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Osprey Population Studies

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PERFORMANCE REPORT

STATE:	VIRGINIA	PROJECT NO.	W-77-R-3
PROJECT TITLE:	NONGAME AND ENDANGERED SPECIES INVESTIGATIONS	STUDY NO.	VII
STUDY TITLE:	OSPREY POPULATION STUDIES	JOB NO.	VII-A,B,C
PERIOD COVERED:	July 1, 1985 - June 30, 1986		

JOB VII-A OBJECTIVE: To make a complete aerial and ground survey of active osprey nests in Virginia to determine total breeding population size.

JOB VII-B OBJECTIVE: To measure hatching and fledging success of a sample of osprey nests representative of all of the major estuaries as well as the Eastern Shore of Virginia.

JOB VII-C OBJECTIVE: To coordinate all transfers of young ospreys from Virginia to other states involved in reintroduction programs for this species.

SUMMARY:

Detailed reproductive data were obtained on a sample of 389 osprey nests from the west side of Chesapeake Bay. Production in this sample of nests was 0.98 young per active nest. Production of ospreys on the west side of Chesapeake Bay has declined 23 percent since 1973. Detailed studies of prey delivery, prey quality, and sibling competition were conducted. These studies suggest that the current osprey population presently exists under a moderate level of food stress.

HATCHING AND FLEDGING SUCCESS

The productivity of ospreys in Chesapeake Bay has been studied for the past 17 years. All data for this time period have been standardized on the basis of a new set of criteria and data entered into the William and Mary Computer.

Data for the breeding season of 1986 are incomplete at this time. Data for 1985 are presented in Table 1. For comparative purposes, data for 1983 and 1984 are shown. In 1984, severe storms damaged or destroyed many nests in early May. Much of the destruction occurred prior to determination of activity of the nests. For this reason, nest sample size is considerably smaller than in both 1983 and 1985.

For purposes of comparison, the state has been divided into a number of study areas as follows.

York River System - mouth of river to West Point

Mobjack Bay - York River to Piankatank River, including the latter

Rappahannock River - mouth of river to Leedstown

Fleets Bay - Fleets Bay to Great Wicomico River, including the latter

Potomac River - Little Wicomico River west to Nomini Bay

Table 1. Productivity of Ospreys from a sample of nests on the western side of Chesapeake Bay 1983-1985.

Study Area	Number of Active Nests			Number of Young Fledged			Number of Young Fledged Per Active Nest		
	1983	1984	1985	1983	1984	1985	1983	1984	1985
York River	50	37	57	58	38	52	1.16	1.02	1.48
Mobjack Bay	92	54	102	122	81	96	1.33	1.50	0.94
Rappahannock River	96	73	98	125	85	106	1.09	1.16	1.08
Potomac River	77	53	84	105	50	87	1.36	0.94	1.04
Fleets Bay	45	16	48	49	17	39	1.09	1.06	0.81
	360	233	389	459	271	380	1.28	1.16	0.98

Average production of fledglings per active nest as indicated is likely an overestimate of tree fledging rates. Young have been counted as fledglings for this tabulation if they had reached 3 1/2 weeks of age at the last time of nest visitation.

There has been evidence of brood reduction of young between hatching and fledging for the past four years on the western side of Chesapeake Bay. This has manifested itself in brood reduction, atypical foraging behavior, and abnormal development of chicks.

Data from both 1983 and 1984 suggested that the Virginia osprey population exists at a very high density for existing environmental conditions. Brood reduction may, therefore, reflect food shortage or food availability.

FOOD HABITS, GROWTH RATES, SIBLING AGGRESSION

Studies were initiated in 1985-1986 to determine levels of food delivery by adults to nestlings, growth rates of young, and basic causes of sibling aggression.

Stinson (1976, 1977) noted the absence of sibling aggression during his 1975 study of the reproductive ecology of ospreys (Pandion haliaetus) of the Chesapeake Bay. However, several more recent studies have indicated the existence of sibling aggression and brood reduction in ospreys (Poole 1979, 1982b, Judge 1980, Roberts 1982, Jamieson et al. 1983, Spitzer 1985, Hagan 1984, Byrd 1983). It has been hypothesized that this behavior is food-related (Poole 1979, 1982b, Byrd 1983). In response to these recent reports, a study of the feeding ecology of the ospreys inhabiting the western shore of the Chesapeake Bay was undertaken during the summer of 1985. Nest occupants were intensively observed during the nestling and post-fledging periods in order to ascertain the quality and quantity of fish delivered and to determine what effect these factors may have on the growth and behavior of the young. A decrease of the amount and/or the quality of the food delivered to the young might reflect an increase in sibling aggression, brood reduction, and a retardation of the growth and development of the young.

