OSPREY WORKSHOP: SUMMARY OF RESEARCH FINDINGS AND MANAGEMENT RECOMMENDATIONS

James Koplin (Editor)
Humboldt State College
Arcata, California

Editor's Note: During the Western Section of The Wildlife Society's 1971 Annual Meeting, a workshop on osprey was held. Dr. Koplin conceived, planned and analyzed pertinent findings from this workshop and edited this paper.

INTRODUCTION

The purpose of this workshop was to pool the range of experience with ospreys among wildlife biologists in order to obtain added insight into factors influencing the distribution and abundance of ospreys in the West. We hoped that from our efforts would emerge a pattern of habitat requirements and the identity of limiting factors that could be restated as management recommendations to assist conservation agencies to protect ospreys from regional extirpation. We also hoped to identify research needs, to standardize techniques and to agree upon a terminology that would be useful and meaningful to us all.

Participants were from every study on ospreys west of the continental divide and south of Canada: Donald and Douglas MacCarter and James Koplin, Flathead Lake, Montana; Donald Johnson, St. Joe River and Lake Coeur d' Alene, Idaho; Hadley Roberts and Gordon Lind, Crane Prairie Reservoir, Oregon; Jack Kahl and David Garber, Eagle Lake and Lake Almanor, California; James Gordon, Shasta and Clair Engle Lakes, California; Robert Gale and Robert Payton, the Salmon River, the upper reaches of the Klamath River and the lower reaches of the Scott River, California; and Forrest Reynolds, Charles Kennedy, Gordon Could and James Koplin, the lower reaches of the Smith, Klamath, Trinity, Little, Mad, Elk, Van Duzen, and Mattole Rivers and Redwood and Salmon Creeks, California. In addition, information was provided by Richard Botzler on diseases and parasites.

REPRODUCTIVE AND POPULATION TRENDS

Eighty nesting efforts at Flathead Lake, Montana, between 1967 and 1970 produced an average of 0.98 fledglings per nest. In California in 1969 and 1970, 89 nesting efforts at Eagle Lake and Lake Almanor, and 39 nesting efforts at Shasta and Clair Engle Lakes averaged 1.06 and 0.79 fledglings per nest respectively. Forty-one nesting efforts on the St. Joe River and Lake Coeur d' Alene, Idaho, averaged 0.95 fledglings per nest, and 85 nesting efforts on Crane Prairie Reservoir, Oregon, averaged 0.86 fledglings per nest in 1969 and 1970.

Fourteen of a total of 35 nests found late in the nesting season on the Scott and the upper reaches of the Klamath Rivers, California, fledged an average of 1.64 young per nest. This value probably is inflated because a number of nesting pairs undoubtedly abandoned their nests as a result of nesting failure prior to the time the survey was conducted. (It is well known from the studies in Montana, Oregon and California that some ospreys experiencing nesting failure abandon their nests in mid to late June; many of the nests on the Klamath and Scott Rivers were not discovered until July.)

Forty-six nests, at least 15 of which were active, were discovered during 1970 on the lower reaches of the Klamath and Eel Rivers, the upper reaches of the South Fork of the Trinity River, the coastal regions of Little and Elk Rivers and Redwood and Salmon Creeks and at Ruth Reservoir on the upper reaches of the Mad River. No nests were found on Salmon River or on the lower reaches of the Smith, Mad or Mattole Rivers, although free-flying ospreys were observed on the Smith and Mad Rivers. Single abandoned nests were located on the lower reaches of each of the Trinity and Van Duzen Rivers; local residents reported observing ospreys on both rivers.

FACTORS INFLUENCING DISTRIBUTION AND ABUNDANCE

Nesting Sites

There are more nests available than ospreys using them at Flathead Lake, Lake Coeur d' Alene and the St. Joe River, Shasta and Clair Engle Lakes, and the rivers in northern California, indicating no shortage of nesting sites in these areas. Nesting sites may be limiting at Eagle Lake, however, because ospreys there utilized a number of sub-optimal nesting sites: the tops of stumps 10 to 25 feet off the ground and the cross arms of a power pole. In addition, the birds are utilizing green trees for nest sites at Lake Almanor; where available, snags apparently are preferred to green trees.

