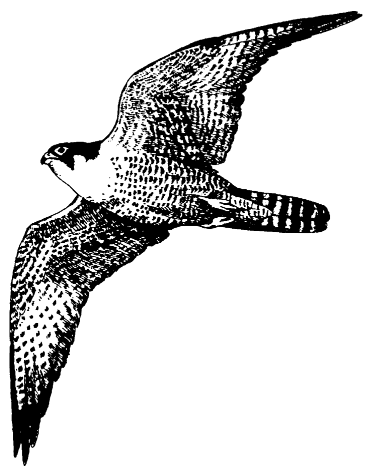
DRAFT

Washington State Status Report

for the Peregrine Falcon



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The Washington Department of Fish and Wildlife maintains a list of endangered, threatened and sensitive species (Washington Administrative Codes 232-12-014 and 232-12-011, Appendix G). In 1990, the Washington Fish and Wildlife Commission adopted listing procedures developed by a group of citizens, interest groups, and state and federal agencies (Washington Administrative Code 232-12-297, Appendix G). The procedures include how species listing will be initiated, criteria for listing and delisting, public review and recovery and management of listed species.

The first step in the process is to develop a preliminary species status report. The report includes a review of information relevant to the species' status in Washington and addresses factors affecting its status including, but not limited to: historic, current, and future species population trends, natural history including ecological relationships, historic and current habitat trends, population demographics and their relationship to long term sustainability, and historic and current species management activities.

The procedures then provide for a 90-day public review opportunity for interested parties to submit new scientific data relevant to the status report, classification recommendation, and any State Environmental Policy Act findings. During the 90-day review period, the Department holds two public meetings: one in eastern Washington and one in western Washington. At the close of the comment period, the Department completes the Final Status Report and Listing Recommendation for presentation to the Washington Fish and Wildlife Commission. The Final Report and Recommendation are then released 30 days prior to the Commission presentation for public review.

This is the Draft Status Report for the Peregrine Falcon. **Submit written comments on this report by 1 November 2001 to: Harriet Allen, Wildlife Program, Washington Department of Fish and Wildlife, 600 Capitol Way N, Olympia, WA 98501-1091**. The Department will present the results of this status review to the Fish and Wildlife Commission for action at the April 2002 meeting.

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Cover illustration by Darrell Pruett

Important Notice

Readers, please note that this report contains information on the status of this species through the 2000 breeding season. Complete data on occupancy and reproductive data for the 2001 breeding season will be included in the final status report. However preliminary information submitted to WDFW at the time of this printing indicates a minimum of 72 territorial pairs and 84 known territories in the state.

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EXECUTIVE SUMMARY

The peregrine falcon experienced a dramatic population decline over much of its nearly global range following the widespread use of the insecticide DDT shortly after World War II. Peregrines are aerial hunters of birds and it was through the accumulation of DDT and other organochlorine contaminants obtained from their prey that led to eggshell thinning and other toxic effects. The thinned eggshells broke on nest ledges or were not viable, and this facilitated a rapid population decline that exterminated the species in eastern North America and greatly reduced its abundance elsewhere. The peregrine was listed as an endangered species by the U.S. Fish and Wildlife Service in 1970 and by the Washington State Fish and Wildlife Commission in 1980. DDT use in North America ceased in the 1970s. At about that same time efforts to breed peregrines in captivity were proving successful and beginning in the 1980s and extending through much of the 1990s these captive-bred falcons were released annually at various locations in the Columbia Gorge and eastern Washington via “hacking.” Hacking efforts proved to be successful in providing recruits to the North American population.

Historical accounts of the nesting population of peregrines in Washington were varied and likely underestimated population size. Historically, 12 breeding territories were known prior to 1980. WDFW began monitoring the population in 1980 and found only 4 pairs in the state. Since 1980 the population has increased substantially and in 2000 there were 56 pairs at 73 known territories. The number of known pairs and territories has doubled since 1993 and 1994, respectively. For the last decade productivity has averaged 1.49 young per territorial pair, a rate of productivity associated with a stable population. The peregrine falcon now occurs in most portions of the state where there are prominent cliffs for nesting and an abundance of prey.

