State of California
The Resources Agency
Department of Fish and Game

OSPREY STUDY
LASSEN AND PLUMAS COUNTIES, CALIFORNIA
1970 - 1971[1]

by

David P. Garber
Wildlife Management Branch

ABSTRACT

During the breeding seasons of 1970 and 1971, 98 pairs of nesting ospreys were studied in Lassen and Plumas Counties, California. Earliest arrival date of breeders was March 24. Egg laying extended from April 29 to June 1. Clutches inspected at 89 occupied nests averaged 2.5 eggs per nest. Incubation, shared by both sexes, lasted 38 days at 4 nests in 1971. Hatching success was 57 percent and nestling survival was 75 percent in 15 nests studied intensively. Age at fledging ranged from 51 to 59 days. Growth rates were similar for young in broods of 1, 2, 3 and 4. A total of 99 young were fledged during the two years from 98 nests resulting in a productivity of 1.01 fledglings per occupied nest. This compared favorably with productivity data from other areas of the U. S. Major causes of reproductive failure were destruction of nests by wind, failure of eggs to hatch and the breaking of eggs in nests. Thirty-eight young birds were banded, 20 banded in 1970 were also color marked.

---

[1] Wildlife Management Branch Administrative Report No. 72-1 (January 1972) Supported by Federal Aid in Wildlife Restoration Project W-54-R, Special Wildlife Investigations.

RECOMMENDATIONS

To preserve and enhance osprey reproduction in Lassen and Plumas Counties, California, it is recommended that the California Department of Fish and Game:

1. Conduct an annual eyrie survey to evaluate osprey population trends.

2. Make periodic investigations of pesticide residues and the effects they may have on osprey reproduction.

3. Work with U. S. Forest Service, Lassen National Forest, to manage osprey at the Eagle Lake Osprey Management Area.

TABLE OF CONTENTS

INTRODUCTION

Status of the osprey (Pandion haliaetus) in the United States is undetermined. In Connecticut, where remnants of large osprey nesting colonies survive, only a few young birds are produced annually (Peterson 1968). In Michigan and Wisconsin osprey nesting populations have experienced similar catastrophic declines in both size and productivity (Postupalsky 1968). Elsewhere in the U. S. -- Massachusetts (Fernandez, personal communication), Montana (Koplin, MacCarter and MacCarter, 1970), and portions of Maryland (Krantz, unpublished; and Reese 1968) -- nesting osprey populations have remained nearly stable in size, but nesting productivities have fluctuated periodically. In contrast, however, nesting populations and reproductive rates of ospreys have remained stable on Chesapeake Bay, Maryland (Reese 1970) and in the Everglades, Florida (Ogden, unpublished).

Limited food resources (Schmid 1966), predation (Ames and Mersereau 1964), and human disturbance and inclement weather (Reese 1970) influence osprey nesting productivity. Ames (1966) implicated organochloride compounds with reduced osprey recruitment and consequent population reduction in Connecticut.

Essential in determining the status of the osprey in the U. S. is an appraisal of its reproductive success in various parts of its range.

Objectives

This paper reports findings of a two-year study of nesting ecology of ospreys in Lassen and Plumas Counties, California. Study objectives were to evaluate the reproductive performance of a representative population of ospreys in northeastern California and record life history phenomena.

Past Work

Grinnell (1915) reported concentrations of ospreys nesting in California at Humboldt Bay, Humboldt County; on the Santa Barbara Channel Islands, Santa Barbara County; at Eagle Lake, Lassen County and on the Kaweah River near Woodlake, Tulare County. Ray (1915), while conducting ornithological studies at Eagle Lake, surmised the osprey population there to be surprisingly large but made no numerical estimate.

Two ospreys banded at Eagle Lake in 1957 and 1959 were recovered in Mexico. The California Department of Fish and Game collected two osprey eggs at Eagle Lake in 1965 and 1966 and analyzed the contents for chlorinated hydrocarbon residues.

During the 1969 osprey breeding season, personnel of the U. S. Forest Service recorded the location of 18 nests at Eagle Lake and 21 nests in other parts of Lassen and Plumas Counties (Kahl, unpublished).

STUDY AREA

Description

Physiography

Study area includes Eagle Lake, Caribou Lake, Mountain Meadows, and McCoy Flat Reservoirs in Lassen County, and Lake Almanor, Clear Creek, North Fork of the Feather River, and Butte Valley in Plumas County, California. Lassen and Plumas Counties encompass approximately 7,118 square miles of land in northeastern California. These counties are contiguous with the State of Nevada on the east and with Modoc County, California, to the north.

Eagle Lake is located in an intermountain valley at an elevation of 5,100 feet, approximately 20 miles north of Susanville (Figure 1). Shoreline exceeds 75 miles in length and impounds about 26,000 surface acres of water. Lake Almanor, a reservoir near Chester, was created in 1914 when Big Meadows Dam was constructed on the North Fork of the Feather River (Figure 2). This lake, elevation 4,490 feet, has a shoreline of approximately 70 miles and impounds about 25,000 surface acres of water. Butte Valley, Mountain Meadows (Figure 2), and McCoy Flat Reservoirs were also created by damming tributaries of the Feather River drainage in the early Twentieth Century. Mountain Meadows, the largest of these reservoirs, impounds approximately 4,000 surface acres of water. Caribou Lake, approximately 20 surface acres of water, is located at an elevation of about 6,500 feet in the Caribou Wilderness Area in southwestern Lassen County.

Topography is characterized by Great Basin plains on the east and Sierra-Cascade Mountains on the west. Lakes occur frequently in intermountain trenches, particularly along the southeastward course of the Feather River in Plumas County.

Plant communities near Eagle Lake, indicative of the eastern portion of the study area, are dominated by western juniper (Juniperus occidentalis), Jeffrey pine (Pinus jeffreyi), and big sagebrush (Artemisia tridentata). Forests are open with trees 10 to 60 feet tall; slopes and flats are usually brush-covered. Forests throughout the remainder of the study area are composed of ponderosa pine (P. ponderosa), sugar pine (P. lambertiana), incense cedar (Libocedrus decurrens), and white fir (Abies concolor), with understories comprised of gooseberry (Ribes spp.), manzanita (Arctostaphylos spp.), and ceanothus (Ceanothus spp.). Trees, 75 to 200 feet in height, form continuous forests.

Climate

Average annual precipitation ranges from 10 to 80 inches falling partly as snow. Mean summer maximum temperatures range from 80 to 93 degrees Fahrenheit; whereas, mean winter minimum temperatures range from 10 to 34 degrees Fahrenheit. Length of growing seasons range from two to seven months with 70 to 210 frost-free days per year.

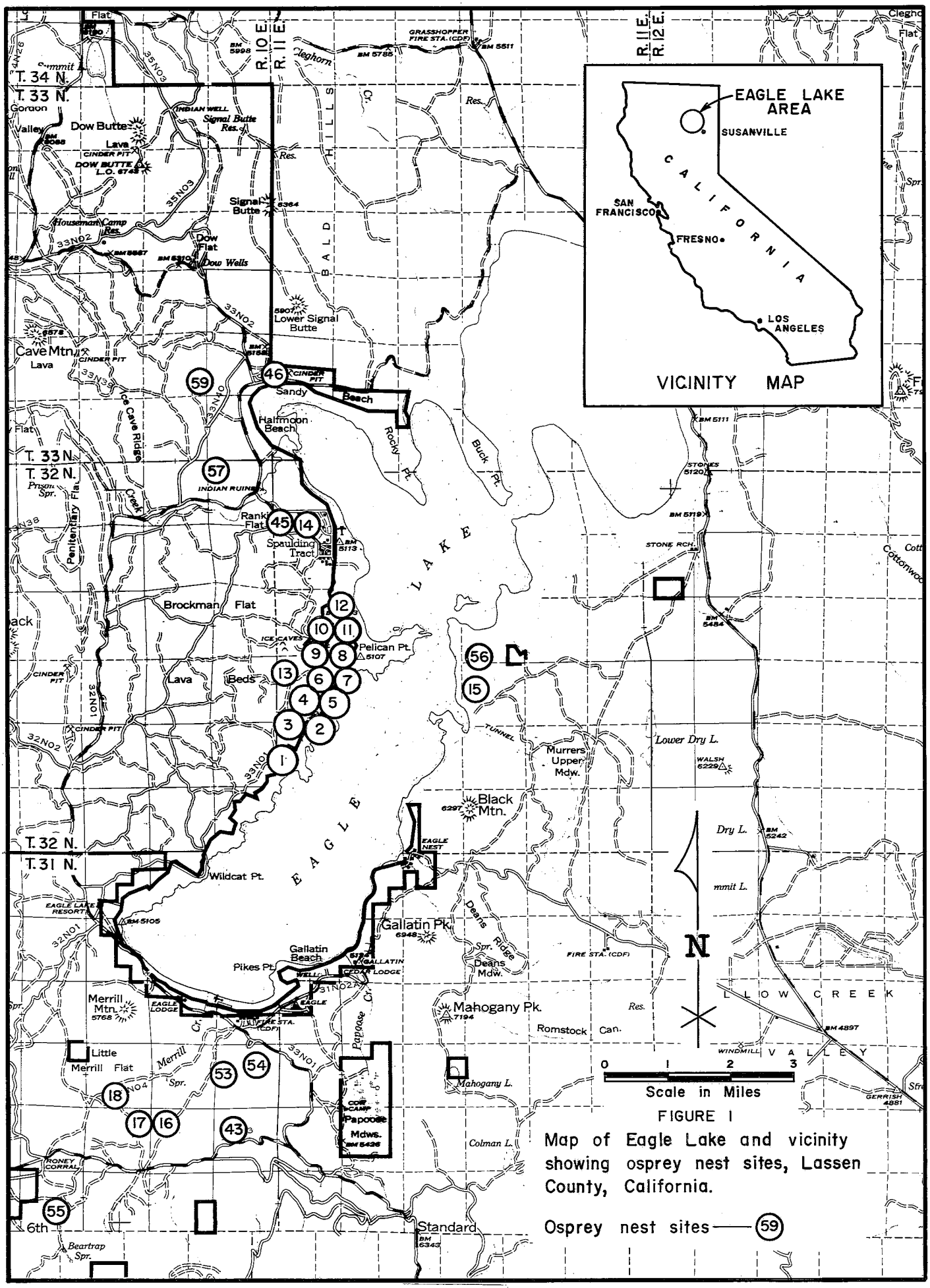

FIGURE 1

Map of Eagle Lake and vicinity showing osprey nest sites, Lassen County, California.