Even though there are many suitable snags in Crane Prairie Reservoir, the majority have been standing in water for over 30 years and, therefore, will probably begin toppling within the next 10 years; it is felt that all will have toppled within the next 20 years.

A survey of the coastal region of Humboldt County, California, revealed many suitable nesting sites, yet no nests were found nearer to the coastline than approximately 1 mile and the majority were from 2 to 5 miles inland. The assumption is that onshore sea breezes and summer fog restrict ospreys from nesting on the coastline.

Observations at Flathead Lake, the St. Joe River and Crane Prairie Reservoir suggest that western populations of ospreys prefer nesting sites surrounded by water. That is, the most crowded nesting conditions observed were at Flathead Lake on the Bird Islands involving less than 5 acres of land on which 4 to 7 pairs of ospreys nested during the summers 1966 to 1970; the shortest nesting sites observed were pilings of a levee extending 10 feet above the surface of Lake Coeur d' Alene at the mouths of the St. Joe and Coeur d' Alene Rivers; the thinnest nesting sites observed were lodge pole pine snags, only 4 to 6 inches in diameter, protruding out of the water of Crane Prairie Reservoir.

In the absence of nesting sites surrounded by water, ospreys apparently prefer elevated nesting sites in the proximity of water as indicated by observations in all study areas.

The majority of nests in all areas except Lake Almanor, and Shasta and Clair Engle Lakes are in the tops of snags, or the tops of living trees with dead crowns, or on the tops of tall stumps. The majority of nests at Lake Almanor and Shasta and Clair Engle Lakes are in the tops of living conifers presumably because of a shortage of preferred snags, stumps and living trees with dead tops.

At Flathead Lake, Couer d' Alene and the St. Joe River, Crane Prairie Reservoir and along the rivers in northern California, with no obvious shortage of preferred nesting sites, the vast majority of nests are in direct proximity of water and virtually all are within a half mile of large bodies of water. At Eagle Lake and Lake Almanor, and Shasta and Clair Engle Lakes with apparent shortages of preferred nesting sites, many nests are removed up to a mile or more from large bodies of water.

The absence or extreme sparsity of osprey nests on the Salmon River and on the lower reaches of the Smith, Trinity, Mad and Van Duzen Rivers, California, presumably was not related to nesting conditions *per se* since the availability and suitability of nesting sites on all four streams appeared to be adequate.

Food

Seventeen species of fish inhabit Flathead Lake: 3 coregonids, 5 salmonids, 2 catastomids, 3 cyprinids, 1 ictalurid, 1 percid and 2 centrarchids. Of these, ospreys are known to have preyed on at least 9 species. Suckers (*Catastomus* sp.) and whitefish (*Coregonus* sp.) represented about 60% and 30% respectively of 159 identifiable prey delivered to osprey nests at Flathead Lake in 1970. Peamouth chubs (*Mylocheilus caurinum*), pumpkinseeds (*Lepomis gibbosus*), northern black bullheads (*Ictalurus melas*), cutthroat trout (*Salmo clarki*) and yellow perch (*Perca flavescens*) constituted the remainder.

Seventeen prey delivered to a nest on Lake Couer d' Alene in 1970 were identifiable: 7 northern squawfish (Ptychocheilus oregonensis), 6 brown bullheads (Ictalurus nebulosis), 3 black crappies (Pomoxis nigromaculatus) and 1 bluegill (Lepomis macrochirus).