The outlook for peregrine populations in the state appears promising, although close monitoring is warranted. The primary threats to the state’s population at this time are its relatively small size and disturbance at nest sites. Small populations typically have low viability because of their vulnerability to chance events, such as demographic, environmental, or genetic stochasticity, and catastrophe. The Washington population, although numerically small, is not isolated however, as the species’ high mobility and noted migratory behavior means that local birds are actually part of a larger regional population. Despite the regional context of the Washington population, its size makes it somewhat vulnerable should a factor emerge with the potential to reduce populations at large spatial scales (e.g. pollution, disease). At present, it does not appear likely that a disease or chemically-induced population decline will occur. Although contaminants are still present in the environment and eggshell thickness has not returned to levels considered normal in the pre-DDT era, the population is steadily increasing, productivity is generally high, the majority of known sites are occupied annually, and peregrines have begun to re-colonize all regions of the state.

Because of the small population size, individual sites contribute substantially to the health and distribution of the overall population of the state. Some sites currently have disturbance factors such as rock climbing, hiking trails, or roads above nest sites, or proposed human developments proposed at or near the sites. Management and/or enforcement intervention is needed at these sites to prevent impacts to nesting success. Consequently, site management plans should be developed to protect nest sites from human disturbance where such disturbance has the potential to adversely affect reproduction. Monitoring will be required to determine the locations and productivity of nest sites.

The WDFW remains concerned about the health of the peregrine falcon population in Washington. The factors that caused the recent population decline have been reduced, however, and the population has increased steadily in recent years. The WDFW therefore recommends that the species be down-listed to sensitive in the state of Washington. A state sensitive species is considered a species "... that is likely to become endangered or threatened in a significant portion of its range within the state without cooperative management or removal of threats" (WAC 232-12-297).

"The peregrine falcon is, perhaps, the most highly specialized and superlatively well developed flying organism on our planet today, combining in a marvelous degree the highest powers of speed and aerial adroitness with massive warlike strength. A powerful, wild, majestic, independent bird, living on the choicest of clean, carnal food, plucked fresh from the air or surface of the waters, rearing its young in the nooks of dangerous mountain cliffs, claiming all the atmosphere as its domain and fearing neither beast that walks nor bird that flies, it is the embodiment of noble rapacity and lonely freedom. It has its legitimate and important place in the great scheme of things, and by its extinction, if that should ever come, the whole world would be impoverished and dulled." (G.H. Thayer 1904)

TAXONOMY

Peregrine falcons (*Falco peregrinus*) are members of the order Falconiformes, which comprises the diurnal birds of prey, and family Falconidae that encompasses the caracaras and falcons. Peregrines are one of five species of *Falco* that occur in Washington at some time in their annual cycle (AOU 1998). Nineteen subspecies of the peregrine are recognized world-wide (White and Boyce 1988) and three subspecies occur in North America (Clark and Wheeler 1987). These three subspecies include the arctic peregrine (*F. p. tundrius*), Peale's peregrine (*F. p. pealei*), and American peregrine (*F. p. anatum*). White and Boyce (1988) used discriminant function analysis of five body and three facial measurements to separate the three subspecies. Overall, *F. p. pealei* was the easiest to discriminate. Males of the different subspecies were easier to separate than females, and with the exception of *pealei*, immatures were more easily separated than adults. Adult females were generally more difficult than males to assign to a subspecies. In the northern part of the species' range, intergrades occur where the subspecies' ranges are adjacent and a number of traits characteristic of one race are shared by individuals of the adjacent race. In the northern hemisphere, there are fewer differences between races than in the southern hemisphere, a trend likely due to the latter being more geographically isolated (White and Boyce 1988).