Osprey nest sites —— (59)

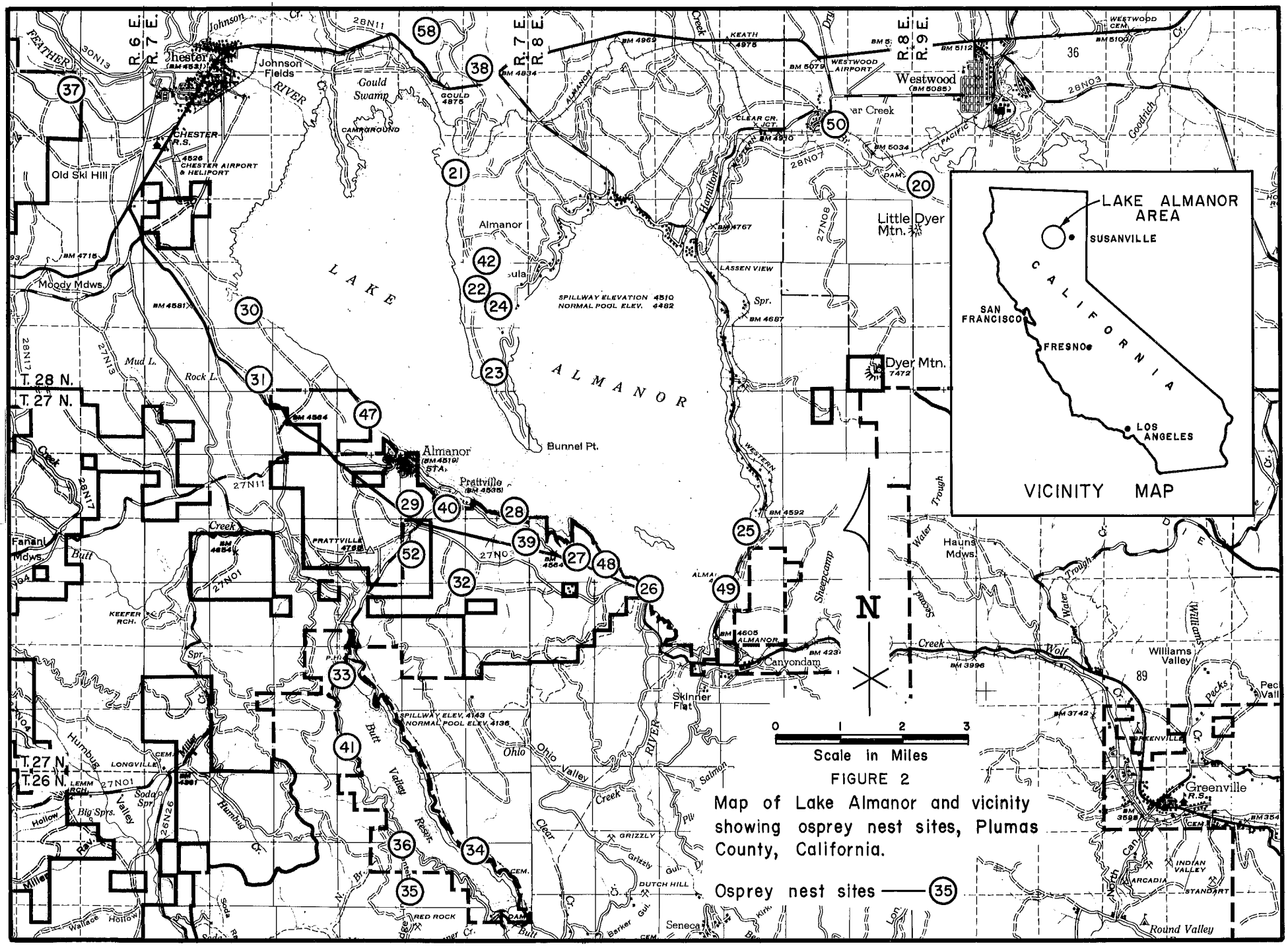

FIGURE 2

Map of Lake Almanor and vicinity showing osprey nest sites, Plumas County, California.

Osprey nest sites —— (35)

Land Use and Ownership

Study area includes portions of Lassen and Plumas National Forests, and Lassen National Park. Approximately 65 percent of the total land area is publicly owned and over 50 percent of the osprey nesting sites occurred on this land (Appendix 1).

Major uses of both public and private lands are for timber production, livestock grazing, and recreation. Lassen National Forest issues permits for harvest of 170,000 board feet of timber annually and grazing leases for approximately 14,000 head of livestock. Forest received over one million visitor days of use by recreationists in 1970. Water sports are exceptionally popular at Eagle Lake and Lake Almanor from June through September. Maximum intensity of land and water use coincides with the nesting period of ospreys.

METHODS

Nest Surveys

During each nesting season approximately 215 linear miles of water courses were surveyed for osprey nesting sites. Boat, automobile and foot transportation were used to locate nests. Sites located during previous surveys were visited on foot prior to April 1 in 1970 and by helicopter on May 22 in 1971 to determine utilization. Sites were considered occupied if a pair of ospreys was observed attending the nest. Nests newly discovered after the breeding season was started were recorded as occupied only if they contained eggs or young. These criteria for evaluating occupancy excluded questionably occupied nests that would deflate productivity values.

Eggs and Young

Clutch sizes were determined by observation from helicopters. Number of fledglings per nest was counted annually prior to August 15, using a variable 15-50 power spotting scope from vantage points on the ground. A fixed-wing airplane was used to make brood counts at 20 nests in 1970. Lack of maneuverability of the aircraft prevented accurate counts, hence this method was abandoned in favor of ground observations.

Twenty-five nest trees were climbed using ladders or gafs and ropes (Figure 3). Contents of seven of these nests were inspected periodically to record egg laying data, hatching dates and growth rates of nestlings.

Twenty-four eggs in various stages of incubation at seven nests were weighed to the nearest gram with a triple beam balance in 1970. An additional 24 eggs in seven nests were weighed similarly in 1971. Length and width of each egg were measured with calipers.

In 1970, nine nestlings at five nests were weighed to the nearest 0.5 gram on a hanging scale at five-day intervals from hatching until fledging. Ten nestlings at four nests were weighed similarly in 1971; however, the time interval between measurement was seven days. Ten young, weighed in 1971, were

FIGURE 3. Author preparing to check osprey nest at Eagle Lake, California, 1970.

identified individually by marking their talons with red nail polish. Length and greatest diameter of tarsus, longest rectrice, complete length of culmen and length of culmen from the anterior opening of nares were recorded for each fledgling bird.

Observations of Behavior

Intensive observations at 13 nests at Eagle Lake and at two nests at Lake Almanor revealed behavioral activities during the two breeding seasons. Observers at Eagle Lake recorded the quantities of fish delivered to four nests with broods of 1, 2, 3 and 4 young from a blind 100 to 200 meters distant. Other behavioral patterns were witnessed from an elevated blind about 10 meters from a nest.

Banding and Marking

The left leg of 20 nestlings, 40 to 60 days old, was banded with U. S. Fish and Wildlife Service bands in 1970. Bands were placed on the right leg of 18 nestlings in 1971. One to three plastic poultry rings (blue, green, and red) were placed on the right leg of birds banded in 1970. Underwing coverts of these birds were also marked with picric acid for recognition at a distance.

Tissue Collection

Two eggs, incubated approximately 20 days each, were taken from different nests in 1970. Twelve nonviable eggs, four dead nestlings, and parts of 34 eggshells were also collected during the study. Thirteen fish from osprey nests at Eagle Lake, six fish from Lake Almanor and a dozen unidentified minnows from Eagle Lake were taken for chemical analyses.

Whole eggs taken in 1970 were frozen intact for two months, thawed and contents removed and placed in glass jars and refrozen. Contents of fractured eggs, nestlings, and fish were individually wrapped in aluminum foil or placed in jars and frozen within two hours after collection. Contents of eggs collected in 1971 were placed in jars and frozen within two hours after collection. Tissues were thawed, homogenized into aggregate samples according to species and collection sites, and analyzed for DDT and its metabolites by Department of Fish and Game's Pesticides Investigation Laboratory using a procedure adapted from deFaubert Maunder, Egan, Godly, Hammond, Roburn, and Thomson (1964).

RESULTS

Population

Earliest sighting of an immigrating osprey was made on March 24, 1970. Observations at five nests at Eagle Lake revealed that members of each pair arrived separately, but within two to seven days of each other. Emigration occurred abruptly during the first week in October. Adults and their young apparently departed at the same time.

Nesting ospreys decreased from 51 pairs in 1970 to 47 pairs in 1971. This eight percent decrease is thought to reflect a reduction in the number of occupied nests discovered due to a decrease in the number of census hours in 1971 rather than a decrease in the nesting population. Young, determined from nest productivity counts, numbered 51 in 1970 and 48 in 1971. Fall populations were probably less than the sum total of adults and fledglings since some unproductive adults apparently left the study area prior to the time young fledged.

Movements of ospreys during nesting periods were localized and functioned for gathering nesting materials, food and for defending nesting sites. Parents at one nest, approximately six miles from a food source, made as many as three or four round trips per day to provide fish for nestlings.

Nests

Description

Nests were 3 to $3\frac{1}{2}$ feet in diameter and 1 to 2 feet in depth (Figure 4). Nest platforms are reduced in size during the winter months as a result of wind. Nests were constructed primarily of sticks, although aquatic vegetation (Scirpus spp., Juncus spp.) and dried cow dung were frequently found in nests. Miscellaneous nest materials included porcupine (Erethizon dorsatum) quills, pelican (Pelecanus sp.) bones, and fishing line.

Inner configuration of nests varied according to nesting activities. During the egg laying and incubating periods a small depression was prominent in the bottom of nests. These shallow cavities varied from 1 to $2\frac{1}{2}$ inches in depth, and were broad enough to accommodate clutches. After eggs hatched and young began to move about, these depressions gradually disappeared and nests became progressively flattened. Although adult ospreys continually added sticks to nests, by the time the young fledged most nests were essentially flat mats of sticks. After the young fledged, nesting sites were used as perches, consequently, nests were broken down even more. By August several nests were completely destroyed by activities of the young and all nesting materials had fallen to the ground.