Five species of fish inhabit Crane Prairie Reservoir: mountain whitefish (Prosopuim williamsoni), kokanee (Onchorhynchus nerka), brook trout (Salvelinus fontinalis), rainbow trout (Salmo gairdneri) and tui chubs (Gila bicolor). Approximately 87% of the numbers of fish in Crane Prairie Reservoir are tui chubs. Fifty-seven percent of 47 prey identified at Crane Prairie Reservoir were tui chubs; 6% were whitefish, and the remaining 37% included a mixture of salmonids.

Six species of fish inhabit Eagle Lake: Eagle Lake trout (Salmo gairdneri aquilarium), Tahoe suckers (Catostomus tahoensis), tui chubs (Gila bicolor), Lahontan redside shiners (Richardsonius egregius), speckled dace (Rhinichtys osculus) and brown bullheads (Ictalurus nobulosus). Fifty-two percent of 31 fish recovered from osprey nests at Eagle Lake were tui chubs; 24% were Tahoe suckers and 24% were Eagle Lake trout.

Thirty-one species of fish inhabit the rivers in northwestern California: 1 petromyzontid, 2 acipenserids, 1 clupeid, 10 salmonids, 1 osmerid, 3 catastomids, 5 cyprinids, 2 ictalurids, 1 gasterosteid, 3 centrarchids, 1 percid and 1 cottid. No information is available on which species are selected by ospreys.

The influence of food supply on reproductive performance of ospreys at Flathead Lake and Eagle Lake was assessed by measuring fishing success, relative rates of delivery of fish to nests differing in brood size and relative rates of growth of chicks in nests differing in brood size. It was assumed that if food supply was not limiting then the following postulates would be acceptable:

(1) Fishing success, measured by the ratio of successful to total dives for fish, would be the same in an area with a relatively low supply of fish as in an area with a relatively high supply of fish;

(2) Quantities of fish delivered to and consumed at nests would be the same on a per chick basis in broods of 2 and 3 as in broods of 1;

(3) Growth rates of individual chicks should be the same in broods of 2 and 3 as in broods of 1.

Flathead Lake is a classical oligotrophic lake with a relatively low biomass of fish compared to Eagle Lake, a classical eutrophic lake with a relatively high biomass of fish. The proportion of fishing efforts resulting in the successful capture of prey was identical at both lakes, 83%. However, the providing parent, presumably the male, was absent from the nesting territory for an average of approximately 70 minutes before returning with a fish at Flathead Lake, but was absent for an average of only 30 minutes before returning with a fish at Eagle Lake. These observations suggest that ospreys have a good chance of capturing prey once located, but that it is more difficult to locate prey in the oligotrophic Flathead Lake than in the eutrophic Eagle Lake. The observations also indicate the need to expand the criteria for measuring fishing success.

Quantities of fish delivered to, and consumed by, each chick averaged the same in a brood of 2 as in a brood of 3 at Eagle Lake in 1970; averaged the same in broods of 1 and 3 which were higher than in a brood of 2 at Flathead Lake in 1969; and averaged highest in a brood of 1, and the same in broods of 2 and 3 at Flathead Lake in 1970. These observations suggest that food supplies were adequate for the needs of each brood; but at Flathead Lake the brood of 2 possibly was inadequately provided for in 1969 and the brood of 1 probably was overly provided for in 1970.

Data was obtained in 1970 on quantities of fish delivered to a brood of three on Lake Couer d' Alene.

The absence of extreme sparsity of osprey nests on the Salmon River and on the lower reaches of the Smith, Trinity, Mad and Van Duzen Rivers may be related to poor food conditions. The majority of stream-nesting ospreys were in the proximity of coastal bays or lagoons or they were on streams draining agricultural areas, bodies of water presumably supporting relatively high populations of fish as a result of nutrient enrichment. The Salmon, Smith, Trinity, Mad and Van Duzen Rivers drain areas with little or no agricultural activity, bodies of water presumably supporting relatively low fish populations as a result poor nutrient supplies.

