Decline and Present Status of Breeding Peregrine Falcons in Oregon

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Unprecedented declines of the Peregrine Falcon (*Falco peregrinus*) throughout much of the Northern Hemisphere became apparent during the Madison Peregrine Falcon Conference in 1965 (Hickey 1969). Data from Britain were the most detailed; broken or missing eggs were much more common in 1949-56 than they had been in earlier years (Ratcliffe 1958). Subsequently, Ratcliffe (1967) showed a significant decrease in eggshell weight of peregrines in Britain starting in 1947 or 1948. Later, the same finding was demonstrated in North America (Hickey and Anderson 1968). The relation of eggshell thickness to DDE residue levels was established for Alaskan peregrines by Cade et al. (1971) and Peakall et al. (1975). Peakall (1976) stated that pesticides were considered to be a major factor in the decline of the peregrine, and tentatively concluded that the level of DDE in eggs that failed to hatch was 15-20 ppm (wet weight).

The peregrine was never studied intensively in Oregon. Bendire (1877) and Willett (1919) reported it fairly common near Malheur Lake in August, but less plentiful than the Prairie Falcon (*Falco mexicanus*). Bendire (1892) took a set of three slightly incubated eggs near Malheur Lake on 24 April 1877. Merrill (1888) reported it as resident and not uncommon at Fort Klamath, and Anthony (in Woodcock 1902) stated that a few were seen along the river below Portland. Bretherton (in Woodcock 1902) also referred to the species as a common breeding resident near Newport (Cape Foulweather) at the turn of the century. Gabrielson and Jewett (1940) considered it a comparatively rare bird in Oregon, where it was usually found following migrating waterfowl or near wintering flocks. They reported knowing of only one nesting pair since 1920 (Lake County). However, Bond (1946), in discussing the western population (which would include Oregon) considered the species "common" ($<$ 2000 square mi./known pair) west of the Sierra-Cascades and "rare" ($>$ 20,000 square mi./known pair) east of the Sierra-Cascades.

Fyfe et al. (1976) reported that recent information from the Pacific Northwest was limited because no concerted effort was made to locate active eyries or even to check all formerly occupied sites. Because many eyrie sites in Oregon have not been checked for more than a decade, our study was designed to resurvey historic eyrie sites and other likely nesting locations. We have also attempted to piece together the present status of the peregrine as a nesting species in Oregon, and to assess trends in the breeding population over the last several decades.

METHODS

The limited information available suggested that egg laying in Oregon begins in mid-April; therefore, our survey effort was made primarily in April, May, June, and July. During spring and summer 1978 and 1979, all historic peregrine nesting locations known to us in Oregon, and other locations which seemed suitable, were surveyed. The study began with a fixed-wing aerial reconnaissance and was followed by a helicopter survey at selected locations (20 hr flying time), but most checking involved vehicle and foot travel. Locations checked were based on Nelson's experience in Oregon, the records and recollections of other key personnel, published literature, and

museum specimens collected during the breeding season. Leads were also provided by state and federal biologists in addition to amateur ornithologists and falconers.

One intact egg was collected; eggshell thickness (including membrane) was measured at the equator with a Starrett 1010M micrometer. The mean thickness was based on seven measurements. The egg was analyzed for organochlorine contaminants at the Patuxent Wildlife Research Center, Laurel, Maryland, using standard methods (Cromartie et al. 1975, Kaiser et al. 1980). Residue levels were not corrected for percentage recovery. The lower limits for quantifiable residues for pesticides and PCB's were 0.1 ppm and 0.5 ppm, respectively. Content of the egg was converted to an approximately fresh wet weight by using egg volume (Stickel et al. 1973); residues are expressed on a fresh wet-weight basis.

HISTORICAL NESTING PAIRS IN OREGON

Bond (1946) reported 136 peregrine nesting sites in the western United States (west of the Continental Divide) but did not report totals by states, although about half (65) were from California (see Hickey 1969:97). However, Bond believed that the actual breeding population was more than twice the numbers known. Fyfe et al. (1976) stated that the Northwest population (Washington, Oregon, Idaho, and western Montana) probably historically numbered over 150 pairs of birds, although definite records existed for only some 50-60 pairs. Cade (1975) stated that the total number of known eyries in Oregon and Washington numbered between 33 and 38.