Location

With the exception of two nests, one built on a power pole and another on microwave relay tower, all nests were constructed in trees. The single requisite for nesting sites apparently was that the nesting tree provide sufficient support for the broad-based nests. Nests at 60 occupied sites (Appendix I) ranged from 8 to 160 feet above ground and averaged 81 feet. Diameter of 60 nest trees at 4 feet above ground ranged from 1 to 7 and averaged 4 feet (Appendix II). Excluding 2 nests on artificial poles, 29 were on dead snags and 29 on the tops of live trees. Few live trees suitable for osprey nesting sites were available near Eagle Lake, hence ospreys used 21 snags and 7 green trees for nest platforms. At Lake Almanor where there was a greater abundance of live trees, the ratio of nests located in snags to those in live trees was 4 to 16. Four nests in other areas of study were on snags and 6 were on green trees. These data suggest that ospreys do not select snags or green trees for

FIGURE 4. Osprey nest at Lake Almanor, California, 1970.

nesting sites; rather they select a nest tree with a broad flat top -- characteristic common to certain snags and mature live trees.

Nesting sites also included at least one pilot tree--a perch utilized by adults when not attending nests. Nests were visible from pilot trees at all sites. Six nesting sites had two or more pilot trees. Where multiple pilot trees existed, observations revealed that osprey use varied with velocity and direction of wind, and time of day. Ninety percent of the pilot trees were standing snags or live trees, ten percent were upright limbs on prostrate snags. Height of perches on 31 pilot trees ranged from 8 to 165 feet above ground and averaged 61 feet. The distance from these pilot trees to respective nest trees ranged from 18 to 920 feet, and averaged 292 feet. (Appendix II). The variation in both type and location of pilot trees suggests that they are not an important influence in selection of nesting sites.

Habitat

All nesting sites were located within 6 miles of natural lakes or reservoirs. Of the 60 sites located, 55 percent were within 1,000 meters of a body of water. The number of nests located at the periphery of lakes and reservoirs suggests that many trees suitable for nesting sites are associated with large bodies of water. In fact, at Lake Almanor and other nearby reservoirs, peripheral nesting sites were created during the period 1914 to 1925 when riparian forests were flooded. An area relatively dense with snags was created at Eagle Lake when trees killed by natural inundation prior to 1917 were exposed when the lake level was lowered about 20 feet by an irrigation tunnel at Bly Bay.

Reese (1970) and Postupalsky (in Valentine 1967) demonstrated that populations of nesting ospreys can increase in density when there is an increase in the number of available nesting sites. In view of this, it is quite likely that water level fluctuations at lakes and reservoirs in the study area have contributed to variations in the density of nesting ospreys.

Interactions

Intraspecific

Courtship flights suggestive of unpaired birds were observed until mid-June. Termination of these flights at that time indicated that all ospreys either had formed pair bonds or had moved from the study area. Nest building began immediately upon arrival. After formation of the pair bonds, male ospreys brought almost all construction materials to nests. Activities of females were limited primarily to participation in defending the nesting territory. At some nests copulation began immediately after the pair bond was formed. At one nest, copulation was witnessed on April 5 and again on April 29, suggesting that breeding may occur through at least a 24-day period.

Interspecific

Small birds generally were tolerated in close proximity of osprey nests. Western kingbirds (Tyrannus verticalis), starlings (Sturnus vulgaris), and tree swallows (Iridoprocne bicolor) nested in cavities below osprey nests. Ospreys were mobbed by these same species and other small birds when away from their nesting sites.

A nest utilized by ospreys in 1969 was used by a pair of Great Basin Canada geese (Branta canadensis moffitti) in 1970. No attempt to displace the nesting goose was witnessed; however, on May 5 the geese were gone and the nest was occupied by ospreys. A clutch was laid by the ospreys but no young were fledged. In 1971, after geese again vacated the nest, ospreys occupied it but failed to lay eggs. Another osprey nest, constructed in 1970, was located approximately 300 yards from a pair of nesting geese. When the gander flew within 50 yards of the osprey nest he was pursued and forced to land on the lake.

Ospreys at nests containing neither eggs nor young usually permitted bald eagles (Haliaeetus leucocephalus), marsh hawks (Circus cyaneus), red-tailed hawks (Buteo jamaicensis), and turkey vultures (Cathartes aura) to pass unmolested. After the clutch was laid, however, ospreys harassed these species passing close to their nests. On three occasions bald eagles seen within 150 yards of occupied osprey nests were escorted through the area by an adult osprey without noise or close pursuit. On two occasions, ospreys returning to nests were harassed by bald eagles and forced to drop fish. A bald eagle, near a group of osprey nests at Eagle Lake, chased three fish-ladened ospreys within a 30-minute interval. Each time, however, the eagle was forced to give up pursuit and to perch on the branches of a tree when several ospreys from hearby nests stooped on it. Pairs of ospreys and bald eagles nesting within 300 yards of each other at Eagle Lake both successfully produced young in 1970. Turkey vultures that came near occupied osprey nests were chased, and on two occasions were forced by ospreys to land on the ground. An unidentified falcon and a red-tailed hawk were witnessed stooping on ospreys. The red-tailed hawk actually forced a pair of ospreys away from their nest.

Feeding Activities

Forty-eight percent of the fish found in osprey nests at Eagle Lake were tui chubs (Gila bicolor), 18 percent were Tahoe suckers (Catostomus tahoensis) and 34 percent were Eagle Lake trout (Salmo gairdneri aquilarium). Size estimates of 46 fish seen in nests at Eagle Lake averaged 12.1 inches. The diet of ospreys at Lake Almanor included brown bull heads (Ictalurus nebulosis), brown trout (Salmo trutta), silver salmon (Oncorhynchus kisutch), tui chubs, and suckers (Catostomus spp.). Eight fish tags found at osprey nesting sites at Lake Almanor in 1970 were from planted trout; 50 percent were from a 1969 introduction of the Massachusetts strain of brown trout.

During the incubation period adult ospreys usually fed while away from the nest. At 2 nests, however, the incubating female was observed to eat pieces of fish offered her by the male. During the brooding period both males and females would tear pieces from fish and feed themselves and their young. (Figure 5). Nestlings, by the eighth week, were capable of feeding themselves.

FIGURE 5. Two osprey nestlings being fed by an adult, Eagle Lake, California, 1971.

Reproductive Effort

Nest Utilization

Sixty nests were discovered during the study. Ninety-one percent of the available nesting sites were occupied in 1970 and 78 percent in 1971. (Table 1). All but three sites occupied in 1969 were also occupied in both 1970 and 1971.

In 1970, 88 percent of the occupied nests were active (contained eggs or chicks) and 87 percent of the occupied nests inspected in 1971 were active. Of the 45 active nests located in 1970, 57 percent were productive (fledged young). Fifty-eight percent of the active nests were productive in 1971.

Egg Laying and Incubation

Intensive observations in 1970 revealed that egg laying extended from April 29 to June 1 with all but 2 of 49 clutches completed by May 20.

Clutch size ranged from 1 to 4 and averaged 2.5 eggs in a total of 89 occupied nests in the study area for 1970 and 1971 (Table 2). Nine nests contained no eggs, 4 contained clutches of 1 egg, 21 contained clutches of 2 eggs, 44 contained clutches of 3 eggs and 11 contained clutches of 4 eggs. The average number of eggs per occupied nest in areas other than Eagle Lake and Lake Almanor fluctuated from 2.0 in 1970 to 3.3 in 1971.

Weights of 24 eggs in advanced stages of incubation at 7 nests were taken May 19 and 21, 1970. Egg weight and length and width measurements were made on May 23, 1971 of 24 eggs at 7 nests. Weights of 48 eggs ranged from 52.4 to 78.5 grams, and averaged 65.1 grams (Table 3). Clutches of 4 eggs had a higher weight range, 68.2 to 78.5 grams, and a higher weight average, 68.4 grams, than did clutches of 3 eggs, range 52.4 to 73.5, average 59.6 grams. Lightest and heaviest eggs of 7 clutches were marked in 1970. There was no apparent relationship between egg weight, hatchability or hatching sequence. Length of 24 eggs ranged from 59.3 to 64.4 mm and averaged 61.4 mm. Egg width ranged from 44.6 to 48.7 mm. and averaged 46.5 mm.

Four days of observations at 7 nests revealed that male ospreys performed an average of 30 percent of the incubation (Garber and Koplin, In Press). After the first egg hatched males were not observed incubating or brooding. Average duration of incubation was 39.5 days in 1970. Three freshly laid eggs in different nests were marked on April 30 and remarked May 23 in 1971. These eggs hatched on June 6, 1971; thus demonstrating a 38-day incubation period. Incubation became sporadic by mid-June at nests in which eggs failed to hatch. At nests where only part of a clutch hatched, incubation of the unhatched eggs terminated when the nestlings were 6 to 10 days of age, presumably so the young could be brooded. At two nests where incubation was discontinued, eggs were discovered at the edges of the nests suggesting that they were being dislodged from the nests.