Disease

Basically, there are two types of diseases affecting populations. Density-dependent diseases, which probably include psittacosis and Newcastle disease, spread more efficiently in crowded than in sparse populations. With this type of factor the rate of mortality theoretically diminishes as the host population declines.

With density-independent diseases, transmission is not determined by the size of the susceptible populations. Intoxications (e.g. botulism) and many arthropod-borne diseases (e.g. bird and mammal malarias) seem best described as density-independent phenomena. Theoretically, this kind of mortality could eradicate a species because the effects are independent of the size of the remaining population.

Although at least one probable density-dependent agent (Newcastle disease virus) has been isolated from the osprey, the decline and complete disappearance from some areas of ospreys resemble density-independent rather than density-dependent mortality.

Some viable pathogens bring about density-independent mortality. But the osprey's food habits rule out most diseases carried by rodents, birds, and other terrestrial vertebrates. One possible density-independent mortality factor is Type C or E botulism. There is evidence that ospreys do take dead fish on accasion. However, to invoke a viable agent as the cause of the decline in ospreys would require that this pathogen simultaneously affects the food chains of ospreys around the world.

A density-independent form of mortality brought about by a non-viable agent appears to be the most plausable explanation of the widespread decline of ospreys.

Interspecific Interactions

There is indirect evidence that magpies and/or ravens preyed on addled eggs at Flathead Lake after the parents abandoned their nests.

A bald eagle was observed harrassing an osprey at Crane Prairie Reservoir in 1970, and 2 ospreys were robbed of fish at Eagle Lake in 1970. However, a pair of bald eagles nesting in the proximity of several pairs of ospreys at Flathead Lake were never observed harrassing the ospreys; in fact, no harrassment of ospreys by the two to four pairs of bald eagles nesting at Flathead Lake was ever observed.

A pair of ospreys nesting on a small island in the vicinity of the only known great blue heron rookery at Flathead Lake, harrassed the herons whenever they left or approached the rookery over the quarter of the island frequented by the ospreys. On several occasions, herons were driven into the water before the ospreys would cease their attack; on one occasion a heron driven into the water was struck repeatedly until it was killed.

Ospreys nested in the proximity of all six known heron rookeries at at Crane Prairie Reservoir; in one case an osprey nested in the top of a tree containing heron nests. Ospreys were observed chasing herons at Crane Prairie Reservoir but none were observed to drive herons into the water.

Eight of the 35 osprey nests discovered on the Scott and upper Klamath Rivers were associated with great blue heron rookeries. It was noted that osprey nests were associated with rookeries on the other rivers in northern California, but the frequency of association was not recorded.

Weather

Wind and snow destroyed approximately 25% of the nests at Crane Prairie Reservoir during the winter of 1968-69.

High winds destroyed or disrupted three of nine nests under close observation at Eagle Lake during the summer of 1970; if other nests in the area were affected similarly 33% would have been lost to wind. Winter winds at Eagle Lake destroy virtually all of the nests which must be rebuilt each nesting season.

Wind is not as disruptive on Flathead Lake nor on the rivers in northern California. Nevertheless, several nests were destroyed at Flathead Lake during the summer of 1969, and 6 to 30 percent of the nests at Flathead Lake were destroyed each winter.

Lightning destroyed the contents of a nest at Eagle Lake in 1969. Coastal weather presumably restricts the distribution of osprey nests in the maritime environments of northern California to protected sites one or more miles inland from the shoreline.

Accidents

Two chicks at Flathead Lake apparently fell from their nests and drowned. A chick at Eagle Lake died from puncture wounds inflicted by porcupine quills used as nest lining by the parents. A chick with a poorly healed wing fracture at Crane Prairie Reservoir apparently fell and killed itself when it tried to fledge.

