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Reproductive success of ospreys at two sites in Connecticut

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REPRODUCTIVE SUCCESS OF OSPREYS AT TWO SITES IN CONNECTICUT

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Abstract

Nest success rates and rates of fish delivery to nests were determined for two large Osprey populations in Connecticut, one at Groton Reservoir, Groton, and one at Great Island, Old Lyme, during 1996 and 1997. Between 1993 and 1996 these Osprey populations had substantially different rates of nest success. Great Island Ospreys fledged few young while Groton Reservoir Ospreys had good nest success. During 1997, however, fledging rates were similar at the two sites. In 1996, low nest success at Great Island resulted from high predation rates, probably due to raccoons. The higher nest success rate at this site in 1997 appears to be due to low predation rates because of the installation of new predator guards on all nest platforms. There was no evidence of raccoon predation at Groton Reservoir in either year. In 1996 Ospreys delivered fish to their nests at a similar rate on Great Island and Groton Reservoir. In 1997 Great Island Ospreys made more fish deliveries to their nests than Groton Reservoir Ospreys.

The Osprey (*Pandion haliaetus*) became a symbol of the environmental movement during the 1960's and 1970's. Several studies at that time showed that this once abundant fish hawk had declined radically in numbers. In the Connecticut River estuary and surrounding areas, more than 200 active Osprey nests were documented in 1940, but by 1970 only eight active nests remained (Spitzer 1980, as cited in Poole 1989). The Osprey's decline was eventually traced to the chemical DDT and other organochlorines that were commonly used as pesticides and routinely sprayed on marshes to control mosquitoes during the 1940's and 1950's (Ames 1966). Since the use of DDT and other insecticides was banned in the 1970's, Osprey numbers along the East Coast have been increasing (Spitzer et al. 1978).

In some areas, such as the Delaware Bay and the Chesapeake Bay, Osprey populations are not making a full recovery. Predation by the Great Horned Owl (*Bubo virginianus*) was advanced as the most likely cause for nest failures along the New Jersey side of the Delaware Bay (Steidler et al. 1991), while food shortage and sibling aggression were deemed the reason for nest failures in the Chesapeake Bay (McLean and Byrd 1991). Sibling aggression and brood reduction, which were common in Chesapeake Bay Ospreys, are often caused by food shortage, but are rarely observed in Ospreys with no food stress (O'Conner 1978; Stinson 1979; Poole 1984). Also, during the nesting months the male Osprey does 99.9% of the hunting for his family (Poole 1989). Food stress could be an indirect cause of the nest failure of Ospreys; if the male cannot find enough food, the female may be forced to hunt also, thereby leaving eggs or chicks vulnerable to predation.

There were 106 active Osprey nests (nests with eggs) in Connecticut during 1996 and 131 active nests during 1997 (Victoria 1996, 1997). The last stronghold for nesting Ospreys in Connecticut during the DDT years was Great Island, a salt marsh located in Old Lyme. Historically, the densest colony of Ospreys in Connecticut has been located in this marsh, and the nests at this site have had a high success rate. During the late 1970's and into the 1980's, when Ospreys began to recover from organochlorine poisoning, Great Island Ospreys continued to increase in numbers and to reproduce effectively. Since 1991, however, the number of successful nests on Great Island had declined dramatically, falling to zero in 1993 and remaining low through 1996 (Victoria 1996; Figure 1). The number of nesting Osprey pairs on Great Island remained high, but their nests produced few fledglings.

Groton Reservoir in Groton, Connecticut has a similar number of nesting pairs to the Great Island population. The Groton Reservoir Ospreys have been very successful at producing young during the same time period that the Great Island Ospreys were reproducing poorly (Figure 1). Great Island Ospreys fish mostly on Long Island Sound and surrounding brackish estuaries, while the Groton Ospreys appear to be fishing mainly at the freshwater reservoir where they nest (personal observation).