TABLE 1

OSPREY NESTING SUCCESS, LASSEN AND PLUMAS COUNTIES, CALIFORNIA, 1969–1971

Nest No.	Occupied Nest			Active (Eggs/Clutch)		Productive (Young Fledged)		
	1969[1]	1970	1971	1970	1971	1969[1]	1970	1971
1	Yes	Yes	Yes	3	3	0	0	0
2	Yes	Yes	Yes	0	0	0	0	0
3	Yes	Yes	Yes	0	0	0	0	0
4	Yes	Yes	Yes	3	3	1	0	2
5	Yes	Yes	No	4	0	3	0	0
6	Yes	Yes	Yes	3	3	2	3	0
7	Yes	Yes	Yes	4	4	4	3	0
8	Yes	Yes	Yes	3	3	0	3	2
9	Yes	Yes	Yes	4	4	3	2	1
10	Yes	Yes	Yes	3	4	2	2	2
11	Yes	Yes	Yes	3	4	0	0	4
12	Yes	Yes	Yes	3	3	2	2	3
13	Yes	Yes	Yes	2	3	0	1	0
14	Yes	Yes	Yes	3	2	0	0	0
15	Yes	Yes	Yes	2	3	2	2	3
16	Yes	Yes	No	3	–	Unk	2	–
17	Yes	No	Yes	–	Unk	1	0	0
18	Yes	Yes	Yes	4	Unk	Unk	1	2
19*	Yes	Yes	No	2	–	1	0	–
20	Yes	Yes	Yes	2	2	2	0	0
21	Yes	Yes	Yes	3	2	0	2	1
22	Yes	Yes	Yes	2	4	1	2	2
23	Yes	Yes	Yes	3	3	2	1	3
24	Yes	Yes	Yes	3	0	0	0	0
25	Yes	Yes	Yes	0	2	1	0	0
26	Yes	Yes	Yes	3	3	0	2	1
27	Yes	No	No	–	–	0	–	–
28	Yes	No	No	–	–	2	–	–
29	Yes	Yes	Yes	2	2	0	0	2
30	Yes	No	No	–	–	0	–	–
31	Yes	Yes	Yes	3	3	3	1	3
32	Yes	Yes	Yes	3	3	0	2	3
33	Yes	Yes	Yes	3	3	2	0	1
34	Yes	Yes	No	1	–	0	0	–
35	Yes	Yes	Yes	Unk	2	1	0	0
36	Yes	Yes	Yes	4	4	2	1	3
37	Yes	Yes	Yes	2	2	1	0	2
38	Yes	Yes	No	3	–	1	0	–
39	–	Yes	Yes	3	3	Unk	2	0
40	–	Yes	Yes	3	2	Unk	1	0
41	–	Yes	Yes	0	2	Unk	0	0
42	–	Yes	Yes	0	2	Unk	0	0
43	–	Yes	Yes	3	Unk	Unk	1	1
44**								
45	–	Yes	Yes	3	3	Unk	3	0
46	–	Yes	No	3	–	Unk	3	–
47	–	Yes	Yes	1	2	Unk	0	2
48	–	Yes	Yes	3	2	Unk	0	0
49	–	Yes	No	1	–	Unk	0	–
50	–	Yes	Yes	1	2	Unk	0	0
51*	–	Yes	Yes	3	3	Unk	3	1
52	–	Yes	No	2	–	Unk	2	–
53	–	Yes	Yes	3	Unk	Unk	1	0
54	–	Yes	Yes	3	Unk	Unk	0	1
55	–	Yes	No	3	–	Unk	0	–
56	–	Unk	Yes	Unk	3	Unk	0	0
57	–	Yes	No	Yes	–	Unk	3	–
58	–	Yes	Yes	–	3	–	–	0
59	–	Yes	Yes	–	0	–	–	0
60*	–	Yes	Yes	–	Unk	–	–	1
61*	–	Yes	Yes	–	Unk	–	–	2

[1] Kahl, unpublished.

*Not shown in Figures 1 or 2.

**Nest located in Shasta County.

TABLE 2

OSPREY NESTING ACTIVITY, CLUTCH SIZE, AND FLEDGING SUCCESS, 1970–1971

	Eagle Lake			Lake Almanor			Other Areas[1]			All Areas Total		
	1970	1971	Total	1970	1971	Total	1970	1971	Total	1970	1971	Grand Total
Total no. nests	26	29	55	19	20	39	11	11	22	56	60	116
No. nests occupied (A)	24	24	48	16	16	32	11	7	18	51	47	98
No. occupied nests (B) inspected for egg	24	17	41	16	14	30	9	7	16	49	38	89
Total no. eggs (C)	65	45	110	38	33	71	18	23	41	111	101	222
Avg. no. eggs per (C/B) inspected occupied nest	2.7	2.6	2.7	2.4	2.4	2.4	2.0	3.3	2.6	2.3	2.6	2.5
No. nests active (D)	22	19	41	14	14	28	10	8	18	46	41	87
No. active nests (E) inspected for egg	22	14	36	14	14	28	8	8	16	44	36	80
Avg. no. eggs per (C/E) inspected active nest	3.0	3.2	3.1	2.7	2.4	2.5	2.3	2.9	2.6	2.8	2.9	2.8
No. nests productive (F)	15	13	28	9	7	16	2	4	6	26	24	50
Total no. fledglings (G)	32	24	56	15	17	32	4	7	11	51	48	99
No. fledglings per occupied nest (G/A)	1.3	1.0	1.2	.9	1.1	1.0	.4	1.0	.6	1.0	1.0	1.0
No. fledglings per active nest (G/D)	1.5	1.3	1.4	1.1	1.2	1.1	.4	.9	.6	1.1	1.2	1.1
No. fledglings per productive nest (G/F)	2.1	1.8	2.0	1.7	2.4	2.0	2.0	1.8	1.8	1.9	2.0	2.0

[1] Includes all nests not located at Eagle Lake or Lake Almanor.

TABLE 3

Osprey Egg Measurements, Eagle Lake, California - 1970-1971

Nest No.	Egg No.	Weight (Grams)	Length (mm.)	Width (mm.)
1**	1	52.4	59.9	45.6
	2	49.6	61.5	46.3
	3	55.8	61.9	46.8
4*	1	59.4	-	-
	2	63.3	-	-
	3	54.3	-	-
5*	1	72.8	-	-
	2	74.9	-	-
	3	75.3	-	-
	4	77.5	-	-
6**	1	61.8	61.4	45.1
	2	61.6	60.5	45.2
	3	60.2	60.3	44.6
7*	1	68.7	-	-
	2	71.5	-	-
	3	69.5	-	-
	4	69.7	-	-
7**	1	72.6	61.9	48.1
	2	69.7	61.6	47.4
	3	73.5	61.0	48.7
9*	1	58.2	-	-
	2	64.4	-	-
	3	69.3	-	-
	4	69.8	-	-
9**	1	64.2	62.1	46.4
	2	68.1	61.4	47.5
	3	78.5	62.1	47.0
	4	62.8	59.8	46.5
10*	1	67.4	-	-
	2	67.6	-	-
	3	68.7	-	-
10**	1	73.9	61.9	48.0
	2	71.4	62.0	48.0
	3	73.6	62.5	48.2
	4	67.8	60.7	47.4
11*	1	57.8	-	-
	2	60.6	-	-
	3	61.3	-	-
11**	1	58.4	60.7	45.8
	2	57.8	61.5	46.1
	3	63.1	64.4	46.3
	4	61.4	60.0	45.1
12*	1	58.1	-	-
	2	58.8	-	-
	3	62.0	-	-
12**	1	58.6	59.3	45.1
	2	63.8	61.4	46.0
	3	61.6	64.0	45.2
Total Eggs		48	24	24
Mean		63.0	61.4	46.5

*1970
**1971

Hatching and Fledging Success

Hatching extended from June 2 to July 3 in 1970: 96 percent of the productive clutches hatched by June 14. Fifteen nests at Eagle Lake were inspected frequently enough to determine hatching success and nestling survival for all eggs laid (Figure 6). These nests produced 28 chicks from 49 eggs for a hatching success of 57 percent. Twenty-one of these 28 chicks (75 percent) fledged. Mortality at these 15 nests was 57 percent from the time eggs were laid until young fledged. This compares closely with a 55 percent loss of eggs for the entire study area, suggesting that similar mortality factors may have occurred throughout the entire study area.

Brooding and Growth of Young

Amount and type of brooding varied with weather conditions and location of nests with relationship to shade. During days of sunny, calm weather, female ospreys sat low and brooded young only at night. Nestlings were left exposed during daylight hours except when parents sheltered them from sun, rain and wind. Brooding decreased as nestlings grew older. When the nestlings were 7 weeks old, adult females moved from their nests during the day and occupied nearby perches. Nestlings were still brooded at night.

Growth rates of all nestlings were linear until approximately the twenty-ninth day of age (Figure 7 and Appendix III). Average growth rates of broods of 1, 2, 3 and 4 young were similar. Weights of 19 young at fledging ranged from 1,362.2 to 1,789.2 grams and averaged 1,590.6 grams (Table 4).

In an effort to find a means to identify sexes a number of measurements were made of fledglings. Averages of these measurements are: diameter and length of tarsi 11.9 mm and 56.7 mm respectively; length of rectrix 171.2 mm; complete culmen 33.2 mm and length of culmen from nare 29.0 mm (Table 4). Measurements failed to indicate sexual dimorphism.

Factors Influencing Reproductive Success

Food Availability

There is evidence from three sources that food availability did not limit osprey productivity at Eagle Lake. First, the fishing success of ospreys at Eagle Lake was similar to that at Flathead Lake, Montana, suggesting that predator efficiency did not limit the availability of food (Table 5). Seventy-eight percent of the ospreys observed were successful in their fishing efforts. Of the successful ospreys, 62 percent were successful in taking fish on the first dive. Secondly, throughout the breeding season, parts of one or more fish could usually be located in or under nests at Eagle Lake indicating that more fish were caught than needed. Thirdly, even though the average daily quantity of fish per chick delivered to broods of 1, 2, 3 and 4 young was inversely related to brood size, average growth rates of the broods were similar (Table 6, Figures 7 and 8). Broods of 4 chicks apparently received adequate food for growth; therefore, broods of 1, 2 and 3 chicks presumably received more than adequate food.