Human Interference

Shooting:

Shooting was responsible for the loss of an adult and two chicks at Crane Prairie Reservoir in 1970, an adult and one chick on the Klamath River in 1969, and an adult on the St. Joe River in 1970. Young boys were observed shooting at ospreys at Flathead Lake in 1967, and a summer resident on Flathead Lake used a nest tree for target practice during the summer of 1969; adjacent neighbors influenced the individual to stop. Several instances of shooting at no objects in particular were recorded near osprey nests on Eagle Lake in 1970. Even though no other instances of shooting were reported, it is almost a certainty that shooting is a fairly common practice in all of the study areas.

Recreation:

Fear was expressed that pronounced recreational activity at Crane Prairie Reservoir may coincide with the time when eggs are hatching; if so any activity in the vicinity of nests might tend to keep incubating or brooding parents off their eggs or young which probably are very vulnerable to temperature extremes characteristic of Crane Prairie Reservoir during the spring and summer.

Recreational activities at Flathead Lake do not take place until well after the eggs have hatched; therefore, recreational activity on Flathead Lake has a minimal influence on survival of eggs about to hatch or on survival of nestlings recently hatched. As a matter of fact, several nests at Flathead Lake and at Shasta Lake that consistently were productive were in the proximity of areas actively frequented by summer residents and recreationists.

Certain cabin owners at Flathead Lake afforded protection for neighboring ospreys which presumably became accustomed to people and paid little or no attention to them. Other cabin owners, however, felled nesting snags to obtain firewood, to get rid of potential fire hazards, or simply to get rid of an "eye sore" in their back yards.

Pollution:

There are several indications that the major portion of the reproductive failure observed in ospreys in the West may be related to DDT pollution:

1. The presence of DDT residues, principally DDE, in egg contents from Flathead Lake, Crane Prairie Reservoir and Eagle Lake.

2. Several instances from Flathead Lake and from Eagle Lake of crushed eggs, cracked eggs and flaking egg shells, all indicative of egg shell thinning.

3. The presence of dead embryos in addled eggs from Flathead Lake and Eagle Lake. In addition, the presence of DDT residues, principally DDE, in bottom sediments, plankton and fish from Flathead Lake, in fish from Eagle Lake and in fish from several streams in northwestern California. Mercury residues have been detected in the flesh of the dead ospreys from Crane Prairie Reservoir. However, there presently is no evidence that mercury contaminants influence reproduction.

It is interesting to note that the fledging rate of ospreys at Flathead Lake was higher in 1970 than at any other time during the four years for which fledging rates were measured--1.35 fledglings per breeding pair in 1970 compared to 1.06 in 1967, 0.70 in 1968, and 0.75 in 1969. The reproductive success of ospreys in the mid-western U. S. was higher in 1970 than during the 1960's also (Postupalsky, personal communication). It is tempting to suggest that the increased reproductive success is related to decreased use of pesticides in these areas. Whether this is the case or not is far from certain at the present time, however.

CONCLUSIONS

On the basis of banding returns from New York and New Jersey, calculated that each breeding female osprey would have to produce a minimum of 1.22 fledglings each year in order to balance the mortality experienced by these populations to maintain population stability. Obviously, ospreys in the four areas in the West for which we have information on productivity are producing fewer than 1.22 young per breeding female. If western populations experience mortality schedules similar to populations in New York and New Jersey, the western populations would be declining at two or three or four or five percent per year.

One indication that western ospreys may not be subject to the same mortality schedules as eastern ospreys is suggested by the fact that the breeding population at Flathead Lake for the four years for which there is information appears to be stable. Nevertheless, 12 to 45 percent of the annual nesting efforts at Flathead Lake failed to produce eggs and 20 to 41 percent of the eggs laid failed to hatch resulting in the failure of 39 to 60 percent of the nesting efforts to produce osprey chicks. In addition, 45 percent of the nesting efforts at Crane Prairie Reservoir failed to produce chicks in 1970; 50 percent of the nesting efforts failed to produce eggs at Shasta Lake in 1970; and at Eagle Lake 10 percent of the nesting efforts failed to produce eggs and 25% of the eggs laid failed to hatch resulting in the failure of 33 percent of the nesting efforts to produce chicks in 1970. Furthermore, every addled egg examined from Flathead and Eagle Lakes contained dead embryos. Thus, there is reason to accept with a great deal of caution apparent trends indicating stability of breeding populations of ospreys.

