

## FORAGING BEHAVIOR OF OSPREYS IN NORTHWESTERN CALIFORNIA\*

by

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**ABSTRACT.** Fishing success of Ospreys (*Pandion haliaetus*) at South Humboldt Bay, California, was determined during spring and summer, 1972. Five hundred twenty-three of the 639 observed fishing efforts (82 percent) were successful. Fifty-six percent of the fishing efforts required only one dive. The mean length of time spent foraging for each successful fishing effort was 11.8 minutes. The highest fishing success occurred during the fledging period, and lowest during incubation, 86 and 79 percent, respectively. Successful fishing efforts were highest on the outgoing tide early in the breeding season. Fishing success on outgoing tides decreased as the season progressed, and increased (59 percent) on the incoming tide. Successful fishing efforts were the same (43 percent) on both incoming and outgoing tides during the brooding period.

Skill and swiftness in capturing prey animals are survival requisites for avian predators occupying terminal positions of food chains. The present study was made to determine the success of Ospreys in securing fish during the breeding season.

The feeding habits of Ospreys were virtually unknown until fairly recently. Lambert (1943) observed Osprey strikes and found their efficiency to be 89 percent. His observations did not take into account the number of dives required per individual Osprey to capture prey. However, as a result of more recent studies, we have a better understanding of the fishing success of Ospreys in different areas of the western United States.

Over a three-year period, MacCarter (1972) found Ospreys at Flathead Lake, Montana, to be 83 percent successful in 158 fishing efforts. At Eagle Lake, Lassen County, California, Garber (1972) found that Ospreys were 80 percent successful in 25 fishing efforts. Ospreys fishing the surf at Usal Creek, northern Mendocino County, California, were 86 percent successful in 116 fishing efforts (French 1972).

Sixty-three percent of fishing efforts at Flathead Lake resulted in capture of prey on the first dive. At Eagle Lake and Usal Creek, successful fishing efforts on the first dive were 52 and 67 percent, respectively.

The foraging behavior of Ospreys at South Humboldt Bay, California was de-

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terminated during spring and summer, 1972. This is a preliminary report of an ongoing study and is based on more than 600 observed fishing efforts.

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### *Study Area*

Humboldt Bay is located on the coastal region of Humboldt County, California, approximately 435 kilometers (270 miles) north of San Francisco. It is 22.5 kilometers (14 miles) long and from 0.8 to 6.4 kilometers (0.5 to 4.0 miles) wide, and lies in a southwesterly to northeasterly direction. Being connected to the ocean, it is subject to tidal changes.

The surface area of Humboldt Bay fluctuates from 62.7 sq. kilometers (24.2 sq. miles) at mean high tide to 33.2 sq. kilometers (12.8 sq. miles) at mean low tide. The Bay is composed of three different parts with respect to fluctuating surface areas. South Bay has 18.4 sq. kilometers (7.1 sq. miles) of surface area at mean high tide, and 7.8 sq. kilometers (3.0 sq. miles) at mean low tide; Entrance Bay has 7.5 sq. kilometers (2.9 sq. miles) at both tides; and North Bay has 36.8 sq. kilometers (14.2 sq. miles) at mean high tide, and 17.9 sq. kilometers (6.9 sq. miles) at mean low tide (Skeesick 1963).

Preliminary observations at Humboldt Bay revealed that Ospreys were primarily fishing South Bay. Therefore, observations were restricted to the southern portion of Humboldt Bay.

### *Methods*

A 20x spotting scope, binoculars and stopwatch were used to obtain information on the fishing activities of Ospreys. Fishing success was measured by recording the total number of fishing efforts—total dives made by one Osprey while under observation. Measurements of predatory efficiency were obtained by recording the total number of dives per fishing effort resulting in capture of prey.

Each fishing effort was timed from the moment an Osprey first was sighted until it either captured fish, or was lost to view.

Observations were made from dawn to dusk for two days each week from a vantage point where a major portion of South Bay could be viewed. Tide conditions were noted during each day of observations.

### *Fishing Success and Predatory Efficiency*

A total of 639 fishing efforts was observed at South Humboldt Bay (Table 1). Fifty-six percent of fishing efforts resulted in capture of prey on the first dive. However, on one occasion an Osprey required 13 dives to capture a fish.