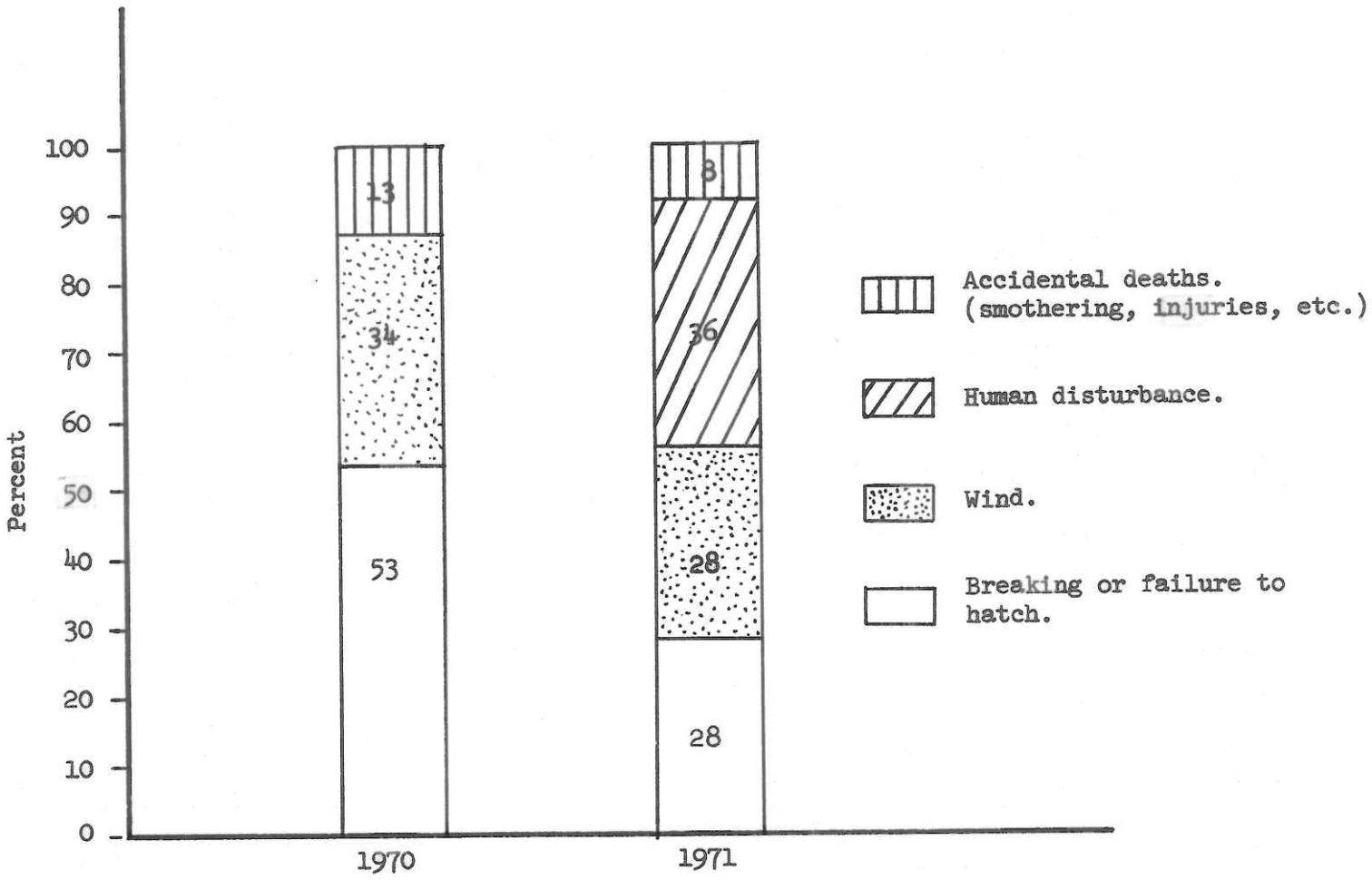

FIGURE 6. Mortality factors accounting for loss of 28 of 49 eggs laid in 15 osprey nests, Eagle Lake, California, 1970-1971.

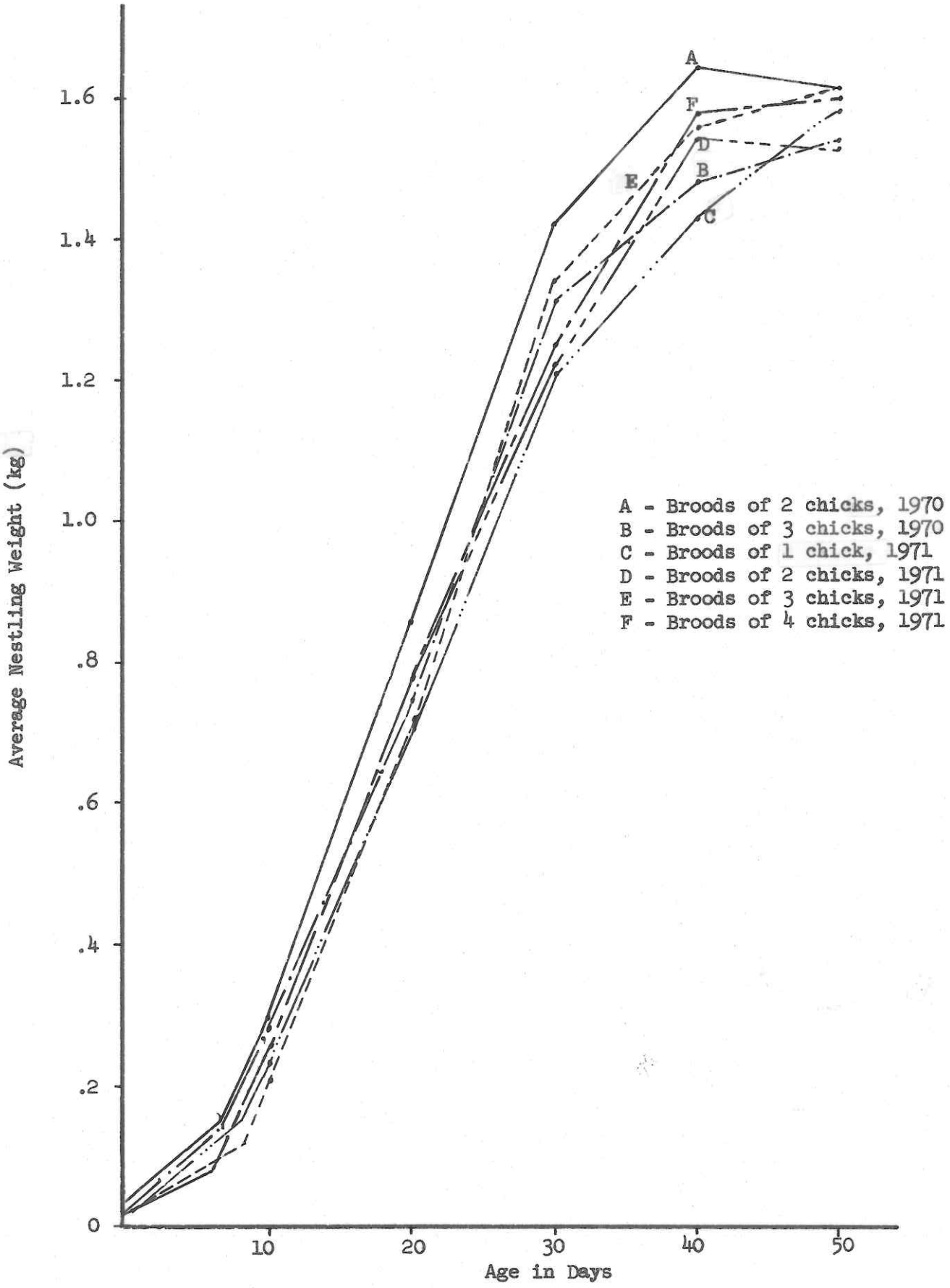

FIGURE 7. Osprey nestling growth rates, Eagle Lake, California.

TABLE 4

Measurements of Nestling Ospreys, Eagle Lake, California, 1970-1971

Nest No.	Osprey No.	Age in Days	Weight (gm)	Diameter of tarsus (mm)	Lengths (mm)			
					Tarsus	Rectrix	Culmen Complete	Culmen From Nare
7*	1	53	1493.8	-	64.1	187	30.9	28.2
	2	51	1562.0	-	67.1	190	30.5	27.0
	3	49	1499.5	-	66.0	173	30.1	26.5
9**	1	51	1562.0	12	65.0	175	35.5	31.0
10*	1	54	1763.6	-	65.6	180	30.1	27.7
	2	51	1650.0	-	67.4	196	33.0	28.4
10**	1	46	1448.4	-	-	-	-	-
	2	52	1704.0	12	62.0	160	37.5	33.0
11**	1	55	1562.0	12.5	59.0	185	33.0	29.0
	2	54	1391.6	11.5	58.5	174	34.5	30.0
	3	52	1675.6	12.5	65.5	176	36.0	31.5
	4	51	1675.6	11.5	63.0	180	36.5	31.0
12*	1	50	1766.5	-	59.8	149	27.6	24.6
	2	55	1539.3	-	63.5	187	31.1	27.6
12**	1	51	1789.2	12.5	61.0	134	34.5	30.0
	2	50	1362.2	12.5	62.5	160	34.5	29.0
	3	48	1647.2	12.5	56.5	134	34.5	30.0
Mean		51.4	1547.2	11.9	56.7	171.2	33.2	29.0

*1970
**1971

TABLE 5

Osprey Fishing Success, Eagle Lake, California
and Flathead Lake, Montana

	No. of Dives	California[1] (%)	Montana[2] (%)
Successful fishing attempts	1	62	64
	2	9	12
	3	5	6
	4	2	1
Total successful		78	83
Unsuccessful fishing attempts		22	17
		100	100

[1] 25 fishing attempts (1970-71)

[2] 158 fishing attempts (1969-71) - Koplin, et al, unpublished.

TABLE 6

Fish Utilization at Osprey Nests Differing in Brood Size
Eagle Lake, California, 1970-1971

Chicks/ Brood (A)	Avg. No. Fish/Day (B)	Avg. Size Index[1] (C)	Avg. Daily Quantities (B) (C)	Avg. Daily Quantity/chick (B) (C)/(A)
0	1(6:6)[2]	2.2	2.2	0
1	3(24:8)	1.9	5.7	5.7
2	3.5(42:12)	2.2	7.7	3.9
3	4.1(45:11)	2.3	9.4	3.1
4	4.9(49:10)	2.3	11.1	2.8

[1] Size index 1 refers to fish less than 6 inches long.
Size index 2 refers to fish between 6 and 12 inches long.
Size index 3 refers to fish between 12 and 18 inches long.
Size index 4 refers to fish in excess of 18 inches long.

[2] Numbers in parenthesis are total fish delivered: days of observation.