New England Ospreys living along the coast apparently rely mainly on three species of fish; winter flounder (*Pleuronectes americanus*) make up 50% of the bird's diet, Atlantic menhaden (*Brevoortia tyrannus*) account for 20% and river herring (*Alosa spp.*) account for 20% (Poole 1989). Survey trawls by the Connecticut Department of Environmental Protection, Fisheries Division, showed that the abundance of winter flounder off the Connecticut coast in 1995 was the lowest since data collection began in 1979 (Simpson et al. 1995; Figure 2). The decrease in winter flounder coincided closely with the initial decrease in nest success at Great Island. If the prey species that makes up 50% of the Osprey diet was less available to Ospreys at Great Island, this might affect

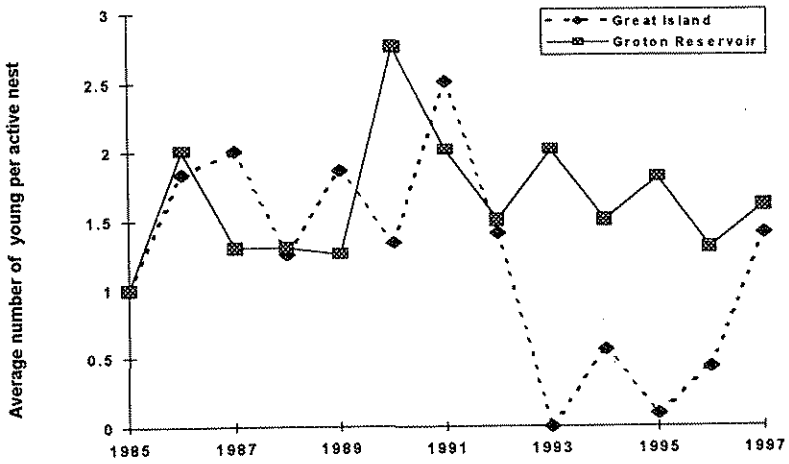

Figure 1. Average number of young fledged per active nest at Great Island and Groton Reservoir, Connecticut, 1985-1997 (from Victoria, 1997).

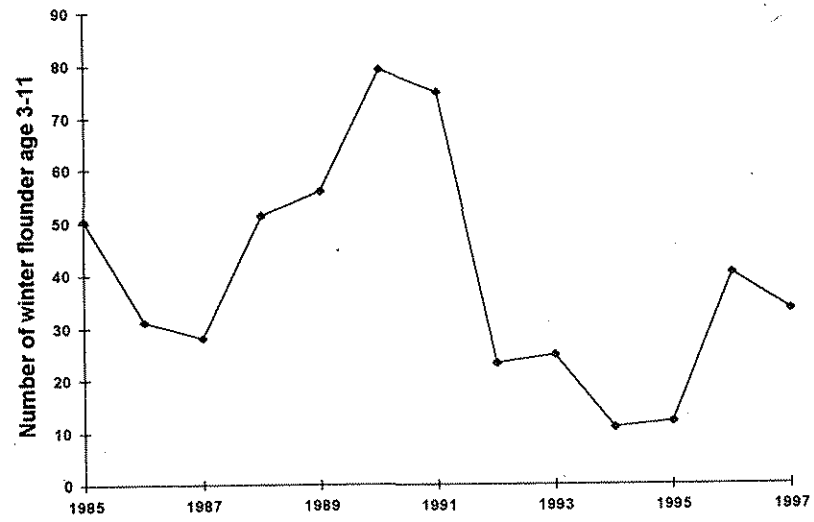

Figure 2. Geometric mean of abundances for 3-11 year old flounder per tow for Long Island Sound along the coast of Connecticut, 1985-1997. (from Penny Howell, CT DEP Marine Div., personal communication, 1998)

nest success. Moreover, the Osprey population at Great Island is large, so there might be many males trying to find enough food for their families in approximately the same area. In contrast, the Groton Reservoir Ospreys apparently feed mainly on freshwater fish, so they would not be affected by the decline in fish populations in Long Island Sound.

This study focused on comparing the diets of Ospreys at Great Island and Groton Reservoir. The main goal was to determine whether the amounts of fish delivered to nests at the two sites were similar. Also, observations on any human and animal activity that might affect the Ospreys were recorded to attempt to determine whether there are other reasons that Great Island Ospreys were unsuccessful at breeding while Groton Reservoir Ospreys were successful.