Nelson (1969) reported that Peregrine Falcons were declining in the western United States, including Oregon, before 1948 and attributed at least part of the decline to climatic changes. He (1969:65) summed up the mid-1960's situation by stating, "I would estimate that 80-90% of the nesting birds in Utah, Idaho, Oregon, Washington, western Wyoming, and western Montana have shifted from their former nesting sites."

Historical records of peregrines nesting were reported from three general regions of Oregon: (1) coastal and western Oregon, (2) the Columbia River, and (3) the Cascade Mountains and eastern Oregon. More recent reports of active sites not known during Bond's studies (before 1948) were not accepted unless activity during our 2-year study could be verified. Following is the information we were able to find concerning the number of pairs historically nesting in each region, and the population changes which have occurred during the last several decades.

Coastal and Western Oregon

Historically, we believe at least 18 locations (not including several ledges at a given location) supported breeding peregrines, and that the majority of the sites were coastal; the remainder ranged from a few miles to about 75 mi inland. Thirteen of the sites were visited a sufficient number of times to determine the general timing of their abandonment. One was lost early in the century, most likely due to human encroachment; one was last occupied in the late 1940's; nine were last occupied in the 1950's; and the remaining two in the 1960's. At the site last occupied in the late 1940's, a pair was present on 18 April 1948; but on 2 May 1948, when a bird was flushed from a depression on the ledge, no eggs were present. Checks in 1950, 1953, and later revealed no birds at the site. S. G. Jewett (unpubl. field notes) recorded a number of sightings of a pair beginning in August 1946 at the Fern Ridge Reservoir. He apparently did not know of the eyrie which was within reasonable distance of the reservoir. Gullion (1951) listed the species as a common winter visitor in the southern Willamette Valley with extreme dates of 21 June (1945) and 3 August (1946)—probably also the same birds. We know of no verified records of peregrines now nesting in this region.

Columbia River (Oregon and Washington Sides)

The Columbia River sites were located primarily in the gorge, but ranged from The

Dalles almost to the ocean. Nelson (1969) reported that Bond knew of 13 pairs historically breeding along the river, but the sites were never all visited by Nelson. Furthermore, some may have been alternate sites. We know the locations of only five sites along the river that were occupied in the late 1930's or early 1940's. Four were visited an adequate number of times to provide the decade last occupied. One was last occupied in the 1940's and three in the 1950's.

Cascade Mountains and Eastern Oregon

We documented at least 19 nesting locations for this region. Sixteen of the locations were visited often enough to determine the decade in which they were last occupied by a pair or single bird. Two were last occupied early in the century, four in the 1930's, two in the 1940's, five in the 1950's, one in the 1960's, and two remained occupied in 1979 (one pair produced two young and one site had a single adult male).

The records from the Fort Rock site typify a location that was last occupied in the 1930's. Jewett collected an adult male (San Diego Museum #20065) at the site on 12 June 1920, and on 11 May 1927 a pair of peregrines were nesting on the west side of Fort Rock (Jewett's unpubl. field notes). Bond noted a pair present in 1937, and W. E. Griffee saw an adult male on 15 April 1938. Checks by Griffee on 22 April 1942, 25 April 1943, and 25 April 1945 produced no peregrines. Bond further documented that the birds were not seen in 1946, 1947, or 1948, and Nelson has not seen the birds in more recent years.

The timing of the last occupancy of eyries by region is summarized in Table 1. It becomes obvious that the majority of the eyries were last occupied in the 1950's. The four sites last occupied in the 1940's were last reported in 1948, 1949 (two sites), and one eastern Oregon site in 1940. It is also noteworthy that the only sites last occupied in the 1930's or early 1940's (before DDT era) were from eastern Oregon.

TABLE 1. Periods when Peregrine Falcon eyries were last occupied in Oregon.

Region (totals)	Unknown	Early in century	1930s	1940s	1950s	1960s	1970s
Coastal and western (18)	5	1	0	1	9	2	0
Columbia River (5)	1	0	0	1	3	0	0
Cascades and eastern (19)	3	2	4	2	5	1	2
Totals (42)	9	3	4	4	17	3	2