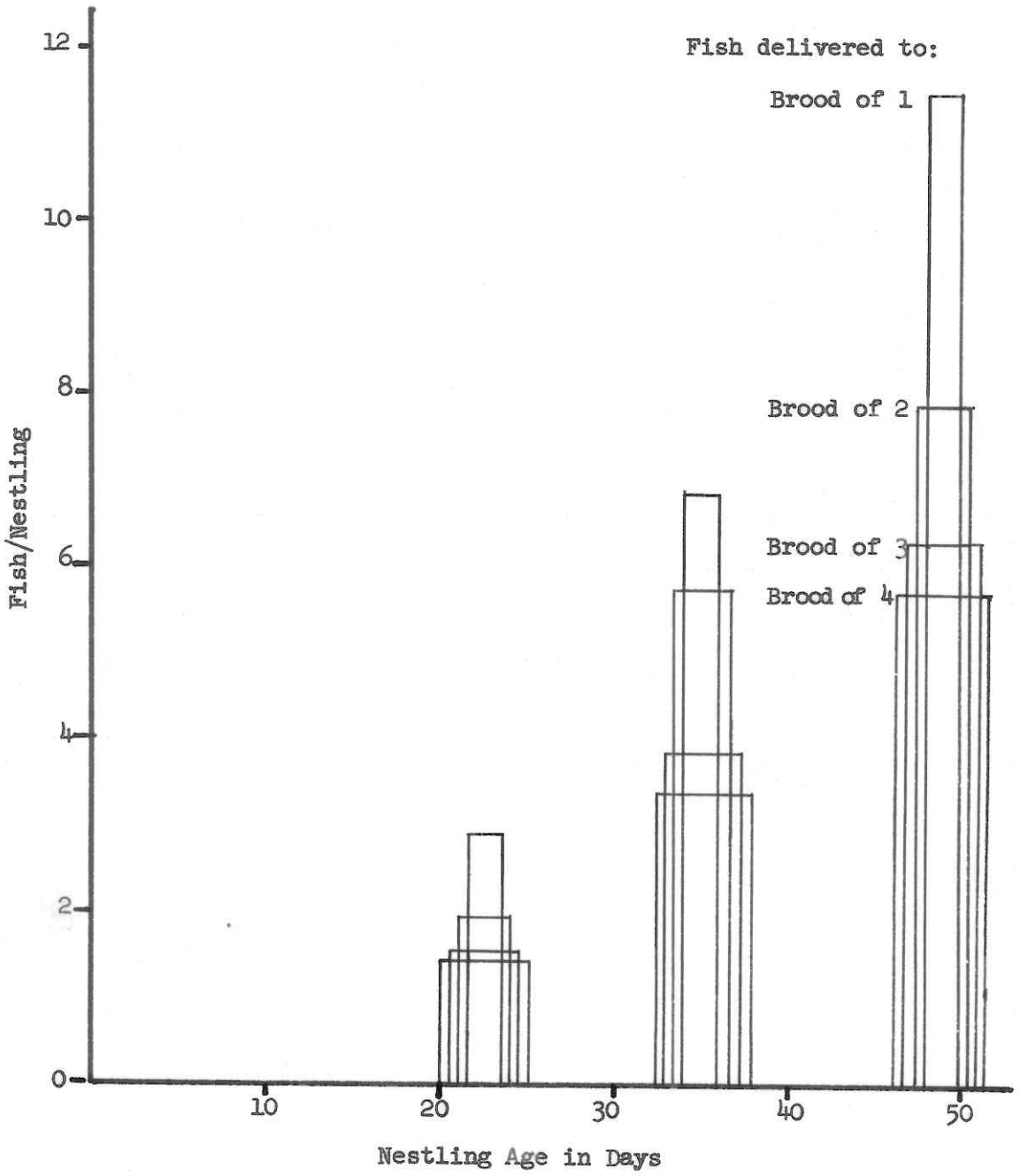

FIGURE 8. Daily quantities of fish delivered to osprey nestlings, Eagle Lake, California.

Weather

In 15 nests inspected frequently enough to determine the fate of each egg laid, the destruction of nests by winds caused 28 percent of nesting mortality (Figure 6). Of 19 nesting failures investigated, 58 percent of the nesting trees were dead snags and 42 percent green trees, suggesting that nesting failures, including wind damage, was not related to the type of nest tree. Majority of the destruction resulted when entire nests were blown from trees. In one case, however, an entire snag was toppled by wind. On July 19 and 20, 1971, two young at different nests were blown out of their nests as they exercised their wings during a storm.

Human Disturbance

Human disturbance caused 36 percent of the egg and nestling loss at 15 nests at Eagle Lake in 1971 (Figure 6). Campers, parked near a nest tree in 1971, caused adult ospreys to abandon the nest containing 4 eggs. Evidence suggested that gulls (Larus spp.) preyed on eggs during the absence of adult osprey. This was the only evidence of predation during the study. In 1970 loggers felled a snag with a nest that contained 3 eggs. Observations revealed that human disturbance at fledging time might also contribute to osprey mortality. During fledgling counts, 11 young ospreys flew from their nests, apparently for the first time. One was retrieved from the lake 30 feet from shore where it had become entangled in dense aquatic vegetation, one was found entangled in a low shrub and another landed in the back of a pickup truck. Early flights, prompted by human disturbance, might increase the incidence of injury to and predation of fledging ospreys.

Fidelity to a nesting site was demonstrated in 1970 when linemen removed a nest twice from a powerline pole. The ospreys constructed a third nest and produced two fledglings.

Accidental Deaths

Accidental deaths accounted for 11 percent of the mortality at 15 Eagle Lake nests (Figure 6). In 1970 a nestling apparently died of wounds inflicted by porcupine quills that were used to line a nest. Two nestlings about 7 days old were found dead apparently smothered in the bottom of a nest; 1 in 1970 and 1 in 1971.

Other Factors

Failure of eggs to hatch and the cracking or crushing of eggs in nests accounted for a loss of 40 percent of the eggs laid at 15 nests at Eagle Lake. Peakall (1970) demonstrated the physiological processes whereby DDT and its metabolites cause eggshell thinning in birds. Ratcliff (1970) further related eggshell thinning to egg breakage in some British raptors. Analyses of tissues collected during this study shows DDT and its metabolites to be present in osprey tissues ($\leq$ 17.9 ppm) and various species of fish ($\leq$ 0.355 ppm)(Table 7). In light of the voluminous data linking avian reproductive impairment with pesticide burdens in ospreys (Ames 1966), herring gulls (Keith 1966), western grebes (Herman, Garrett and Rudd 1968), and

TABLE 7

Pesticide Residues in Osprey and Fish Tissues
Collected at Eagle Lake and Lake Almanor, California

Year	Sample Description	No. in Composite	Sample Weight (Gm.)	% Lipids in Sample	Residues Expressed as µg/gm Sample (p.p.m.) pp'DDE	op'DDT	pp'DDD	pp'DDT	TDEE	Dieldrin	Total
	Osprey Samples from Eagle Lake Area										
1965	Yolk	2	9.22	53.6	23.9	-	-	4.25	-	ND	28.150
	Yolk	2	9.50	55.5	34.8	-	-	3.48	-	.17	38.450
1966	1 week embryo	2	143.5	10.9	6.6	-	1.3	.2	.3	.1	8.800
	2 week embryo	2	140.7	8.7	6.8	-	.7	.2	.3	.1	8.100
1970	Near term embryos	4	-	-	5.66	TR	.954	.420	-	-	7.034
	2 week embryo and whole nestling (died)	2	-	-	3.62	TR	1.050	ND	-	-	4.670
	1 fresh, 1 cracked, 1 addled	3	-	-	17.00	TR	.907	ND	-	-	17.907
	Near term embryo addled	1	-	-	10.60	ND	1.82	ND	-	-	12.420
1971	Watery, cracked shell	1	43.3	4.31	4.10	TR	.74	.12	-	-	4.96
	Watery, addled	1	43.7	2.86	2.18	TR	TR	.38	-	-	2.56
	Near term embryo, addled	1	37.3	1.30	3.59	TR	1.94	.98	-	-	6.51
	Watery, addled	1	32.5	1.61	1.13	ND	1.40	.98	-	-	3.51
	Nestling										
1970	Whole body and whole egg (fresh)	2	-	-	5.55	TR	.758	TR	-	-	6.308
	Whole body	1	-	-	.364	TR	.094	ND	-	-	.461
1971	Whole body, 3 days old	1	29.5	1.25	3.31	ND	.77	.41	-	-	4.49
	Fish Samples from Eagle Lake										
1970	Tui chubs	3	-	-	.189	ND	.057	TR	-	-	.246
	Eagle Lake trout	2	-	-	.084	ND	ND	.111	-	-	.194
	Tahoe sucker	1	-	-	.122	ND	.072	.025	-	-	.219
	Small fish (<250 mm) unidentified	Unknown	-	-	.136	ND	ND	ND	-	-	.136
	Fish Samples from Lake Almanor										
1970	Kokanee salmon	3	-	-	ND	ND	ND	ND	-	-	ND
	Tahoe sucker	1	-	-	.200	ND	.089	.066	-	-	.355
	Western sucker	1	-	-	.049	ND	TR	ND	-	-	.049
	Tui chub	1	-	-	ND	ND	ND	ND	-	-	ND

TR = Less than 0.01 p.p.m.
ND = None detected

other raptorial and fish-eating birds (Keith 1966, Hickey and Anderson 1968, and others), it seems safe to assume that part of the reproductive impairment suffered by ospreys during the present study may be related to the presence of DDT and its metabolites. An eggshell analysis is being made and will be reported later.

DISCUSSION

Ninety-nine young were fledged from 98 occupied nests for an average of 1.01 fledgling per nest. Nests at Eagle Lake fledged .30 less young per occupied nest in 1971 than in 1970; however, nests at Lake Almanor and other areas fledged .40 more young in 1971 than in 1970. Number of young produced per occupied nest for the study as a whole exceeded productivity reported for Michigan, compared favorably with that in Montana and Maryland, but was lower than in Florida. The average number of fledglings produced per productive nest equaled or exceeded all recorded areas of the United States (Table 8).

Based on the recoveries of banded ospreys, Henny and Ogden (1970) calculated that each breeding female in populations in New York and New Jersey would have to produce an average of 1.22 young per year for population stability. Band recoveries from ospreys in the western United States have been insufficient to calculate a mortality rate.

If ospreys in northern California are subject to mortality similar to that of ospreys in New York and New Jersey, the population is declining at a rate of approximately two percent per annum.

TABLE 8

Osprey Reproductive Success in the U. S.