Study Areas

Great Island is a 122-hectare salt marsh located in Old Lyme, Connecticut. It is separated from the mainland by about 30 meters. It is easily accessible to animals like whitetail deer (*Odocoileus virginianus*) and raccoons (*Procyon lotor*). The area is also heavily used by people during summer weekends for recreational activities like canoeing, kayaking, fishing and crabbing. Ospreys nesting on Great Island use artificial nesting platforms which are about 4 meters high. Nest platforms are within sight of each other. Almost all nests on Great Island are equipped with metal sheets designed to keep ground predators out of the nests. These metal sheets wrap around the nesting poles immediately underneath the platforms. There were 14 nesting pairs of Osprey on Great Island during 1996 and 16 pairs in 1997. During both years there were several young birds that did not build nests. In 1997, Great Island was closed to recreational activity by the Department of Environmental Protection during the incubation and hatching periods, from May 26 to July 7.

The Groton Reservoir is a system of interconnected freshwater reservoirs covering about 216 hectares. The area is fenced and locked to keep the public out but is heavily used by Groton town employees. Trucks and lawnmowers are constantly passing by the Osprey nests. Fishing, hunting and all types of water recreation are prohibited in the Groton Reservoir. Groton Ospreys use converted utility poles that have platforms attached on the tops for nest sites. These poles are 9 meters high, so the Groton Ospreys were nesting much farther off the ground than the Great Island Ospreys. The Groton poles are not equipped with predator guards. The nests are

located farther apart than those at Great Island; in many cases, they are not within sight of other Osprey nests. Some of the poles are close to electrical high tension wires, but none are directly connected to any electrical wires. There were 12 pairs of nesting Osprey at Groton Reservoir during 1996 and 16 pairs during 1997.

Methods

Osprey nests were studied from May 28 to July 18, 1996 and May 30 to July 18, 1997. Initially 13 nests at Great Island and 12 nests at Groton Reservoir were monitored in 1996, but observations were concentrated at nests that continued to have chicks as the summer progressed. In 1997, 16 nests were initially monitored at each site. Observations were made in two-hour periods per nest for six hours per day. Nests were watched on a rotating schedule so that each nest was observed during each time slot. Observations were from 7 a.m. to 1 p.m. or 1 p.m. to 7 p.m., also on a weekly rotating schedule. Weather conditions were recorded for each observation period. Deliveries of fish to nests were also recorded. Where possible, fish species were identified. Confirmation of fish identifications were made by checking remains at the base of the nests.

A nest check was made at Great Island in the early part of the study and then again for banding purposes at both Great Island and Groton Reservoir in the last week of June, 1996 and the second week of July, 1996. Numbers of eggs and chicks were recorded, and during the second nest check inviable eggs were collected for contaminant testing by Environmental Research Institute, Storrs, Connecticut. Evidence of sibling aggression was also recorded.

In the fall and winter of 1996, new predator guards designed specifically to deter raccoons were installed on all nests at Great Island. These guards were concave metal disks placed about one meter under the base of the Osprey platform. The circumference of the discs was 71 cm, wide enough so that a raccoon would be unable to reach over the edge. They resembled squirrel guards placed under backyard bird feeders, only much larger.

From March 16 to June 19, 1997, weekly nest checks were made on Great Island with a mirror pole to make exact egg and chick counts. These checks were impossible at Groton Reservoir due to the height of the Osprey platforms. Banding was again conducted at both Groton and Great Island from the end of June and continued to mid July.

It was unusual for Ospreys to deliver more than one fish to their nest during an observation period, so the chi-square test was used to analyze the frequency of fish deliveries. The analysis was based on whether fish were or were not delivered during an observation period.