PROCEDURES

A total of seven broods of ospreys in nests located in Mathews and Lancaster counties, Virginia was studied. All nests were approximately 25-125 meters from shore; therefore, the nests and their occupants were easily observable from land and readily accessible by boat. In most study locations the ospreys were subjected to various amounts of human activity (including our own), but they appeared to easily habituate to such disturbance though we lack supporting data.

Between May 21 and July 25, observations were made on seven nests chosen such that two could be observed simultaneously. More than 600 observation hours were accumulated, or if nests are considered singly, over 1000 hours were amassed. Observation periods of approximately eight hours were randomly arranged such that a full day of observations was gathered at each nest over the four-day observation week. Morning observation periods began at daybreak (approximately 0530 hours) and lasted until 1300 hours and ended at nightfall (approximately 2030 hours). An assortment of spotting scopes were used for observation, including a 20 x 60 Nikon, a 40 x 60 Nikon and a 40 x 80 Questar. During the observation periods, all behaviors were noted, as well as the size, number, and species of fish delivered to the nest. To improve on the estimation of fish size, a 48 centimeter wooden rod graduated at 12 centimeter intervals was affixed to the nest. The tarsus length of the adult ospreys was used for the same purpose. Fish lengths were later converted to grams using length-weight relationships specific for each fish species. We also recorded the number of bites of fish eaten by the nest occupants during three one-minute periods that were randomly spaced. Information on weather,

hunting activities, and the amount of time the male spends perched near the nest was also recorded.

During the ten weeks, nests were visited twice a week to weigh and measure the young. Nest visits were limited to approximately ten minutes. Length measurements of the longitudinal axis of the body, the tail, the culmen, and the tarsus were noted and recorded. Weights were collected using 1000 and 2000 gram Pesola spring scales. Crops were palpated to determine the extent of fullness. The ages of the young were known within one day, and, in some cases, the exact date of hatching was noted. In nearly all the cases, sex was determined by using tail length (MacNamara 1977), behavior, and feather color. All chicks were banded with U.S. Fish and Wildlife Service aluminum bands as well as colored leg bands to ensure positive identification. Band weights were subtracted from all subsequent weights. Also, red nail polish was applied to the middle toe of the larger sibling of the brood to allow for identification early in the study. Typewriter correction fluid applied to the crown was used for the same purpose. Later in the study, picric acid (a harmless dye) applied to the neck and upper breast feathers ensured identification as well.

Prey remains were collected during the nest visits. These remains were individually bagged, labeled, and later identified using articulated skeletons, preserved specimens, and the assistance of the curator of the Virginia Institute of Marine Science. Diet composition was then based upon the frequency of occurrence of the prey item.

In July of 1985, samples were collected of each of the fish included in the ospreys' diet. Samples were dried for ten days at temperatures between 55 and 60^{C}, ground in a Wiley Mill and pelletized. Using a Phillipson oxygen microbomb calorimeter and following the standard procedure for its use, calories per milligram dry weight per sample were ultimately calculated.

Growth curves generated from the logistic equation best represent the growth of ospreys (Stinson 1977, Ricklefs 1967, 1968, 1976): $W = A/(1+e\ \exp[-K(t-t_o)])$, where W = weight at time (age) t, A = asymptote (or maximum weight) of the growth curve, K = the growth rate constant, and t_o = age at the inflection point of the growth curve (1/2 of the asymptotic weight). The inverse measure of growth, t_{10-90} (days) = 1.098/(dw/dt), representing the time it takes a young to grow from 10 to 90 percent of its asymptotic weight, was also used (Ricklefs 1976). All regressions, correlations, and other statistical analyses were performed on the College of William and Mary's 9955 Prime computer using the SPSSX (1983) and Minitab (Ryan 1985) software packages.

GROWTH RATES, FLEDGLING WEIGHTS, AND FLEDGING AGE OF THE YOUNG

A total of 16 chicks in seven broods was studied. Two chicks died within the first ten days of the study leaving five broods of two, one brood of one, and one brood of three young. Four of the five two-young broods were comprised of a male and a female, but in brood three, it was not absolutely certain that Y1 was in fact a female,

though it was treated as such. The one-young brood contained a female, and two females and a male comprised the three-young brood.

Rank, as determined by the young's weight relative to its siblings, was generally maintained throughout the nestling period. This held true for all the chicks of all the broods, except number seven. In this brood, no switching of rank was detected until the latter part of nestling development when the young weighed more than 1100 grams. The two females of this brood attained greater weight than the male.