Over-all, Ospreys were 82 percent successful in their fishing efforts. Of the 116 unsuccessful fishing efforts (18 percent), only 21 (3 percent) involved Ospreys that flew inland without securing fish. The remaining 95 (15 percent) unsuccessful fishing efforts involved birds lost to view.

**Table 1.** Relative fishing success of Ospreys fishing South Humboldt Bay, Usal Creek, Eagle Lake, California; and Flathead Lake, Montana. Modified from Koplín *et al.* (in press).

No. of dives per successful fishing effort	S. Humboldt Bay (% of 639 fishing efforts)	Usal Creek (% of 116 fishing efforts)	Eagle Lake (% of 25 fishing efforts)	Flathead Lake (% of 158 fishing efforts)
1	56	67	52	63
2	18	15	16	12
3	6	3	8	7
4	1	1	4	1
5	0.6	—	—	—
6	0.2	—	—	—
13	0.2	—	—	—
Total % Successful fishing efforts	82	86	80	83

The 639 fishing efforts were stratified into five phases of the breeding cycle: pre-incubation, incubation, brooding, fledging and post-fledging (Figure 1). This was done to determine whether fishing success of Ospreys changed through the breeding season. At Nova Scotia, Lambert (1943) found a decrease in the capture of fish from May through August. Fishing success varied through the season at South Bay. The highest success was during the fledging period and the lowest during incubation, 86 and 79 percent, respectively.

#### *Time Spent Foraging*

Mean length of time spent foraging from first sighting until the capture of prey for the 523 successful fishing efforts was 11.8 minutes. However, in terms of different phases of the breeding season, it appears as if average foraging time was inversely related to food demand (Figure 2). That is, as the demand for fish by the growing young increased, average foraging time decreased. Consequently, when demand was highest during brooding, average foraging time was lowest. When young began fledging and a continuous supply of fish was no longer essential, average foraging time again increased through the late fledging and post-fledging periods.

#### *Effects of Tidal Change*

Fishing success was highest (59 percent) on the outgoing tide early in the breeding season. Success in relation to season declined on the outgoing tide and increased on the incoming tide (Figure 3). Successful fishing efforts were the