FOOD HABITS

Sherrod (1978) summarized the diets of North American Falconiformes. The peregrine may be considered to prey minimally on mammals but primarily on birds. Eight studies cited showed in excess of 94% birds in the diet (basis of occurrence, not biomass). The literature on prey of peregrines in Oregon consists of three notes documenting the taking of a Cinnamon Teal (*Anas cyanoptera*) (Gabrielson 1922), a Ring-necked Pheasant (*Phasianus colchicus*) (Gullion 1947), and a Bonaparte's Gull (*Larus philadelphia*) (Browning 1973), with the exception of general statements about falcons taking waterfowl. Jewett (unpubl. field notes) recorded remains of the following species at an inland eyrie: Lewis Woodpecker (*Melanerpes lewis*), Yellow Warbler (*Dendroica petechia*), Common Flicker (*Colaptes auratus*), Mourning Dove (*Zenaida macroura*), Black-billed Magpie (*Pica pica*), Western Meadowlark (*Sturnella neglecta*), Mountain Bluebird (*Sialia currucoides*), Stellers Jay (*Cyanocitta stelleri*), Microtus sp., Black-tailed Jack Rabbit (*Lepus californicus*), and Townsend Ground Squirrel (*Spermophilus townsendii*). We recorded 19 prey species at the active 1979 eyrie: Sora (*Porzana carolina*), Black Turnstone (*Arenaria melanocephala*),

Rock Dove (*Columba livia*), Pygmy Owl (*Galucidium gnoma*), Hairy Woodpecker (*Picoides villosus*), Lewis Woodpecker, Gray Jay (*Perisoreus canadensis*), Common Crow (*Corvus brachyrhynchos*), Clark's Nutcracker (*Nucifraga columbiana*), Western Meadowlark, Brewer's Blackbird (*Euphagus cyanocephalus*), Brown-headed Cowbird (*Molothrus ater*), Evening Grosbeak (*Hesperiphona vespertina*), Pine Siskin (*Carduelis pinus*), Lazuli Bunting (*Passerina amoena*), Western Tanager (*Piranga ludoviciana*), Violet-green Swallow (*Tachycineta thalassina*), Cedar Waxwing (*Bombycilla cedrorum*), and Mountain Bluebird. More Rock Doves and Evening Grosbeaks were found at the 1979 eyrie than any other species. Of the 19 species, 6 were migratory, 3 partially migratory, and 10 permanent residents in Oregon (Gabrielson and Jewett 1940). The Peregrine Falcon in Oregon, as in other parts of its range, preys almost totally upon birds.

PESTICIDES AND EGGSHELL THINNING

The relation of pesticide content of egg to eggshell thinning has been studied in detail in Britain (Ratcliffe 1970) and North America (Cade et al. 1971, Peakall et al. 1975). The discovery that organochlorine pesticides could be extracted from the lipid of membranes of dried eggshells for analysis (Peakall 1974) made it possible to relate eggshell thinning to pesticide levels even when the egg contents were not available. Recent studies have shown the presence of DDE in the membranes of peregrine eggs collected in 1948-50 in California (Peakall 1974) and in 1947-52 in Britain (Peakall et al. 1976). From eastern North America, a small sample of Peregrine Falcon eggs showed substantial eggshell thinning and high levels of DDE by 1947 (Peakall and Kiff 1979). This population is now extinct (Fyfe et al. 1976). One unhatched egg was collected in Oregon in October 1979 from a nest in which two young were fledged; its shell thickness was 0.295 mm, which is 19% below the pre-1947 mean of 0.365 $\pm$ 0.003 (95% C.L.) reported for southern California (Anderson and Hickey 1972). Assuming a normal distribution, the probability of finding a pre-1947 peregrine egg with a shell thickness of 0.295 mm or less is extremely small ($P = 0.0012$). The unhatched egg contained a well-developed embryo; perhaps one week from hatching. Organochlorine contaminants (ppm wet weight) in the egg were: DDE 19, DDD 0.10, dieldrin 0.61, heptachlor epoxide 0.29, oxychlordane 0.09, *cis*-chlordane 0.12, *trans*-nonachlor 0.19, HCB 0.09, and est. PCB 2.9.

A summary of the 1945-65 aerial spraying of DDT in the Pacific Northwest and California to control forest insects is presented in Table 2. Additionally, 427,000 a (mostly at ¾ lb/a) of coniferous forest in eastern Oregon, eastern Washington, and northern Idaho were sprayed in 1974. Although forest spraying with DDT was a fraction of the total acreage treated, the distribution among states and the temporal pattern of application is of interest because many peregrines were associated with forested lands. Note that Oregon forests received the most DDT (17% of total commercial forest land in Oregon treated [Moore and Loper 1980]), but were closely followed by Idaho and Montana. Washington and California forests received considerably less. The location and year of forest insect control projects in Oregon using DDT are shown in Figure 1.