The only factor likely to be common to all of the areas that could account for the reproductive failures is DDT contamination; in those populations examined sizeable quantities of DDT residues have been detected suggesting that DDT residues will be detected in the populations not yet examined.

MANAGEMENT IMPLICATIONS

From the foregoing, it is obvious that rectification of one limiting factor is to preserve nesting sites or potential nesting sites. This brings any such osprey management program into direct conflict with land management policies calling for the felling of snags as potential fire threats, especially in areas such as Eagle Lake and Crane Prairie Reservoir where nesting sites are or will become limiting.

Rough fish apparently represent the major prey selected by ospreys and in many fisheries management projects rough fish are drastically reduced to increase the abundance of game fishes. Therefore, in areas where ospreys are fairly abundant the practice of reducing populations of rough or trash fish should be discouraged.

Recreational activities taking place when chicks and eggs are the most vulnerable very definitely should be discouraged. Indiscriminate shooting and target practicing in areas where ospreys are nesting should also be discouraged.

The devastating influence of wind in areas such as Eagle Lake might be reduced by shoring up nesting sites and nesting platforms to minimize the influence of wind.

Government agencies now concerned for the welfare of ospreys and other predatory birds and mammals would do well to continue and to intensify their efforts and to influence sister agencies to adopt similar points of view.

Short of banning their use, there is little that can be done to curb the influence of pesticides. However, there are indications that in areas where the use of chlorinated hydrocarbons has been reduced there has been a corresponding increase in the reproductive success of afflicted birds, particularly in Great Britain where the peregrine falcon has started to undergo a certain amount of recovery following the reduction in use of pesticides in 1967. As mentioned, it is very possible that the increased reproductive rate of ospreys at Flathead Lake and in the Midwest during the summer of 1970 was related to the reduction in use of DDT during recent years. Therefore, a reduction in the use of chlorinated hydrocarbons might very well have a beneficial influence on reproduction of ospreys.

A ban on, or a reduction in the use of, pesticides probably would have to be on an international basis to be very effective. That is, curbing the use of pesticides in the United States where ospreys breed may not have a very important influence in restoring their reproductive potential as long as pesticides continue to be used in areas where the birds winter.

EXISTING MANAGEMENT PLANS

The Deschutes National Forest and the Oregon State Game Commission, and the Lassen National Forest have adopted and put into practice the initial phases of osprey management plans prepared by Hadley Roberts for Crane Prairie Reservoir and by Jack Kahl for Eagle Lake and Lake Almanor.

The management plan for Crane Prairie Reservoir called for creation of an osprey management area, osprey habitat survey, an information and education program, experimentation with artificial nesting poles, nest maintenance program, marking of trees to be reserved for nesting sites, and initiation of a research program--to obtain information on life history, productivity, food habits, pesticides, manipulation of fish populations and habitat requirements. The management plan for Eagle Lake and Lake Almanor calls for a habitat survey, continual surveillance for nesting sites, a program to preserve existing nesting sites and to erect artificial nesting sites as needed, and initiation of an information and education program. The California Department of Fish and Game is cooperating in this effort by supporting a two-year investigation to provide information on life history, productivity, food habits, pesticides and habitat requirements.

Robert Gale is preparing a management plan for the Klamath National Forest.

