre-DDT abundance. While it is true that significant portions of the region's wetlands have suffered destruction and loss of productivity at the hands of man in the past 30 years (O'Connor and Terry, 1972; Long Island Sound Regional Study, 1975), relatively little of this alteration has occurred in the areas where Osprey nesting is concentrated, *i.e.*, eastern Long Island, eastern Connecticut, and southeastern Massachusetts. Increasing efforts to put up nest platforms have helped to bolster the nesting potential of many areas, and the greater concern of private citizens and of state agencies responsible for Osprey management now offer these birds a measure of protection and encouragement that has been lacking in the past.

While potential nest sites should continue to be available for the foreseeable future, food limitation may well turn out to be a more important factor affecting population recovery. Current trends on Gardiner's Island have made us aware of how reproduction and recruitment can be affected by food resources; indeed the future recovery of this key colony seems extremely doubtful given its reduced recruitment. Although the Gardiner's Island colony has shown evidence of the most severe food stress in the region, other colonies have also experienced substantial brood-size reduction through starvation in certain years (Poole, in prep.). Despite the fact that they are opportunistic fishers, Ospreys are often dependent on only a few locations that harbor predictable and accessible fish concentrations. Such shallow-water bays usually support intensive human activity and so are increasingly vulnerable to pressures like dredging, boating, fishing and shellfishing. Thus while it is difficult to measure historical changes in fish populations, working as one must with the variations in effort and technology of human fisheries, it nonetheless seems that an important factor in defining the future carrying capacity of Osprey habitat in the New York-to-Boston region is going to be food availability and the impact of man on this limited resource.

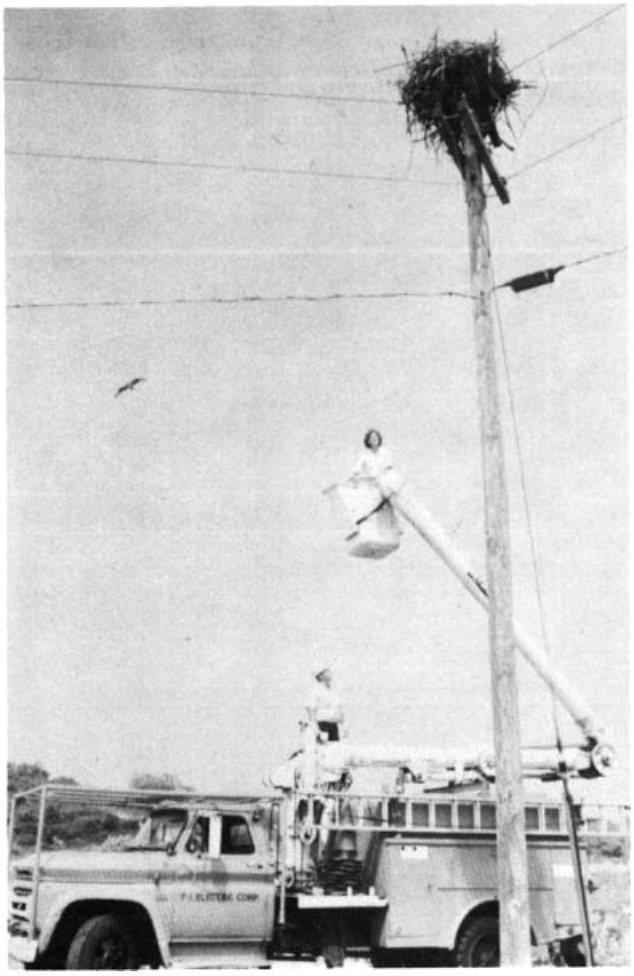

Figure 7. *An Osprey nest on a power pole, Fisher's I., N.Y.*

Osprey populations appear to have a moderately high intrinsic rate of growth (defined as r strategy), *i.e.*, a favorable balance of births over deaths. Spitzer (1979) has calculated that, given the average clutch size in this population (3.23), only one-fourth of the eggs laid need to produce fledging young in order to provide population stability. In addition, Poole (1979, in prep.) has found brood-size reduction to be an important factor in Osprey reproductive strategy. Together these facts indicate, according to current theory, that Ospreys have probably evolved with fluctuating (but often abundant) food resources; *i.e.*, that food limitation has probably exerted less stringent pressures during the evolution of this species than with many other similar-sized, but lower r, raptors. Lower r, or more K-selected species (see Pianka, 1970, for a discussion of the classical correlates of K-selection; also Parker and Ogden, 1979), tend to show limited recruitment, and recover slowly, if at all, from population declines (Botkin and Miller, 1974).

It is this potentially favorable balance of natality over mortality that explains much of Osprey population dynamics. It explains why moderately contaminated Osprey populations, such as those in Chesapeake Bay that have shown reduced egg hatching rates (up to 50% in the central Chesapeake area—Reese, 1977), have nonetheless managed to remain stable. It helps to explain why Ospreys can breed in areas where they periodically suffer brood-size reduction up to 50% (or more), figures recorded from Florida Bay and Gardiner's Island, New York (Ogden, 1977; Spitzer, 1978; Poole, in prep.). It also helps account for the occasional high nesting density of this species as well as its nearly worldwide distribution. Similarly, it is this favorable recruitment potential which will be the key element in any recovery of severely reduced populations like those in New Jersey (Henny *et al.*, 1977) or between New York and Boston. Given a continuation of their current population increase of 8-10%/year, one might expect to see pre-pesticide totals (1000 pairs) back in the region by the year 2005, making the unrealistic assumption that the habitat could support them. This same rate of increase could double the population, perhaps a more reasonable possibility, in 8-10 years.

In summary, research during the past decade on the population dynamics of coastal Ospreys nesting between New York and Boston indicates the great adaptability of this raptor, its tolerance of an environment increasingly dominated by man and its potential for regaining losses incurred during the DDT era. Such adaptability points the way toward a gradual but steady recovery of this population, with future environmental carrying capacity along an intensely developed coast the unknown factor in the equation. Probably Ospreys will never reach their former abundance in the region, but continuing surveys will no doubt show the population stabilized at a large enough level to make it a common and widespread member of the local avifauna.

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Figure 8. *An Osprey nest with four young, ten days old.*

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—Section of Ecology and Systematics, Langmuir Laboratory, Cornell University, Ithaca, NY 14850 (Spitzer), Boston University Marine Program, Marine Biological Laboratory, Woods Hole, MA 02543 (Poole).