CLIMATIC CHANGES

Captain Bendire (1877:109) observed southeastern Oregon during peak water years in the 1870's and stated, ". . . the country may be called well watered throughout; a continuous chain of shallow lakes extends from here [Camp Harney] to the southwest for more than two hundred miles, and some of these are from ten to twenty miles wide and thirty to fifty miles in length. . . . The many lakes form a natural highway and convenient resting places for the immense hordes of water fowl passing

TABLE 2. Acreage aerially sprayed with DDT to control forest insects in the Pacific Northwest and California, 1945-65 (data from U.S. Forest Service).

Year	Acreage sprayed with DDT				
	Oregon	Washington	Idaho	Montana	California
1945	2,000				
1947	14,000	4,000	396,000		
1948	4,000[a]				
1949	267,000				
1950	907,000	26,000			
1951	791,000[b]	125,000[b]			
1952	522,000	135,000		12,000	3,000
1953	370,000		16,000	117,000	
1954	68,000		255,000		
1955	621,000		964,000	246,000	
1956			595,000	766,000	10,000
1957			661,000	721,000	1,000
1958	818,000			18,000	
1959				127,000	2,000
1960				118,000[c]	
1961			1,000		
1962	33,000[b]	46,000		452,000[c]	
1963		14,000[b]	207,000[d]	415,000[c]	
1964			525,000[e]		3,000[b]
1965	66,000[b]		120,000[b]		59,000[b]
TOTALS	4,483,000	350,000	3,740,000	2,992,000	78,000

Note: No footnotes, 1 lb/acre; [a]½ to 2 lbs/acre; [b]¾ lb/acre; [c]½ lb/acre; [d]½ to 1½ lb/acre; [e]½ to 1 lb/acre.

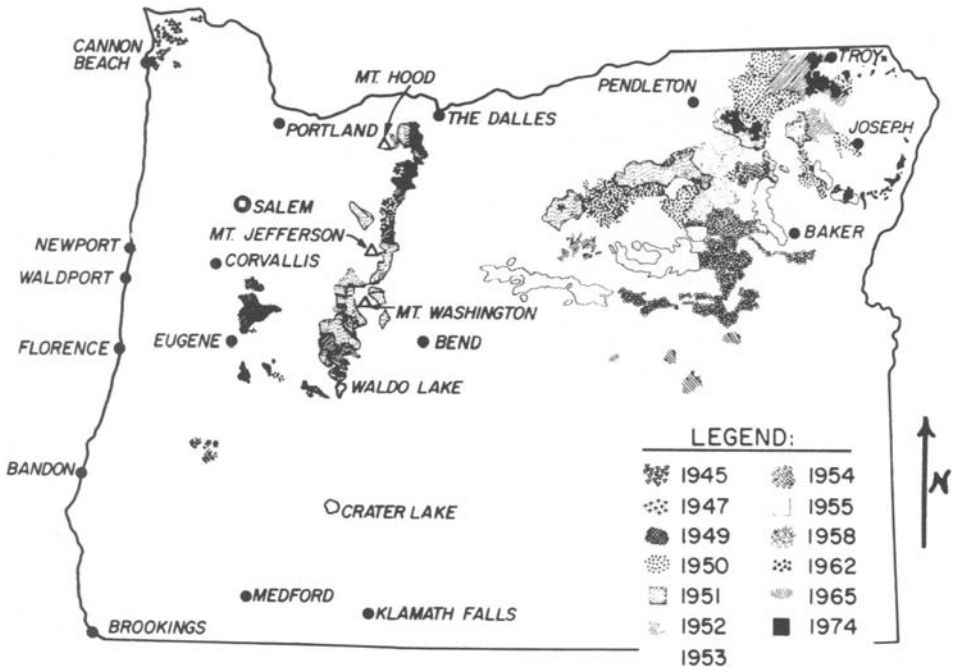

FIGURE 1. Forest insect aerial spray projects in Oregon with DDT (from Moore and Loper 1980; reprinted with permission from Pestic. Monit. J.).

through here during the spring and fall migrations; they also furnish safe and undisturbed breeding resorts for many species." Bendire further noted that in Harney Valley, the peregrine was seen only near Malheur Lake—attracted by the great numbers of waterfowl.