Location and Year	Nest Utilization: No. Nests Studied (A)	Nest Utilization: No. Nests Occupied (B)	Nesting Success: No. Nests Productive (C)	Nesting Success: % Nesting Success (C/B) (100)	Nesting Productivity: No. Fledglings (D)	Nesting Productivity: No. Fledglings Per Productive Nest (D/C)	Nesting Productivity: No. Fledglings Per Occupied Nest (D/B)
California							
1969 1/		38	21	55	40	1.9	1.1
1970 2/	56	51	26	51	51	1.9	1.0
1971 2/	60	47	26	57	48	1.9	1.0
Florida 3/							
1968	53	44	32	72	56	1.8	1.3
1969	50	39	30	77	45	1.5	1.2
Maryland							
1966 4/		77	47	61	79	2.0	1.0
1967 4/		83	48	58	80	1.9	1.0
1968 4/		93	52	56	89	1.7	1.0
1969 4/		94	51	54	90	2.0	1.0
1970 5/		102	55	54	22	1.9	1.0
1971 5/		105	53	55	91	1.7	0.9
Michigan							
1965 6/	53	50	11	22	18	1.6	0.4
1966 6/	54	50	9	18	15	1.7	0.3
1967 6/	64	62	17	27	30	1.8	0.5
1968 7/		69	25	36	32	1.3	0.5
1969 7/		67	23	34	33	1.4	0.5
1970 7/		79	33	42	61	1.8	0.8
1971 7/		74	41	55	79	1.9	1.1
Montana 8/							
1967	33	16	8	50	17	2.1	1.1
1968	33	20	8	40	14	1.8	0.7
1969	36	20	9	45	15	1.7	0.8
1970	40	24	17	70	31	1.8	1.4
Idaho 9/							
1970	55	37	20	55	32	1.7	1.0
1971	77	60	26	43	46	1.8	0.8

1/ Kahl, (unpublished)
2/ This study
3/ Ogden (unpublished)
4/ Reese 1970
5/ Reese, personal communication
6/ Postupalsky in Hickey 1969
7/ Postupalsky, personal communication
8/ Koplin, et.al., (unpublished)
9/ Schroeder (unpublished - Master of Science Thesis, U. of Idaho, Moscow, Idaho)

ACKNOWLEDGEMENTS

I am grateful to Dr. James R. Koplin of Humboldt State College for guidance in planning and execution of the study, and for critical review of the manuscript. Gordon Gould and Mike McInnis aided in collection and interpretation of data. Special thanks to personnel of the U. S. Forest Service, Lassen National Forest, for financial and material support; and particularly to Jack Kahl, Wildlife Biologist, for allowing use of unpublished data and for unprecedented concern for the welfare of the study.

LITERATURE CITED

Ames, P. L. and G. S. Mersereau. 1964. Some factors in the decline of the osprey in Connecticut. Auk 81:173-185.

Ames, P. L. 1966. DDT residues in the eggs of the osprey in the northeastern United States and their relationship to nesting success. J. Appl. Ecol. 3 (suppl.):87-97.

Bureau of Sport Fisheries and Wildlife. 1968. Rare and endangered fish and wildlife of the United States. Committee on Rare and Endangered Wildlife Species, Res. Pub. No. 34, Washington, D. C.

de Faubert Maunder, M. J., H. Egan, E. W. Godly, E. W. Hammond, J. Roburn, and J. Thomson. 1964. Clean-up of animal fats and dairy products for the analysis of chlorinated pesticide residues. Analyst 89:168-174.

Garber, D. P. and J. R. Koplin. Prolonged and bisexual incubation by California ospreys. Condor In Press.

Grinnell, J. 1915. Distributional list of the birds of California in Pacific Coast Avifauna 11:68.

Henny, C. J. and J. C. Ogden. 1970. Estimated status of osprey populations in the United States. Jour. Wildlife Management. 34:214-217.

Herman, S. G., R. L. Garrett, and R. L. Rudd. 1970. Pesticides and the western grebe. Chemical Fallout Proceeding Publication Reprint. University of Rochester, Rochester, New York.

Hickey, J. J. and D. W. Anderson. 1968. Chlorinated hydrocarbons and eggshell changes in raptorial and fish-eating birds. Science 162(3850): 271+.

Hickey, J. J. ed. 1969. Peregrine falcon populations. University of Wisconsin Press, Madison, Wisconsin.

Kahl, J. R. 1971. Osprey habitat management plan. Unpublished report. Lassen National Forest, Susanville, California.

Keith, J. A. 1966. Insecticide contaminations in wetland habitats and their effects on fish-eating birds. J. Appl. Ecol. 3(Suppl.):71-85.

Keith, J. A. 1966. Reproduction in a population of herring gulls (Larus argentalus) contaminated by DDT. J. Appl. Ecol. 3(Suppl.):57-70.

Koplin, J.R., D. L. MacCarter and D. S. MacCarter. 1970. Flathead Lake osprey study (final report). Mimeographed report.

Krantz, G. U. S. Fish and Wildlife Service. Patuxent, Maryland. Unpublished report.

Ogden, J. C. Florida Bay osprey population study. Unpublished report. National Park Service, Homestead, Florida

Peakall, D. B. 1970. Pesticides and the reproduction of birds. Scientific American, April. 73-78.

Peterson, R. T. 1968. Brief reports: the status of the osprey: population trends in the northeastern United States. In Peregrine Falcon Populations (J. J. Hickey, Ed.). University of Wisconsin Press.

Postupalsky, S. 1968. The status of the osprey in the north-central United States, 1967. Detroit Audubon Society. Mimeographed report, February 3, 1968.

Ratcliffe, D. A. 1970. Changes attributable to pesticides in egg breakage frequency and eggshell thickness in some British birds. Journ. of Applied Ecology, Vol. 7, No. 1:67-115.

Ray, M. S. 1915. Nesting of the American osprey at Eagle Lake, California. Condor 17:70-74.

Reese, J. 1968. Breeding osprey survey of Queen Annes County, Maryland, Maryland Birdlife 24(4):91-95.

Reese, J. 1970. Reproduction in a Chesapeake Bay osprey population. Auk 87(4):747-759.

Schmid, F. C. 1966. The status of the osprey in Cape May County, New Jersey between 1939 and 1963. Chesapeake Science 7:221-223.

Valentine, A. 1967. Man-made osprey nesting sites a success. Michigan Audubon Newsletter 14(4):4-5.

APPENDIX I

Location and Land Ownership of Osprey Nest Sites, Lassen and Plumas Counties, California 1970-1971

Nest#	Location 2/	Land Owner 1/
1	R11E T32N Sec.30	LNF
2	R11E T32N Sec.30	LNF
3	R11E T32N Sec.19	LNF
4	R11E T32N Sec.19	LNF
5	R11E T32N Sec.19	LNF
6	R11E T32N Sec.19	LNF
7	R11E T32N Sec.19	LNF
8	R11E T32N Sec.19	LNF
9	R11E T32N Sec.18	LNF
10	R11E T32N Sec.18	LNF
11	R11E T32N Sec.18	LNF
12	R11E T32N Sec.17	LNF
13	R11E T32N Sec.19	LNF
14	R11E T32N Sec. 6	P
15	R11E T32N Sec.22	BLM
16	R10E T31N Sec.26	PLC
17	R10E T31N Sec.26	PLC
18	R10E T31N Sec.22	PLC
19*	R 9E T31N Sec.34	LNF
20	R 9E T28N Sec.18	PG&E
21	R 7E T28N Sec.14	PLC
22	R 7E T28N Sec.25	P
23	R 7E T28N Sec.36	P
24	R 7E T28N Sec.25	P
25	R 8E T27N Sec.15	PG&E
26	R 8E T27N Sec.20	PNF
27	R 8E T27N Sec.18	LNF
28	R 7E T27N Sec.12	LNF
29	R 7E T27N Sec.11	LNF
30	R 7E T28N Sec.29	PLC
31	R 7E T28N Sec.32	PLC
32	R 7E T27N Sec.13	LNF
33	R 7E T27N Sec.27	PG&E
34	R 7E T26N Sec.12	PG&E
35	R 7E T26N Sec.11	PNF
36	R 7E T26N Sec.11	PG&E
37	R 6E T28N Sec.11	PLC
38	R 7E T28N Sec. 1	PLC
39	R 8E T27N Sec.18	LNF
40	R 7E T27N Sec.11	LNF
41	R 7E T27N Sec.34	PG&E
42	R 7E T28N Sec.24	PLC
43	R10E T31N Sec.25	PLC
44**		
45	R11E T32N Sec. 6	P
46	R11E T33N Sec.30	LNF
47	R 7E T27N Sec. 3	LNF
48	R 8E T27N Sec.17	LNF
49	R 8E T27N Sec.22	PG&E
50	R 8E T28N Sec.11	PLC
51*	R 9E T30N Sec. 9	LNF
52	R 7E T27N Sec.14	PG&E
53	R10E T31N Sec.24	PLC
54	R10E T31N Sec.24	PLC
55	R10E T31N Sec.33	PLC
56	R11E T32N Sec.15	BLM
57	R10E T32N Sec. 1	LNF
58	R 7E T28N Sec. 2	PG&E
59	R10E T33N Sec.26	LNF
60*	R10E T34N Sec.28	LNF
61*	R10E T32N Sec. 2	LNF

*Not shown in Figures 1 or 2

**Nest #44 located in Shasta County

1/ Land Owners:

- LNF Lassen National Forest
- PNF Plumas National Forest
- PG&E Pacific Gas and Electric
- PLC Private Lumber Companies
- P Other private

2/ Mt. Diablo Base and Meridian

APPENDIX II

Osprey Nest and Pilot Tree Description, Lassen and Plumas Counties, California, 1970-1971