DESCRIPTION

Peregrines, like other falcons, are known for their fast and powerful flight. Fast flight is facilitated by the large, powerful flight muscles and long, pointed wings (Clark and Wheeler 1987). Peregrines exhibit reversed sexual dimorphism, whereby females are larger than males (Snyder and Wiley 1976). For example, female arctic peregrines can weigh from 1.6 to 2.1 lbs (0.7 to 0.9 kg) and males from 1 to 1.5 lbs (0.5 to 0.7 kg) (Clark and Wheeler 1987). Wing spans range from 37 to 39 in. (94 to 99 cm) and 40 to 46 in. (102 to 117 cm) for male and female arctic peregrines, respectively. Body length in males ranges from 14 to 16 in. (36 to 41 cm) and in females from 16 to18 in. (41 to 46 cm). Immatures are larger than adults because of their longer tails and wider wings (Clark and Wheeler 1987).

Peregrines, like other falcons, have powerful feet for grasping or striking prey. The hallux acts in opposition to three forward toes, each with a sharp, curved talon. Instead of killing their prey by penetration with their talons, peregrines deliver a powerful bite to the back of the head or neck of their quarry (Cade 1982).

The peregrine is a large, dark falcon, with a wide, dark malar area on the side of the head. In most plumages, the dark head appears hooded, and in flight the underwings appear dark. The back and upperwing coverts of adults are slate gray with blue-gray barring and feather fringing. The three North American subspecies differ in size and plumage (Fig. 1). The arctic peregrine is the smallest and lightest in color, the American peregrine is larger and darker, and the Peale's peregrine is the largest and darkest of the three (Clark and Wheeler 1987). The arctic peregrine has a blackish head with a pale forehead, a narrower malar stripe relative to the other two subspecies, a large white area on the cheek, and pale markings on the hind neck. The American peregrine is distinguished by a black head that has a smaller white to rufous cheek patch (or none) and white throat that often sets off the wide dark malar stripe. Underparts typically have a rufous wash that is heavier on the breast. The rufous breast is unstreaked or slightly streaked and the white belly is barred with black on the arctic and American subspecies, whereas for the Peale's, the white breast is more heavily spotted. The Peale's peregrine is similar to the American peregrine, but more heavily marked, and usually darker. The white cheek patch is larger and streaked. The breast is white with dense spotting, and lacks the rufous wash (Clark and Wheeler 1987).

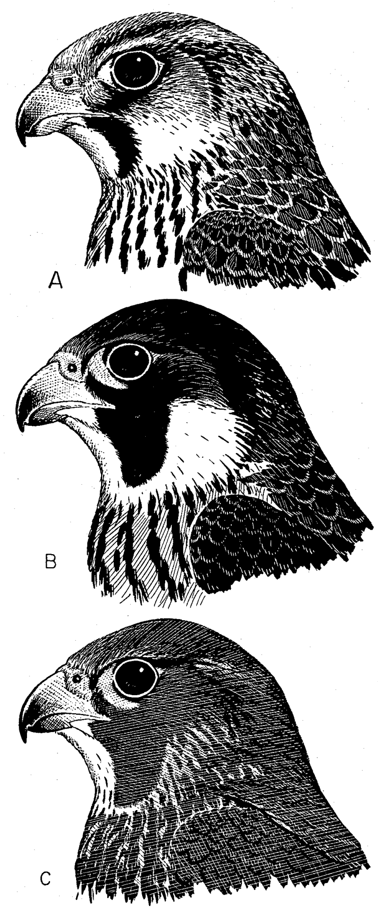

Figure 1. Facial patterns of first-year North American peregrines showing main subspecies characters; (A) arctic peregrine, (B) American peregrine, and (C) Peale's peregrine. Adapted from Beebe (1974); used with permission of Royal British Columbia Museum.

Sexes are often similar in plumage. In general, adult males are whiter on the breast and less heavily barred on the belly than adult females. In general, immature peregrines are dark brownish above with heavily streaked underparts. On perched birds, wingtips extend to (adult) or almost to (immature) the tail tip. In adult birds, the eye-ring, cere, and legs are yellow to yellow-orange; in immature birds, the eye-ring and cere are light blue, or occasionally yellowish, and leg color varies from light blue to yellow (Clark and Wheeler 1987). In flight, the absence of contrasting axillaries (underwing feathers closest to body) and wing coverts distinguishes all peregrines from prairie falcons (*Falco mexicanus*).