Nelson (1969) stated the combination of rising average temperatures and drastically reduced snowfall and precipitation, starting sometime after 1870, changed soil conditions, dried up small lakes and ponds, and significantly lowered the surface water area of larger lakes in the Intermountain West. He further noted that this change caused a critical reduction in habitat for shorebirds that are important prey species for peregrines. The long-term change in climatic conditions in the Intermountain West probably can best be shown by water levels in the Great Salt Lake, Utah (Fig. 2). Water levels peaked in 1873 (4,211 ft. elev.), declined at the turn of the century, increased in the early 1920's, and declined precipitously in the late 1920's and early 1930's reaching lows in 1935 (4,194 ft. elev.) and again in 1963 (4,191 ft. elev.). More recently, water levels and habitat have made significant improvement but remain below those reported in the 1870's. Porter and White (1973) discussed the peregrine decline in Utah with respect to drought. They noted that the desertion of some eyries during the early 1940's and perhaps earlier in the century is explainable on the basis of Nelson's climatic change hypothesis. However, they state that if climate had been the sole cause of the decline in Utah, one should have expected the reactivation of eyries by the early 1950's following the development of the migratory waterfowl refuges in Utah, yet this did not happen.

Stockton and Meko (1975) also presented a long-term history of drought in the western United States as inferred from tree rings. They concluded that the mid-1930's drought in the western United States was unsurpassed in magnitude by any drought in the previous two centuries (since 1700). According to a similar study by Keen (1937) for eastern Oregon, the period 1918-34 was the driest in at least 650 years. Many of the Oregon lakes Bendire (1877) observed at or near the highest levels in the mid-1870's were dry or almost dry in the early 1930's; they were dry or almost dry again in the early 1960's, thus paralleling the pattern shown for the

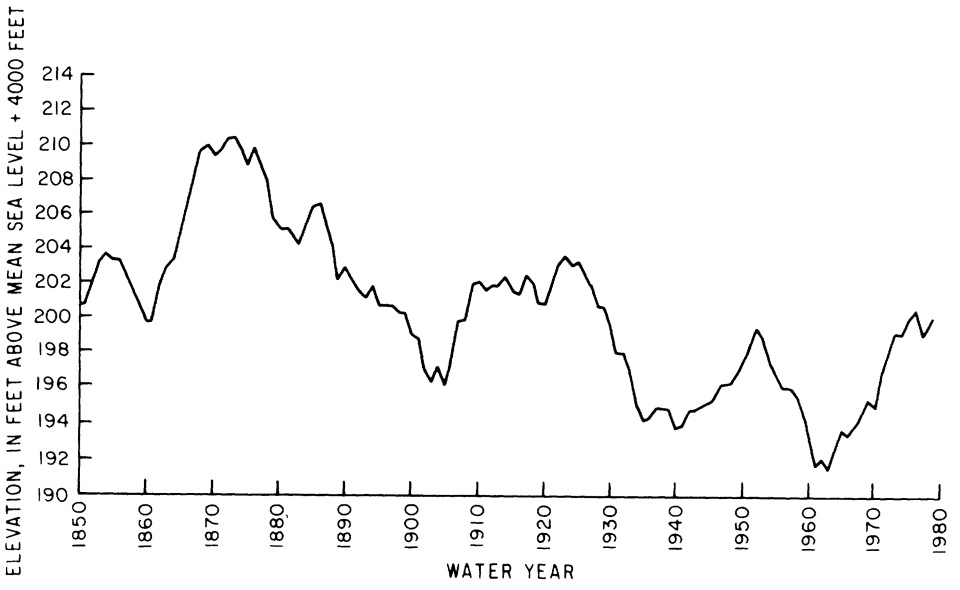

FIGURE 2. Water surface elevations of Great Salt Lake (data from U.S. Geological Survey).

Great Salt Lake. However, water levels in 1979 showed considerable improvement (Table 3).

TABLE 3. Percentage changes in the surface area of lakes in the northwest (from Phillips and Van Denburgh [1971] and U.S. Geological Survey [unpublished data] for 1979 unless otherwise indicated).