RESEARCH NEEDS

Perhaps the most immediately needed basic information is to learn the migration routes of ospreys nesting in the West and where they spend their winters. A total of only 55 ospreys have been banded in Colorado, California, Montana and Saskatchewan through the summer of 1968; of these, 6 have been recovered--2 in California, 1 in New Mexico, 1 in Louisiana, 1 in Coahuila, Mexico, and 1 in Nayarit, Mexico. An osprey banded at Eagle Lake in July 1970 was recovered in east Texas in the same year. With the exception

of the bird recovered in Nayarit, Mexico, all were recovered either during the summer prior to migration or during the early autumn when they most probably were migrating (Bird Banding Laboratory, U. S. Fish and Wildlife Service). Thus, on the basis of available information, it appears as if western ospreys migrate through the southwestern United States to the west-central coast of Mexico.

If western ospreys winter as far south as Guatemala--there is reason to believe they do since ospreys, which remain in their winter range as immature birds, were observed frequently in Guatemala during the summer of 1970 by S. G. Herman--they are exposed to very high levels of DDT applied 30 to 70 times each growing season to cotton crops. Knowledge of the migration routes in relation to agricultural areas utilized in transit is extremely desirable for the same reason.

Equally important but of less immediate concern is the need for extensive banding information to calculate mortality schedules of western populations of ospreys.

TERMINOLOGY AND TECHNIQUES

With the exception of items d and f under "active nest" and the use of occupied and used nests as synonymous for active nest, participants of this workshop subscribe to the recommendations proposed by Sergej Postupalsky in his mimeographed paper, "Bald Eagle and Osprey Nesting Studies, Recommended Methods and Terminology." Interested readers are advised to contact Mr. Postupalsky directly for copies of the paper c/o Department of Wildlife Ecology, University of Wisconsin, Madison, Wisconsin.

Aircraft have proven to be the only means of obtaining clutch and brood counts in inaccessible osprey nests at Flathead Lake, Crane Prairie Reservoir, Shasta and Clair Engle Lakes, and Eagle Lake and Lake Almanor. Aircraft also have greatly assisted the surveillance of streams in northwestern California for nests. Continued use of aircraft is indispensible for future research and management needs.

SUMMARY

Participants from several Federal and State conservation agencies, universities, and colleges met to compare findings from osprey studies being conducted in Montana, Idaho, Oregon, and California, for the purpose of identifying factors influencing the distribution and abundance of ospreys nesting in the West, for making management recommendations, for identifying research needs and for standardizing techniques and terminology.

Different populations are exposed to different limiting factors or potential limiting factors: ospreys in northeastern California have insufficient numbers of suitable nesting sites to support more than 50 to 60 breeding pairs of birds; the absence of sparsity of nesting ospreys along some streams with an abundance of apparently suitable nesting sites in northwestern California may be related to poor food conditions; the absence of nesting ospreys in apparently suitable nesting habitat within one to three miles of the Pacific shoreline in northern California and in Oregon presumably is related to the limiting influence of summer fog and afternoon sea breezes.

All populations of ospreys for which information on productivity was available are reproducing at rates below 1.22 young per breeding pair, the rate necessary to maintain population stability in eastern ospreys.

A small portion of the reproductive inhibition is attributable to losses of eggs and nestlings from accidental falls, weather, felling of nest sites by humans, shooting, and disturbance from recreational activity. The major portion of the reproductive inhibition, however, is attributable to the failure of some nesting females to lay eggs and to the failure of a large portion of eggs laid to hatch. At this time it is impossible to invoke any environmental factor other than contamination by pesticides to explain this form of reproductive inhibition.

Management recommendations include the protection and construction of nesting sites, shoring up of nests in areas exposed to heavy winds, careful review of fisheries management plans involving reduction of rough fish populations, discouraging recreational activity at the time eggs are hatching and when young chicks are being brooded, and banning or greatly restricting widespread use of chlorinated hydrocarbons, especially DDT. The management plans of the Deschutes National Forest and the Lassen National Forest are briefly summarized.

The most immediate research need is to learn the migratory routes of western ospreys and where they winter. Banding information also is needed to calculate mortality schedules of western ospreys.

Participants generally subscribe to the terminology and techniques proposed by Sergej Postupalsky.