DISTRIBUTION

Global

The peregrine has one of the most extensive natural distributions of any bird in the world, surpassed only by the raven (*Corvus corax*) and osprey (*Pandion haliaetus*) (Cade 1982). Peregrines breed on every continent, except Antarctica, and on many oceanic islands (Cade 1982, White and Boyce 1988). Nesting populations occur from 55ºS at Tierra del Fuego, in South America, to 76ºN latitude in western Greenland (Cade 1982).

North America

The peregrine breeds, or formerly bred, in North America from northern Alaska, northern Canada, south along the Pacific coast to southern Baja California, and in the Rocky Mountains to southern Arizona, New Mexico, and western Texas, occasionally to the Sonora coast and northern Mexico (Johnsgard 1990, AOU 1998). Peregrines formerly bred in Kansas, Arkansas, Louisiana, Tennessee, Alabama, and Georgia. The species was extirpated as a breeder east of the Rocky Mountains and south of the boreal forest in Canada stemming from the widespread application of DDT in the environment, its bio-accumulation in the food chain, and resulting impairment of peregrine reproduction. Peregrines have been re-introduced in this region through cooperative conservation measures. Peregrines winter from southern Alaska, the Queen Charlotte Islands, coastal British Columbia and the eastern United States, south through Central America, the West Indies, and South America (Johnsgard 1990, AOU 1998).

The three North American subspecies breed and winter in different geographic areas (Fig. 2). The arctic peregrine breeds in the tundra areas of northern North America. This subspecies is highly migratory, wintering from Baja California and the Gulf Coast to Chile and Argentina. The Peale's peregrine breeds in the Kuril Islands, in northeastern Asia (AOU 1957, Beebe 1974), and in North America, from the Aleutian Islands to the Queen Charlotte Islands, northern Vancouver Island, and the northwest coast of Washington. This subspecies is largely sedentary, is resident year-round in parts of the Aleutian Islands, the Alaskan Panhandle, and the Queen Charlotte Islands. Immatures and some breeding adults move south to winter along the coast in southern British Columbia, Washington, Oregon, California, and rarely northern Mexico. The American peregrine breeds in areas not occupied by *F. p. pealei* or *F. p. tundrius,* although some overlap likely occurs along the "borders" of the respective subspecific ranges. Northern populations of *F. p. anatum* are relatively migratory, wintering at least to the Gulf Coast, whereas southern populations are thought to be more sedentary (Johnsgard 1990).