	Maximum size		Lowest size		1979	
State and lake	Sq. miles	year	Sq. miles	year	Sq. miles	Percent of max.
Utah						
Great Salt	2452	1873	916	1963	1666	68%
Oregon						
Goose	194	1868, 1881	Dry	1926, 1929-34	155 (est.)	80%
Malheur	[a]	1877-81	Dry	1934	97	—
Abert	[b]	—	Dry	1924, others thru 1937	58 (est.)	—
Summer	71	pre-1905	Dry	1931, 1950, 1961	45 (est.)[c]	63%

[a]A drain was apparently closed by an extension of the 'sand reef"; about 12 feet higher than 1979 (Piper et al. 1939), but no surface area estimates available; [b]No estimates before 1906; [c]Estimated by A. Boyd Claggett (Oregon Dept. Fish and Wildlife).

CONCLUSIONS AND DISCUSSION

The Oregon breeding population of peregrines was minimally 39 pairs in the 1930's and now (1979) reduced to 1 known pair and a single adult male. A few additional pairs may be in the state, but the pattern of loss is unmistakable. A few sites were abandoned early in the century, probably due to man's activities in the immediate vicinity of the eyries. Five sites were abandoned in the eastern portion of the state before the advent of DDT use. These losses support Nelson's (1969) hypothesis of climatic change leading to the replacement of peregrines with Prairie Falcons. This hypothesis is further supported by the fact that few, if any, eyries were abandoned in the more mesic western Oregon and Columbia River regions during the same time period.

Most of the statewide population decline occurred during the 1950's, which corresponds to the period of peak DDT use in the United States, as well as peak use in the forests of Oregon. Total domestic uses of DDT in the United States were reduced nearly 50% between 1958 and 1966 (Mrak 1969), and the chemical product was banned nationwide in 1972. However, an unhatched peregrine egg found at the only known Oregon eyrie in 1979 still contained 19 ppm DDE and lesser amounts of other contaminants. The eggshell was 19% thinner than normal. These 1979 findings are especially disheartening in view of Peakall's (1976) tentative conclusion that hatching failure occurs when DDE reaches 15-20 ppm in peregrine eggs. Also, Lincer (1975) pointed out that not one North American raptor population exhibiting 18% or more eggshell thinning has been able to maintain a stable self-perpetuating population. This pair of peregrines may indeed be fortunate that they produced two young in 1979.

Further support for the contention that DDT played an important role in the statewide peregrine decline is available from a single DDT spray project (¾ lb/a) in Oregon in 1974. One year later, the American Kestrel (*Falco sparverius*)—not a species showing widespread population declines—laid eggs that were 10.4% thinner in the spray area than in the control area (13 to 28 miles away) and 11.5% thinner than the pre-DDT era norm (Henny 1977). Furthermore, residues in blood plasma of the

Goshawk (*Accipiter gentilis*), Cooper's Hawk (*A. cooperii*), and Sharp-shinned Hawk (*A. striatus*) showed an even greater pesticide buildup in the same spray area. Thus, an eggshell thinning response to a DDT spraying can be almost immediate following application of the pesticide. This result further supports Peakall's (1974) finding of DDE in the membranes of peregrine eggs collected in nearby California in 1948-50, and Ratcliffe's (1967) finding of a significant decrease in eggshell weight of the peregrine in Britain beginning in 1947 or 1948. The peregrine decline we report for Oregon is similar to that reported in many other locations (Hickey 1969).

The source of the contaminants is not fully understood. Potential sources include the peregrine's breeding or wintering grounds, or somewhere within the prey species' range. Coastal peregrines at one site in Oregon were permanent residents (L. L. Schramm, pers. comm.), but we know little about the characteristics of the interior population. It is noteworthy that the two adults and two young at the interior site in 1979 were still present on 12 October. The American Kestrels associated with the 1974 DDT spray project were migratory (Henny, unpubl. data) yet exhibited significant eggshell thinning when their breeding area was sprayed. Also, at least a portion of the prey species at the 1979 peregrine eyrie was migratory.

California's population of peregrines was historically larger than the Oregon population (Herman et al. 1970, Herman 1971); however, at least 23 nesting territories remained occupied in 1978 (Harlow 1978). Sixteen of the sites were in the northern interior region of California (much of it forested) which was seldom sprayed with DDT (Table 2). We believe that local use of DDT may have played an important role in the Oregon population decline; however, we recognize that DDT does circulate over a wide area—e.g., when it was sprayed in the Pacific Northwest during the summer of 1974, the chemical rained down on New York State (Peakall 1976a). That the pattern of coastal peregrine eyries are the most adversely affected seems inescapable. They are unoccupied in Oregon, they have low occupancy with poor production in adjacent California (Harlow 1978), and they are the last to be reoccupied in Britain (Ratcliffe 1980).