Using the asymptotic weight of each young, the average growth rate constant (K) for the fourteen young was .138 (S.D.=.0178, N=14):. The male K was .141 (S.D.=.0240, N=6) and that of the females was .136 (S.D.=.0131, N=8). These growth rate constants were not significantly different (oneway anova, P=.625). The time required for the males and the females to grow from 10 to 90 percent of their asymptotic weight was 32.068 days (S.D.=6.482, N=6) and 32.510 days (S.D.=3.041, N=8) respectively.

In order to compare growth rates of ospreys with those calculated by Stinson (1977), new asymptotic values were estimated. Since asymptotic weight near fledging time is inversely proportional to brood size (Stinson 1977), the largest average weight of the young of that particular brood size was used to represent the asymptote (Stinson 1977). Therefore, using 1700 grams to represent the asymptote or maximum weight of the one-young brood, 1605 grams to represent that of the two-young brood and 1717 grams to represent that of the three-young brood, the growth rate constant (K) of the fourteen young was .130 (S.D.=.043, N=14). The time required for the young to grow from 10 to 90 per cent of the asymptotic weight was 37.229 days (S.D.+11.456, N=14).

Growth rates as figured above (Ricklefs 1967, 1968, 1976; Stinson 1977) reflect the rate of growth as a percentage of the asymptote. In ospreys, since the male and female asymptotic weights are significantly different, and both sexes take about the same time to fledge, ostensibly their actual rates of growth must be different. Graphic analysis of the male and female growth curves suggest that the rates are in fact different. Between broods, a number of comparisons are of note. The young of broods five, six and seven fledged significantly later than young in some of the other broods. If only the two-young broods are compared, the young of brood five fledged significantly later than the young of the other broods. Between all seven broods, results of an analysis of covariance reveal that the growth rates (K) of the young of these broods were significantly different (P=.027); however, between the two young broods growth rates were not significantly different (analysis of covariance, P=.469). This suggests that the young of broods of one and three young (broods six and seven respectively) grew at different rates than the young of the two-young broods. In terms of asymptotic weights of the young, there was no significant difference among the two-young broods (oneway anova, P=.899).

Examination within the broods is revealing. Low-ranking young (Y2 of broods five and seven) had later fledging dates (mean = 57.5 days) than the other young. Furthermore, the growth rate of the low-ranking young - a male - of brood five was substantially less than the growth rates of the other males of the two-young broods. Even though this male was eleven days older than the other males at the last weighing before fledging, it had the lowest asymptotic weight and the shortest body length of all osprey young. The low ranking female of brood seven had the shortest tail and wing chord of all female young and it, along with the female of brood 6, had the shortest body length of all other female young.

BROOD REDUCTION

Brood reduction was limited to two of the seven broods. One of the chicks (Y3) of brood five died at approximately six days of age and was found a day later, May 31, 1985. The second-hatched young (Y2) of brood six was ten days old at death and was found less than a day afterward (June 4, 1985). Both bodies were found in the nest, nearly intact, and with little evidence of external injury. Autopsies performed by a local veterinarian implicated malnutrition as the probable cause of death.

DIET COMPOSITION, QUANTITY AND QUALITY OF PREY DELIVERED TO THE NEST AND RATES OF DELIVERY

Based on this study, Atlantic menhaden (Brevoortia tyrannus) comprised 68.2 percent of the diet. American eel (Anguilla rostrata) made up 4.2 percent of the diet, while white perch (Morone americana), oyster toadfish (Opsanus tau), Atlantic croaker (Micropogonias undulatus), and summer flounder (Paralichthys dentatus) each comprised approximately three percent of the diet. During the ten weeks of observation, we recorded fifteen different species of fish delivered to the nest. Between broods, diet composition was varied; however, nearly all the broods received at least 50 percent menhaden. In fact, the diet of the nest five occupants was 83 percent menhaden.

Analysis of prey remains revealed that menhaden constituted 64.9 percent, while oyster toadfish, needlefish (Strongylura marina), white perch, Atlantic croaker and sunfish (Lepomis macrochirus) together composed 23.1 percent. Summer flounder, bluefish (Pomatomus saltatrix) and American eel were also represented in the remain.

In terms of the amount and quality of fish delivered to the nest, a few between-brood comparisons are of note. The occupants of nest seven were the recipients of the greatest amount of food. Of the two-young broods, the females and young of broods four and five received the greatest amount of fish. Conversely, the occupants of brood one received the least amount of fish. Similarly, the greatest number of calories were delivered to those ospreys of nests five, six and seven The nest one occupants received the least number of calories during the nestling period.

Results indicate the ospreys of all broods studied in 1985 appeared to be getting an adequate amount of kilocalories per day to meet their average daily energy requirements.