Results

There were no significant differences in the rate of fish deliveries for Ospreys at the two study sites in 1996 (χ^2= 0.25, P= 0.62). Ospreys delivered either one fish or no fish during the two-hour observation periods in 1996. In 1996, more of the observation periods were cloudy or rainy, which might result in reduced hunting success, at Groton than at Great Island, but there was no significant difference in the rate of fish delivery between the sites when only sunny days were compared (χ^2= 0.38, P= 0.54). Also, there were no significant differences in the rate of fish deliveries on cloudy and rainy days compared with sunny days (χ^2 =0.29, P=0.59), or for early summer (May 28 - June 15) in 1996 χ^2 =0.39, P=0.24).

In 1997, the rate of fish delivery was higher at Great Island than at Groton Reservoir (χ^2= 7.27, P=0.007). Although, there were more cloudy or rainy observation periods at Great Island than at Groton Reservoir, the rate of fish delivery was still significantly higher at Great Island when only sunny days were compared (χ^2=3.96, P= 0.046).

Ospreys at Great Island made use of a variety of fish species, with flounder, herring, menhaden, scup (*Stenotomus crysops*), and striped bass (*Morone saxatilis*) observed. At Groton Reservoir, it was difficult to identify fish because of the height of the Osprey nest poles. Large mouth bass (*Micropterus salmoides*) were carried to nests by Ospreys, but no fish remains were located at the base of nest poles at Groton during either year. A fishing expedition in two of the main reservoirs in 1996 yielded perch (*Perca flavescens*) and large mouth bass as the predominant catch.

Reproductive success at Great Island remained low in 1996, with only six birds fledged from 14 active nests. In contrast, Groton Reservoir fledged 16 birds from 12 active nests. This was a significant difference (χ^2= 6.62, P= 0.01). During 1996, Groton Reservoir nest productivity was the lowest in six years but still within the recent normal range for the site (Figure 1). During the nest check on June 12, 1996, one dead chick was recovered. Three dead chicks were found in nests during the June 24, 1996 nest checks at Groton Reservoir, which were made following a five-day period of rain and fog.

Nest success was much greater at Great Island in 1997 than in

1996, with 23 chicks fledging. In contrast to 1996, there was no significant difference in the number of successful nests at the two sites (χ^2= 0.58, P= 0.44) or in the number of chicks fledged at the two sites (χ^2= 1.53, P= 0.67) for 1997. There were no extended periods of rain or fog in the 1997 season, and no dead bodies of chicks were discovered at either site in the 1997 season.

Sibling aggression was noted in one nest with three chicks at Groton Reservoir in 1996. A larger chick was observed pushing two smaller nest mates to the edge of the nest and pecking them viciously when they tried to obtain food from the parent Osprey. The two smaller chicks in this nest had disappeared by the June 24, 1996 nest check. There was no evidence of sibling aggression at Great Island in 1996. There were no incidents of sibling aggression noted at Groton reservoir in 1997, but two incidents were observed in different nests at Great Island in 1997.

Eight of the nest poles on Great Island had raccoon claw marks in 1996. The claw marks were three-lined and were located along the base and up the length of the support poles of the Osprey nesting platforms. Also, a raccoon family was found living in a Barn Owl (*Tyto alba*) nesting box which was located on Great Island. This box was covered with the same three-lined scratch marks that were found on the nesting poles. There were no obviously fresh raccoon marks found on nest poles at Great Island in 1997, after the new predator guards had been installed and the Barn Owl box had been removed.

On Great Island nests rest on wire mesh that makes up the inside support of the Osprey platforms. At one nest, eggs had dropped through the nesting material and the wire mesh platform. At another site in Old Lyme located upriver from Great Island, three chicks dropped through the nesting material, two died on the ground and one died caught in the wire mesh of the platform (Hank Golet, pers. communication). At Groton Reservoir the platforms are made of solid wood, so nothing could drop through them.