Nest No.	Nest Trees: Location	Nest Trees: Height From Ground (Ft.)	Nest Trees: Diameter at Four Feet	Distance From Pilot Tree to Nest Tree 1/ (Ft.)	Pilot Trees: Type or Species	Pilot Trees: Height From Ground (Ft.)
1*	Snag	68	3	336	Snag	78
2*	Snag	8	3	Unk	Unk	Unk
3*	Snag	21	4	Unk	Unk	Unk
4*	Snag	15	2	123	Snag	21
5*	Snag	24	2	253	Snag	22
6*	Snag	55	2	276	Snag	21
7*	Snag	12	3	192	Branch	12
8*	Jeffrey Pine	60	2	145	Jeffrey Pine	12
9*	Snag	10	6	150	Snag	25
10*	Snag	13	2	69	Snag	9
11*	Snag	13	2	54	Jeffrey Pine	11
12*	Snag	21	3	375	Branch	8
13	Snag	52	3	242	Snag	78
14	Snag	69	3	75	Ponderosa Pine	114
15	Snag	28	3	130	Snag	24
16	White Fir	78	4	920	Snag	68
17	White Fir	122	4	Unk	Unk	Unk
18	White Fir	71	4	920	White Fir	68
19*	White Fir	103	7	Unk	Unk	Unk
20*	Snag	48	4	Unk	Unk	Unk
21*	White Fir	150	6	Unk	Unk	Unk
22	Incense Cedar	85	4	605	Snag	85
23	White Fir	105	4	302	White Fir	91
24	Incense Cedar	148	5	Unk	Unk	Unk
25*	Snag	90	6	Unk	Unk	Unk
26*	White Fir	125	4	280	White Fir	88
27	White Fir	128	3	Unk	Unk	Unk
28*	Snag	100	2	Unk	Unk	Unk
29	White Fir	150	6	Unk	Unk	Unk
30*	Snag	43	4	Unk	Unk	Unk
31*	White Fir	160	5	542	White Fir	92
32	White Fir	135	5	241	Unk	91
33*	Snag (Moved to microwave relay tower in 1971)	145	6	Unk	Unk	Unk
34*	White Fir	145	5	442	White Fir	123
35	White Fir	103	5	Unk	Unk	Unk
36*	Snag	65	3	Unk	Unk	Unk
37	White Fir	105	4	240	Snag	82
38	Snag	110	4	Unk	Unk	Unk
39*	White Fir	152	4	Unk	Unk	Unk
40	White Fir	108	7	Unk	Unk	Unk
41*	Douglas Fir	68	2	Unk	Unk	Unk
42	White Fir	72	5	Unk	Unk	Unk
43	Snag	65	4	118	Snag	118
44**						
45	Snag	61	3	246	Ponderosa Pine	92
46*	Power Pole	33	1	400	Pole	33
47*	Snag	147	4	103	Snag	71
48*	Incense Cedar	116	6	Unk	Unk	Unk
49*	White Fir	128	4	543	Snag	56
50	Ponderosa Pine	138	5	Unk	Unk	Unk
51*	Snag	61	4	Unk	Unk	Unk
52	White Fir	138	7	Unk	Unk	Unk
53	Snag	85	3	427	Snag	72
54	Snag	72	4	Unk	Unk	Unk
55	Snag	109	5	165	Ponderosa Pine	165
56*	Snag	22	2	18	Snag	18
57*	Snag	53	3	Unk	Unk	Unk
58*	White Fir	93	4	Unk	Unk	Unk
59	S. Cedar	52	4	Unk	Unk	Unk
60	White Fir	58	5	150	White Fir	68
61	Ponderosa Pine	72	5	Unk	Unk	Unk

1/ Distances were approximated by pacing.
*Within approximately 1,000 yards of water.
**Nest no. 44 not in study area.

APPENDIX III

Growth of 19 Osprey Nestlings, Eagle Lake, California, 1970-1971[1/]

1970

Age-Days After Hatching		Nest 7			Nest 9		Nest 10		Nest 12	
		Chick 1	Chick 2	Chick 3	Chick 1	Chick 2	Chick 1	Chick 2	Chick 1	Chick 2
	Date of Hatch	6/9	6/12	6/14	6/2	6/7	6/9	6/12	6/8	6/13
1		-	-	-	-	-	-	-	-	-
2		-	-	-	-	-	-	-	-	-
3		-	-	-	-	-	-	-	-	-
4		-	-	79.0	-	-	-	-	-	-
5		-	-	-	-	-	-	-	-	59.6
6		-	142.0	-	-	-	-	113.6	-	-
7		-	-	-	-	-	-	-	-	-
8		-	-	235.7	-	-	-	-	-	-
9		224.4	-	-	-	-	238.6	-	-	176.1
10		-	-	-	-	-	-	340.8	201.6	-
11		-	-	-	-	448.7	-	-	-	-
12		-	-	-	-	-	-	-	-	-
13		468.6	-	-	-	-	522.6	-	-	-
14		-	-	468.6	-	-	-	-	420.3	-
15		-	-	-	-	724.2	-	-	-	363.5
16		-	599.2	-	576.5	-	-	619.1	-	-
17		-	-	-	-	-	-	-	-	-
18		-	-	-	-	-	-	-	-	-
19		772.5	-	732.7	-	-	908.8	-	-	-
20		-	-	-	823.6	-	-	-	746.9	627.6
21		-	923.0	-	-	1121.2	-	968.4	-	-
22		-	-	-	-	-	-	-	-	-
23		-	-	-	-	-	-	-	-	-
24		1028.1	-	1016.7	-	-	1201.3	-	-	-
25		-	-	-	-	-	-	-	1059.3	903.1
26		-	1187.1	-	1138.8	1329.1	-	1400.1	-	-
27		-	-	-	-	-	-	-	-	-
28		-	-	-	-	-	-	-	-	-
29		1266.6	-	1303.5	-	-	1593.2	-	-	-
30		-	-	-	-	-	-	-	1340.5	1187.1
31		-	1442.7	-	1357.5	1590.4	-	1607.4	-	-
32		-	-	-	-	-	-	-	-	-
33		1508.0	-	-	-	-	-	-	-	-
34		-	-	1431.4	-	-	1729.6	-	-	-
35		-	-	-	-	-	-	-	-	-
36		-	1539.3	-	1633.0	1669.9	-	-	1564.8	1366.8
37		-	-	-	-	-	-	-	-	-
38		1564.3	-	-	-	-	-	1823.3	-	-
39		-	-	1428.5	-	-	1860.2	-	-	-
40		-	-	-	-	-	-	-	1749.4	1431.5
41		-	1508.0	-	1709.7	-	-	1775.8	-	-
42		-	-	-	-	-	-	-	-	-
43		1474.0	-	-	-	-	-	-	-	-
44		-	-	1465.4	-	-	1789.2	-	-	-
45		-	-	-	-	-	-	-	1718.2	1385.9
46		-	1562.0	-	-	1587.6	-	1758.0	-	-
47		-	-	-	-	-	-	-	-	-
48		1545.0	-	-	-	-	-	-	-	-
49		-	-	1499.5	-	-	1721.0	-	-	-
50		-	-	-	-	-	-	-	1766.5	1485.3
51		-	1562.0	-	1556.3	1579.0	-	1650.0	-	-
52		-	-	-	-	-	-	-	-	-
53		1493.8	-	-	-	-	-	-	-	-
54		-	-	1482.5	-	-	1763.6	-	-	-
55		-	-	-	-	-	-	-	1755.1	1539.3
56		-	1633.0	-	1539.3	-	-	1669.9	-	-
57		-	-	-	-	-	-	-	-	-
58		1607.4	-	-	-	-	-	-	-	-
59		-	-	-	-	-	1598.9	-	-	-
60		-	-	-	-	-	-	-	-	-
Fledged										

[1/] Weight in grams.

APPENDIX III (Cont.)

Growth of 19 Osprey Nestlings, Eagle Lake, California, 1970-1971[1/]

	1971										
		Nest 9	Nest 10		Nest 11				Nest 12		
Age-Days After Hatching		Chick 1	Chick 1	Chick 2	Chick 1	Chick 2	Chick 3	Chick 4	Chick 1	Chick 2	Chick 3
	Date of Hatch	6/6	6/4	6/5	6/2	6/3	6/5	6/6	6/6	6/7	6/9?
1		-	-	-	-	-	-	-	-	-	-
2		-	-	-	-	-	-	-	-	-	-
3		-	-	-	-	-	-	-	-	-	-
4		-	-	-	-	-	-	-	-	-	-
5		-	-	-	-	-	-	-	-	-	-
6		-	-	-	-	-	-	-	-	-	96.6
7		-	-	-	-	-	-	-	-	-	-
8		-	-	-	-	-	-	-	-	119.3	-
9		198.8	-	-	-	-	-	213.0	227.2	-	-
10		-	-	278.3	-	-	227.2	-	-	-	-
11		-	340.8	-	-	-	-	-	-	-	-
12		-	-	-	-	335.1	-	-	-	-	-
13		-	-	-	383.4	-	-	-	-	-	-
14		-	-	-	-	-	-	-	-	-	255.6
15		-	-	-	-	-	-	-	-	-	-
16		-	-	-	-	-	-	-	-	426.0	-
17		511.2	-	-	-	-	-	568.0	624.8	-	-
18		-	-	568.0	-	-	596.4	-	-	-	-
19		-	681.6	-	-	710.0	-	-	-	-	-
20		-	-	-	748.4	-	-	-	-	-	710.0
21		-	-	-	-	-	-	-	-	-	-
22		-	-	-	-	-	-	-	-	852.0	-
23		899.8	-	-	-	-	-	1046.6	899.8	-	-
24		-	-	1107.6	-	-	1121.8	-	-	-	-
25		-	1136.0	-	-	-	-	-	-	-	-
26		-	-	-	-	899.8	-	-	-	-	-
27		-	-	-	1178.6	-	-	-	-	-	1107.6
28		-	-	-	-	-	-	-	-	-	-
29		-	-	-	-	-	-	-	-	1130.0	-
30		1198.5	-	-	-	-	-	1263.8	1462.6	-	-
31		-	-	1362.2	-	-	1292.2	-	-	-	-
32		-	1462.6	-	-	-	-	-	-	-	-
33		-	-	-	-	1263.8	-	-	-	-	-
34		-	-	-	1391.6	-	-	-	-	-	1533.6
35		-	-	-	-	-	-	-	-	-	-
36		-	-	-	-	-	-	-	-	1434.2	-
37		1476.8	-	-	-	-	-	1547.8	1689.8	-	-
38		-	-	1661.4	-	-	1675.6	-	-	-	-
39		-	1359.8	-	-	-	-	-	-	-	-
40		-	-	-	-	1476.8	-	-	-	-	-
41		-	-	-	1491.0	-	-	-	-	-	1448.4
42		-	-	-	-	-	-	-	-	-	-
43		-	-	-	-	-	-	-	-	1448.4	-
44		1562.0	-	-	-	-	-	1618.8	1789.2	-	-
45		-	-	1675.6	-	-	1789.2	-	-	-	-
46		-	1448.4	-	-	-	-	-	-	-	-
47		-	-	-	-	1420.0	-	-	-	-	-
48		-	-	-	1562.0	-	-	-	-	-	1647.2
49		-	-	-	-	-	-	-	-	-	-
50		-	-	-	-	-	-	-	-	1362.2	-
51		1562.0	-	-	-	-	-	1675.6	1789.2	-	-
52		-	-	1704.0	-	-	1675.6	-	-	-	-
53		-	-	-	-	-	-	-	-	-	-
54		-	-	-	-	1391.6	-	-	-	-	-
55		-	-	-	1562.0	-	-	-	-	-	-
56		-	-	-	-	-	-	-	-	-	-
57		-	-	-	-	-	-	-	-	-	-
58		-	-	-	-	-	-	-	-	-	-
59		-	-	-	-	-	-	-	-	-	-
60		-	-	-	-	-	-	-	-	-	-

Fledged

[1/] Weight in grams.