The average rate of delivery of fish to the nest was .351 fish per hour (S.D.=.143, N=52). Prey delivery rates were highest to nests five, six and seven.

CORRELATIONS BETWEEN SIBLING AGGRESSION AND PREY QUALITY AND QUANTITY.

In terms of the seven broods, sibling aggression and the quality of prey delivered to the nest are positively correlated ($r=.754$, $df=5$, $P=.05$;. However, there is no correlation between sibling aggression and the quantity (total centimeters) of prey delivered to the nest ($r=.652$, $df=5$, $P>.05$).

Clearly, at least in comparison to 1975, sibling aggression has become a relatively common behavior of osprey nestlings of the Chesapeake Bay. These studies have documented the occurrence of thirty-two incidents of sibling aggression and two occurrences of brood reduction. In his study of the development of behavior in nestling ospreys, Roberts (1982) documented the aggression between siblings of two nests. In one case, the adults abandoned an 18 day old young (Roberts, personal communication). Spitzer (1985) has for the past three years monitored osprey productivity in several areas of the Bay's eastern shore, and, in at least one area, has noted substantial brood reduction of approximately 60 percent. Previous to the studies of Roberts (1982), Spitzer (1985) and Byrd (1983), there have been no documented reports of sibling aggression or brood reduction among Chesapeake Bay osprey. In fact, Stinson (1976, 1977) clearly indicated that no signs of sibling incompatibility existed during his 1975 study of the reproductive behavior of osprey inhabiting the western shore of the Bay.

In 1985, not only were 32 sibling attacks observed but threatening postures and the taking of fish were common behaviors. Crop examinations during our nest visits revealed empty crops more than half the time. In 1975, the young were fed sequentially (Stinson 1976). In 1985, in many instances, the young dominated each other - through aggression and/or posturing - and, as a consequence, feeding of the young was often nonsequential. Ranking young were fed repeatedly and low-ranking young were often ignored. Other contrasts between the 1975 and 1985 results exist.

In Florida Bay, Poole (1979) has documented the consistent aggression of one nestling against its nestmate. Measurements gathered in the days during and after witnessing the aggression revealed a significant difference in size and weight between the aggressor and the intimidated sibling - differences very similar to those observed in Chesapeake Bay osprey young in 1985. Poole (1982) noted that sibling aggression could be turned on and off with the degree of hunger of the dominant young, which argues that food

availability does in fact influence this behavior, the aggressive young he studied nearly always stopped fighting after being fed - a finding identical to ours. Hatching asynchrony, as well, might have influenced the incidence of sibling aggression and the subsequent brood reduction observed in these florida Bay ospreys (Poole 1982). Third chicks in food-stressed colonies grew significantly slower than their siblings (Poole 1982b). In short, Poole (1979), 1982) offered evidence to suggest that sibling aggression is due to food scarcity and to a lesser degree, hatching asynchrony. The aggression, in turn, is important in causing brood reduction; subordinate siblings were forced out of the nest, or more commonly, denied access to food.

In 1985, the growth and behavior of young Chesapeake Bay ospreys is markedly different from that exhibited ten years ago, and it is likely that these ospreys are suffering from a food shortage. The intolerance of altruistic feeding, the occurrence of sibling aggression throughout the breeding season in all multi-young broods, the ability of this aggression to be turned on and off with the hunger of the dominant chick, the incidence of brood reduction in our study nests as well as in Spitzer's (along the eastern shore of the Bay), the significant 35 percent decrease in food delivery rates and in the amount of time the male spends perched near the nest, all seem to indicate that fish are not as plentiful as they once were. Apparently the osprey population today has reached the carrying capacity of the Bay. This carrying capacity is probably substantially less than it was fifty years ago when, it has been estimated, five times as many ospreys hunted the Bay's waters (Stinson and Byrd 1976). Further studies of the osprey may not only reveal more about the health of the Chesapeake Bay osprey population but more about the overall health of the Bay. A complete discussion of brood reduction and sibling aggression may be found in McLean, P.K. 1986. The Feeding Ecology of Chesapeake Bay Ospreys and the Growth and Behavior of Their Young, M.A Thesis. College of William and Mary, Williamsburg, Va. 83 pp.

TRANSFER OF YOUNG

Project personnel participated in the transfer of osprey to other states for hacking purposes. Seven ospreys were flown to Tennessee and six to West Virginia.

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TARGET DATE FOR COMPLETION: Continuing

STATUS OF PROGRESS: On Schedule

SIGNIFICANT DEVIATIONS IN PROGRESS: None

RECOMMENDATIONS: Continue Study

COST THIS SEGMENT: Federal $7,206 State $2,402 Total $9,608

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