Discussion

In 1996 male Ospreys at Great Island and Groton Reservoir delivered fish to nests at a similar rate, but nest success was substantially higher at Groton Reservoir. Great Island Ospreys fledged few chicks in 1996. Groton Reservoir had slightly lower nest success in 1996 than in previous years, but it was still within the normal range for the past ten years. The entire State of Connecticut had slightly lowered nest success in 1996 (Figure 3). This could

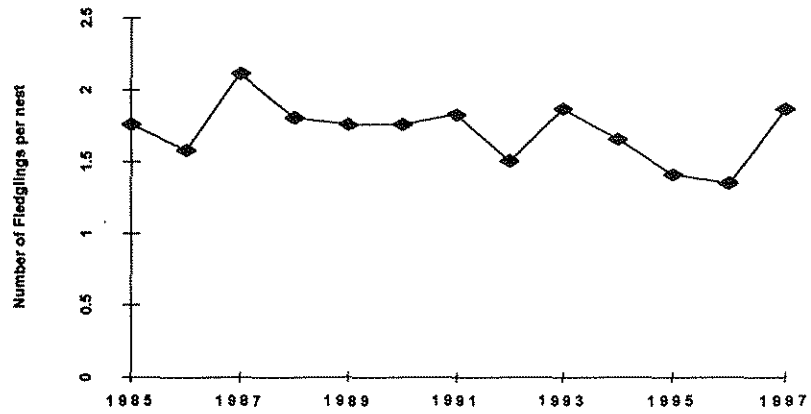

Figure 3. Average number of Ospreys fledging per active nest for Connecticut from 1985 to 1997 (from Victoria, 1997).

have been a result of the extended periods of rain and fog, which may have interfered with the male Ospreys' hunting success. Groton Reservoir personnel noted that the reservoir water levels were very high in 1996 due to the large amounts of rain during the summer. The reservoir generally has steep sides and when completely filled it has few shallow areas, so fish may not have been as available to the Ospreys in 1996 compared to other summers when the water levels became lower as the summer progressed. At Great Island fog occurred down to the water level for an extended period, but nests had already lost their chicks at this site before the inclement weather developed, so weather was probably not a major factor in fledging success at Great Island in 1996.

In 1997 there was no significant difference in fledging success between Groton Reservoir and Great Island. Significantly more fish were delivered to nests at Great Island than at Groton Reservoir, and there were no extended periods of rain or fog that might have affected hunting success in 1997 at either site. For a number of reasons fledging rates may have been similar at the two sites even though more fish deliveries were made at Great Island. First, the fish caught at Great Island may have been smaller or nutritionally inferior to those caught at Groton Utilities. This would require more fish to be delivered to Great Island nests to equal those delivered at Groton Utilities. Another possibility is that other factors besides food availability were involved in limiting Osprey fledging success and had these factors not been present, Great Island would have fledged more chicks than Groton Reservoir because there was

more food delivered to Great Island nests. These additional limiting factors might include predation, human disturbance and pesticide contamination of eggs.

Food stress forcing both adult birds off their nest at the same time was not thought to have been a major factor at either Great Island or Groton Reservoir since an adult bird was present during 90% of the observation periods in both 1996 and 1997. Human activity was the most common reason both parent Ospreys were forced off their nests at the same time at both locations. However, at Groton Reservoir food stress resulting from the weather may have affected nest success in 1996, which was the lowest it had been in six years (Figure 1).

Sibling aggression, which has been found to result from food stress (Poole 1984), was observed at Groton Reservoir in 1996, which supports the hypothesis that starvation contributed to nest failures there. Also, during nest checks at Groton Reservoir in 1996, several large dead chicks were found. The dead chicks at Groton Reservoir were discovered subsequent to the extended period of rain and fog. Nestling Ospreys often starve during prolonged storms (Poole 1989).

At Great Island in 1996 the remains of eggs were found, but no bodies of nestlings, and no incidents of sibling aggression were observed at the three nests with fledglings.

Sibling aggression was also noted at Great Island in 1997, even though more food deliveries were made there than at Groton Reservoir. The incidents occurred in two separate nests. However, only two incidents were recorded. If food were in short supply for the Great Island Osprey population, this probably would have resulted in more widespread sibling aggression affecting more nests.

Another possible factor is the nesting experience of the birds at Great Island. Because the same Ospreys usually return to nest at the same site from year to year (Poole 1989), many of the birds at Great Island had their first successful clutch in four years in 1997. Some of the younger birds may never have had a successful clutch. This would make them inexperienced parents and may have affected their nest success rate. If this is true, it would explain the sibling aggression at certain nests on the island in 1997, even though there seemed to be abundant food overall. It would also help explain why more chicks were not fledged on the island compared to Groton Reservoir, even though fish delivery rates were higher at Great Island.