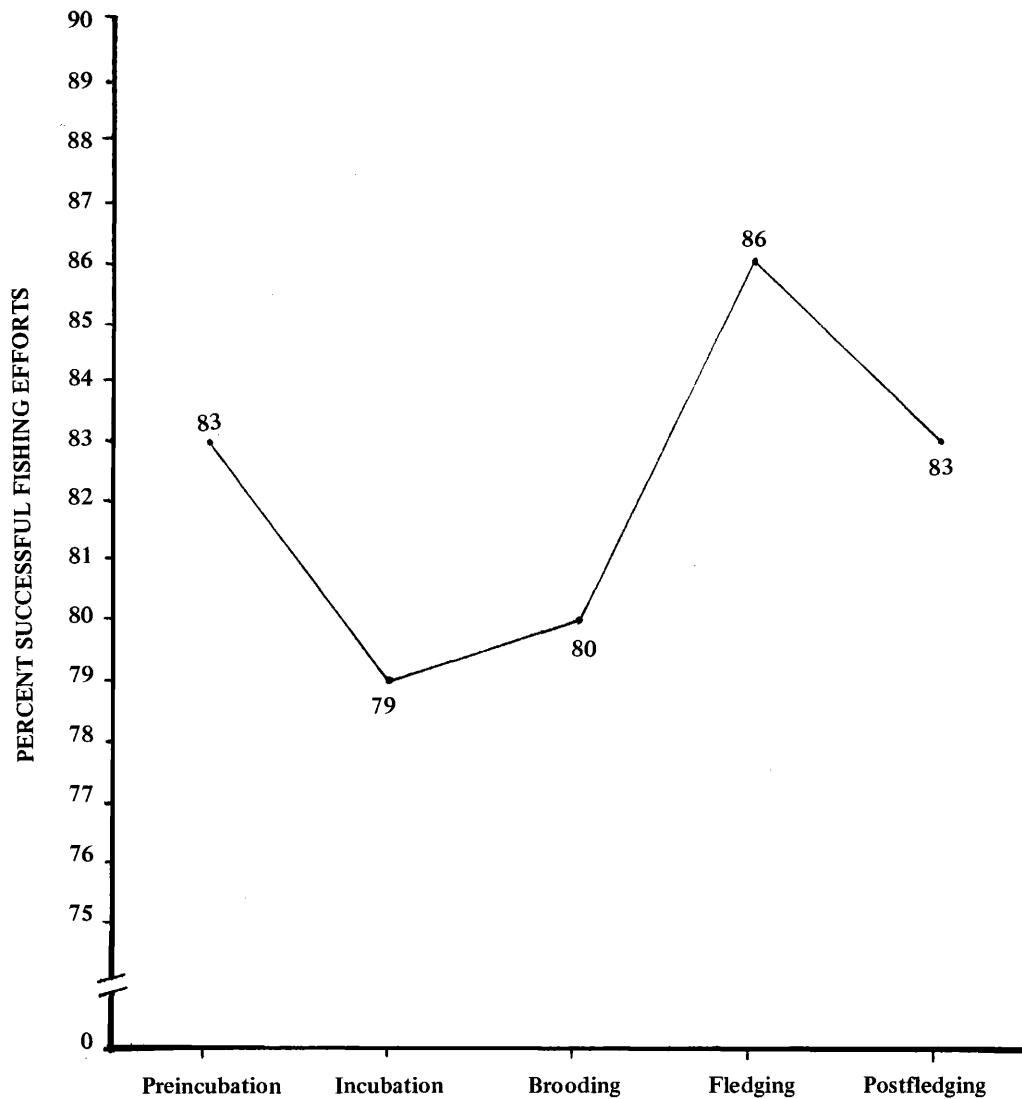


Figure 1. Successful fishing efforts for each period of the breeding season.

same (43 percent) on both incoming and outgoing tides during the brooding period. We are at a loss to explain these findings, but suspect differential movements of fish in and out of the Bay on a seasonal basis.

*Prey Species*

Sixty-three percent of the fish taken by Ospreys were surfperch (*Embiotoci-*

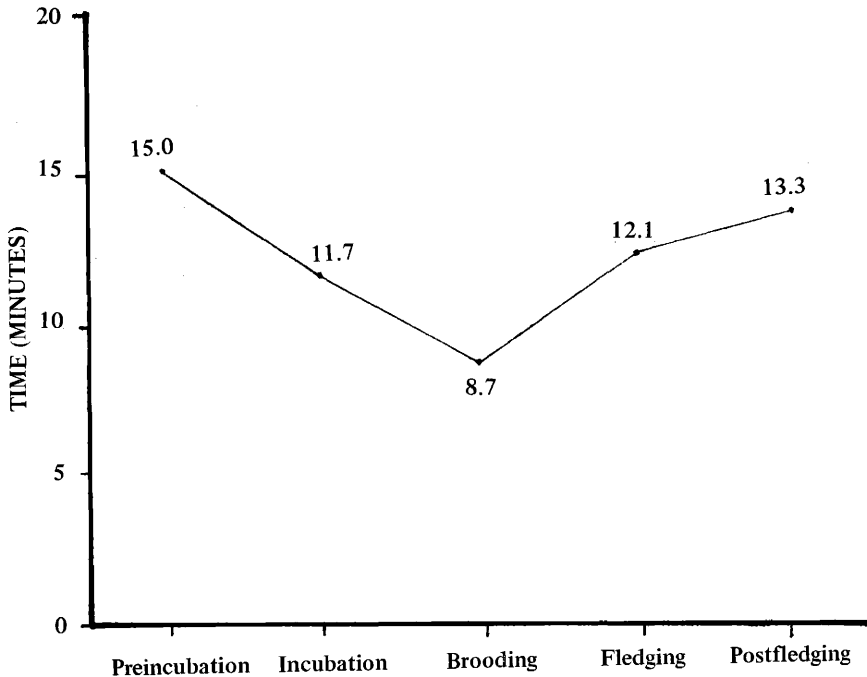


Figure 2. Mean length of time spent foraging for successful fishing efforts for each period of the breeding season.

dae). Of the fish caught, three percent were anchovies (Engraulidae), two percent silversides (Atherinidae), two percent herrings (Clupidae), one percent sculpins (Cottidae), and 29 percent were unidentifiable. In addition, the remains of nine surfperch, two silversides and one sculpin were found beneath a perch used by Ospreys for feeding at South Bay.