Field observations and data from eastern Oregon show significant improvement in peregrine habitat since 1961, yet there has been no peregrine recovery.

RECOMMENDATIONS

The nearly extirpated population of the Peregrine Falcon in Oregon is in need of immediate assistance. We believe that reintroduction is the only approach that has the potential for positive results. Several areas where peregrines nested historically seem suitable at the present time for reintroduction on the basis of habitat quality. However, we believe the accurate classification of critical habitat or reintroduction sites is tenuous due to the bird's individual variability. Recognizing these problems we have listed, in order of priority, the following regions: (1) Malheur-Steens Mountain (preferably at or adjacent to Malheur National Wildlife Refuge), (2) Warner Basin-Summer Lake (preferably at or adjacent to Summer Lake Wildlife Management Area), and (3) the Columbia Gorge. We have some reservations about the suitability of the Columbia Gorge. If these birds were resident, suitable wintering areas may now be limited because of human encroachment. We have recommended a National Wildlife Refuge and a State Wildlife Management Area as two prime reintroduction sites for several reasons: (1) the greater abundance of prey, and (2) the presence of wildlife management personnel. Furthermore, release of peregrines on refuges in the eastern United States has been successful. Also, where potential conflicts with Great Horned Owls (*Bubo virginianus*) and Golden Eagles (*Aquila chrysaetos*) exist at historic nesting cliffs, we recommend that towers or nesting platforms in suitable locations be constructed (as in the east) as an alternative for the reintroduction of captive-bred

peregrines. Also, there are many isolated Prairie Falcon eyries in Oregon adjacent to historic peregrine eyries which could be used for foster parent reintroductions. A careful evaluation for insect problems in addition to nearby Golden Eagles and Great Horned Owls is essential if this approach is pursued. We have not recommended coastal release sites in Oregon because poor productivity still occurs in this region of adjacent California.

In the reintroduction of peregrines to any locality, a thorough research of DDT use in the vicinity should be made for guidance to areas where the least contamination exists. We remain concerned about contamination in Oregon because of the 19 ppm found in one unhatched egg at the only eyrie located in 1979. A collection of prey samples in Oregon provides an index to pollutant contamination and is underway. However, such an evaluation is difficult to relate to nesting peregrines' contaminant intake. The biomass of each prey species consumed is an unknown since many birds of prey, including peregrines, are opportunistic feeders. Furthermore, peregrines may become resident at some sites and migrants (going who knows where and possibly obtaining additional contaminants) at other locations due to the diverse climate in Oregon.

SUMMARY

In 1979, only one Peregrine Falcon pair (they fledged two young) and a single adult male were located. A population decline east of the Cascades began in the 1930's, probably resulting from a climatic change (drought); however, a statewide decline began in the late 1940's, accelerated in the 1950's, and by the 1960's few pairs remained. The statewide decline closely paralleled the pattern of DDT use. Furthermore, DDE was found in membranes of peregrine eggs from nearby California as early as 1948. Moreover, an unhatched Peregrine Falcon egg found at the Oregon eyrie in 1979 contained 19 ppm DDE and lesser amounts of other contaminants. The eggshell was 19% thinner than normal. The future of the nearly extirpated Peregrine Falcon in Oregon remains uncertain in spite of improved water and habitat conditions in eastern Oregon. Reintroduction of captive-bred birds seems to be the last hope.

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ADDENDUM: The eyrie in 1979 was active again in 1980; however, the three eggs laid failed to hatch. Mean shell thickness of the three eggs was 0.299 mm (range 0.291-0.303), mean DDE residues were 18 ppm (range 16-20), PCB's 2.2 (2.1-2.3), DDD 0.13 (0.12-0.13), dieldrin 0.38 (0.30-0.52), heptachlor epoxide 0.25 (0.20-0.34), oxychlordane 0.13 (0.11-0.16), *cis*-chlordane 0.07 (0.06-0.08), HCB 0.10 (0.07-0.13), *trans*-nonachlor 0.08 (nd-0.10), and mirex 0.05 (nd-0.06). The 18% shell thinning in 1980 was similar to the 19% in 1979; the 16-20 ppm DDE in 1980 was similar to the 19 ppm in 1979, which suggests that the same bird laid the eggs each year. Other pesticide residues were also similar each year.