At Great Island the evidence for raccoon predation in 1996 was strong. Most of the eggs or chicks disappeared before they were

visible from the ground. Eight of the nest platform poles showed evidence of raccoon marks, but it could not be determined from physical evidence that raccoons had actually made it to the platforms themselves. The nests that fledged young on Great Island in 1996 were nests that were located away from the nest box inhabited by raccoons, except for one nest, which had an extra long predator guard. No evidence of predation was noted at Groton Reservoir, perhaps due to the great height of the Osprey nesting poles.

In 1997 there were no fresh raccoon claw marks noted on the poles at Great Island, and there was a significant increase between 1996 and 1997 in the number of young that hatched and survived to fledge, indicating that removal of the nest box from the island and installing better predator guards improved nest success. A volunteer described another nest located upriver from Great Island that also had an improved predator guard installed which had fresh raccoon claw marks under the guard but none above the guard (Hank Golet, pers. comm.). One hundred of these predator guards were installed on poles along the Connecticut shore before the 1997 season, and Connecticut experienced a rise in fledging success rate for 1997, which reversed a three-year decline. Possibly raccoons had an impact on Osprey nest success throughout coastal Connecticut.

Two clutches of eggs on Great Island in 1997 did not hatch for unknown reasons. These eggs were removed for contaminant testing. At least one clutch of eggs on the island dropped through the 2 inch by 4 inch mesh screen that made up the base of the platforms on Great Island. Several of the nests on Great Island had scanty nest cups in 1997, and the lack of nesting material may cause eggs to drop through the mesh. Also, it is possible that raccoons could have pulled eggs through the mesh of scanty nests before the improved predator guards were installed.

Human disturbance could have been a factor in the failure of Osprey nests at Great Island. Weekdays during the summer were very quiet, with little or no human activity. On the weekends in 1996, however, a constant stream of people moved around Great Island. Kayakers were observed pausing for many minutes directly under Osprey nests in 1996 while the parent birds circled overhead. Crabbers ran motor boats in all the mosquito ditches they could navigate and a dog from a nearby anchored recreational power boat was also observed running on the marsh. This activity removed parent birds from their nests for extended periods on the weekends. No predation was observed during these events, but

the absence of parents could have had a detrimental effect on the incubation of eggs. Perhaps if this activity had occurred regularly, like the human activity at Groton Reservoir, the Ospreys would have become habituated to it. At Groton Reservoir noisy mowers were observed going right up to the base of Osprey poles while the parent birds looked on unconcernedly. In contrast, the osprey in a nest located in a remote part of the Groton Reservoir was repeatedly disturbed whenever anyone passed by. A study of the effects of human activity on Bald Eagles (*Haliaeetus leucocephalus*) in the northern Chesapeake Bay suggested that the more frequent the disturbance, the greater the chance that the eagle would adjust to it (Buehler et al. 1991). The fact that Ospreys have been known to nest at airports and even on a tower in a busy parking lot at Ocean Beach Park, New London, suggests that they can become habituated to regular human activity.

In 1997 Great Island was closed to human activity for the initial part of the nesting season. One of the nests which had eggs that did not hatch for unknown reasons was located at the end of a dock where human activity kept the parent birds off the nest for extended periods. This occurred early in the season in fairly cold weather, so the eggs may have been chilled enough to prevent hatching.

Osprey nest success throughout Connecticut was the lowest in 10 years in 1996 (Figure 3), possibly due to weather conditions. Twenty dead chicks were found statewide during late season nest checks, which is above the normal number (Victoria 1996). Results from postmortems at the Northeast Research Center for Wildlife Diseases at the University of Connecticut indicated that some of the birds had infections ranging from fungal pulmonary infection to yeast infection in the crop and inflammation of the caeca or appendix (Victoria 1996). The chicks may have been weakened due to lack of food following inclement weather, making them more susceptible to infection. No adult birds were known to have succumbed to infection.