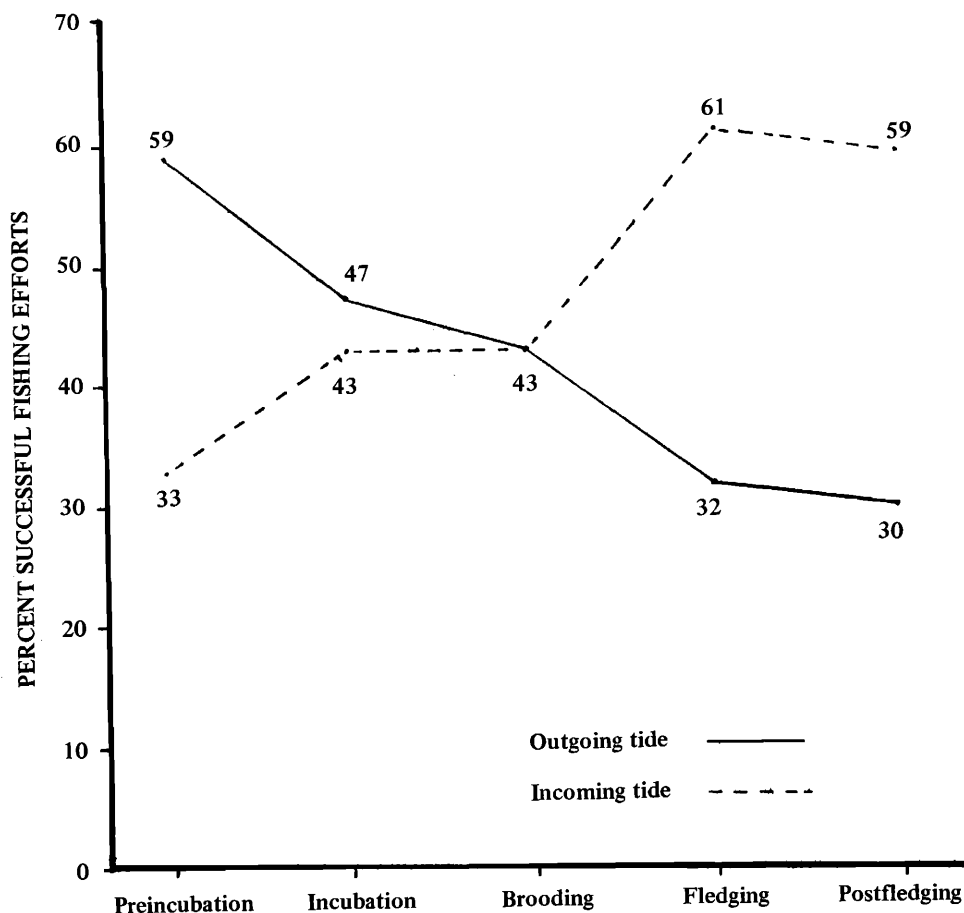
The lengths of 211 fish caught by Ospreys were estimated to be 18 to 23 cm (7-9 inches). Seven fish were less than 10 cm (4 inches) long, and only one was greater than 38 cm (15 inches) long.

#### *Discussion*

Mech (1966) stated that predators miss far more prey than they catch. However, as indicated in this and other studies, Ospreys are an exception. They are successful predators.

Ospreys are capable of capturing two fish, one in each foot, on a single dive as observed by French (1972) at Usal Creek. One of us (M. L. U.) also witnessed a double catch at Usal Creek.

On several occasions, when Ospreys dropped the fish they were carrying, they quickly secured a second. Ospreys were seen to consume a small fish com-



**Figure 3.** Successful fishing efforts for each period of the breeding season in relation to the tide cycle.

pletely and begin fishing again, capturing a second, often larger fish before heading inland to the nest site.

As indicated by the average time spent foraging and the number of successful fishing efforts requiring one dive, Ospreys have little difficulty in locating and capturing prey. When only the 523 successful fishing efforts are considered 69 percent were successful on the first dive; 523 of the 834 total dives (62 percent) resulted in capture of fish, indicating that Ospreys catch fish more often than they miss.

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