In 1997 statewide nest success reached the second highest that it has been in twelve years. Winter flounder populations for 1996 and 1997 were slightly higher than during the previous four years, but not nearly as high as they were in 1990 and 1991 (Figure 2). Flounder populations were actually higher in 1996 than 1997. Most of the fish deliveries at Great Island in 1997 were of species other than flounder. This confirms that Osprey are very adaptable in their choice of prey species, which is consistent with the hypothesis that

food availability was not the limiting factor for Osprey fledging success at Great Island.

Pesticide residues in eggs are not thought to have played a large part in nest failures. Data concerning organochlorines were available for inviable eggs collected in 1994 and 1995 (Victoria 1995 and 1996). There was very little difference in the major organochlorine contaminants in eggs collected from Groton Reservoir and Great Island during these years, but sample sizes were small. The levels of Aroclor (PCB) at both sites exceeded 5 ppm, a level which has been shown to negatively affect hatching rates (Victoria 1996). In 1996 most nest failures occurred early in the season at Great Island, and later in the season when the chicks were already quite large at Groton Reservoir, indicating that dissimilar causes of mortality were at work at the two sites.

Conclusions

Similar rates of fish delivery occurred at Osprey nests at Groton Reservoir and Great Island in 1996, but there were significantly fewer chicks fledged at Great Island that year. In 1997 significantly more fish deliveries were made at Great Island than at Groton Reservoir, but there was no significant difference in the number of chicks fledged. Similar fledging success rates at the two sites in 1997 resulted from a significant increase in the number of chicks fledged at Great Island between 1996 and 1997. The removal of the raccoons from Great Island and the installation of the improved predator guards before the 1997 breeding season probably protected the eggs and chicks past the vulnerable early stages and allowed them to fledge. The fact that nest success rate was much improved for the entire state of Connecticut in 1997, but was not correspondingly greatly improved in Rhode Island (L. Suprock, pers. comm.) or Massachusetts (B.Davis, pers. comm.), may have been a result of the new predator guards installed on most nest poles in Connecticut. Predation may be one of the strongest potential limiting factors on Osprey nest success.

ACKNOWLEDGMENT

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FORAGING TACTICS OF THE BLACK-BELLIED PLOVER

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The Black-bellied Plover (*Pluvialis squatarola*) (family Charadriidae) is North America's largest breeding plover. It nests at high latitudes and winters in temperate and tropical areas throughout much of the world, and is a common bird along Connecticut's shore during its spring and fall migrations. The foraging behavior of this plover with the conspicuous dark belly in breeding plumage has been studied extensively. The feeding tactics of plovers are particularly interesting to ornithologists because plovers have relatively high rates of metabolic energy expenditure for their size (Kerston and Piersma 1987). Their high rate of daily energy expenditure places strong natural selection on plovers to gather energy economically. That is, traits allowing them to gather more calories in less time should assist them in surviving and successfully raising offspring, and such traits should thus increase in plover populations (Schoener 1971).

Unlike many sandpipers, which search for tactile cues by moving their bills through a substrate (e.g., sand), plovers search for visual cues on the surface of a substrate (Barnard 1985). Black-bellied Plovers have a simple foraging repertoire familiar to all shoreside bird watchers. They run rapidly to a spot on the substrate, stop, and scan visually from a standing position for cues associated with prey. If they sight a prey item, they run to it and peck at it, and if they capture it they pull it from the substrate and consume it. If they scan from one location for a period of time without spotting signs of a prey item, they run to a new location (Pienkowski 1983a; Paulson 1995). This sequence of behaviors appears stereotyped and unvarying, but quantitative studies have revealed that plovers adjust the components of this sequence to environmental conditions in sophisticated ways. In the present paper, I summarize some of these findings on the foraging tactics of Black-bellied Plovers and discuss the relationship these tactics have to foraging efficiency and environmental conditions.

Diet

On their breeding areas and on inland migratory stopovers, Black-bellied Plovers rely primarily on insects, although they will occasionally eat freshwater crustaceans, seeds, and berries