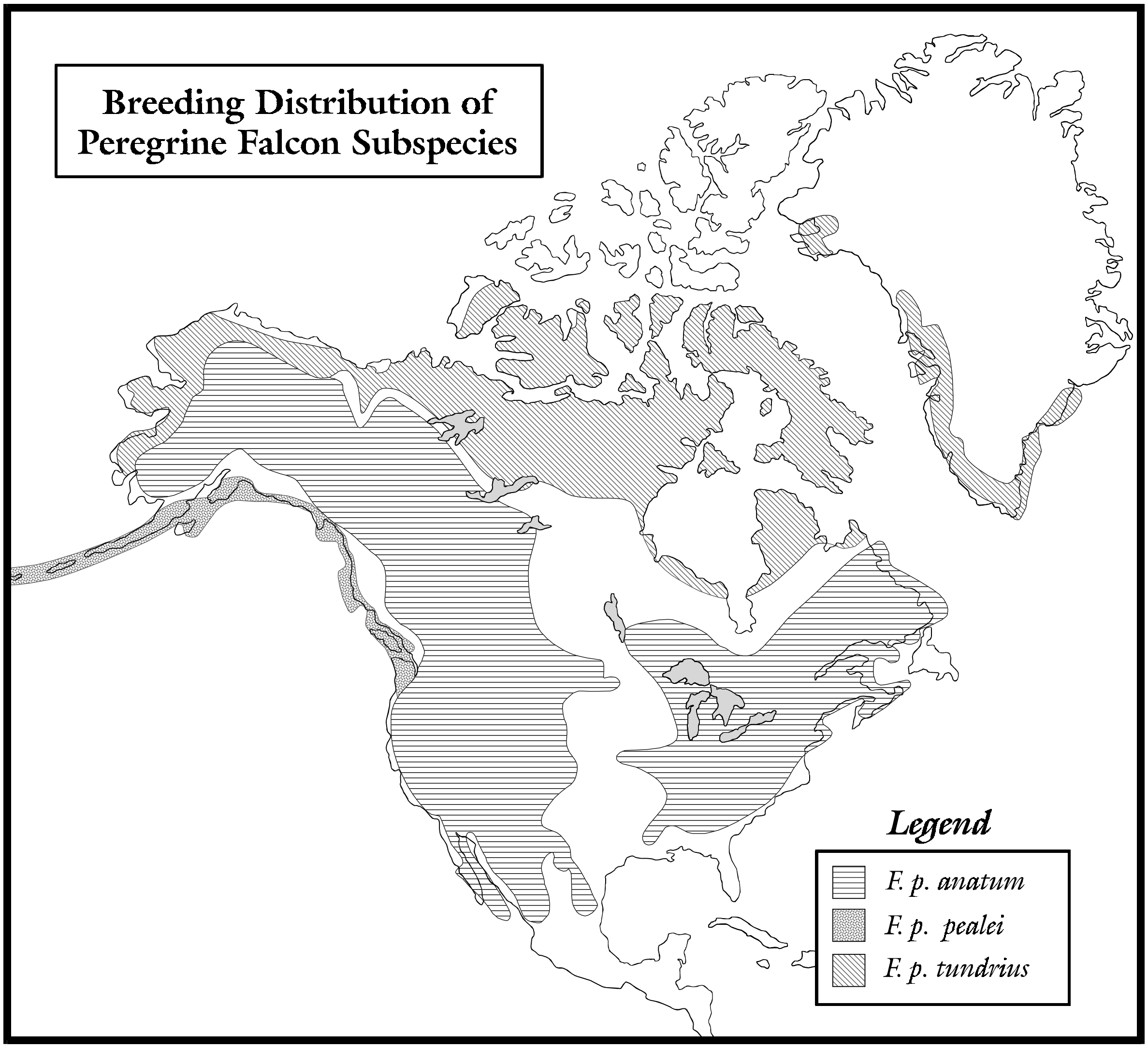

Figure 2. Geographic range of the peregrine falcon in North America; adapted from White and Boyce (1988).

Washington

Breeding range. Peregrines can be found nesting from the cooler, maritime region west of the Cascade Mountains to the more arid, dry climate of eastern Washington. The greatest number of nesting sites in the state occur in the San Juan Islands and lowlands of northern Puget Sound, and along the outer northern coast of western Washington (Fig. 3). In these regions, peregrines nest on islands, “sea stacks”, or shoreline cliffs. Lower numbers occur in the forested slopes of the Cascade Mountains and in the Columbia River Gorge, where peregrines nest on cliffs that are usually in close proximity to large lakes, or overlook river valleys or the Columbia River. Far fewer peregrine sites occur in the Columbia basin where a few nest sites are found at prominent points overlooking major lakes and rivers. Some peregrines in the Columbia Gorge are suspected to have nested on both the Washington and Oregon sides of the river in different years. This situation also occurs with one breeding territory located along the border with Idaho and with territories overlapping from the San Juan Islands into British Columbia, Canada (P. DeBruyn, pers. comm.).

Historical records suggest that both the Peale's and American peregrine nested in Washington, but the boundary that delimited the breeding distributions of these two subspecies in western Washington was imperfectly defined. Brooks (1926) considered the Peale's peregrine to range south only as far as 50ºN, and therefore not to occur in Washington. Most other naturalists believed Peale's bred in Washington. At the present time, both *F. p. pealei* and *F. p. anatum* are considered to breed in western Washington (Fig. 3). The degree of overlap between these two subspecies in western Washington remains unknown, particularly along the outer coast. Dawson and Bowles (1909) considered birds nesting along the western coast of Washington, and probably the northern coast of the Olympic Peninsula, to be Peale's. They described the breeding range of the American peregrine as extending throughout the state, anywhere suitable cliffs overlooked water, but not overlapping the distribution of Peale's along the coast. Kitchin (1949) and Jewett

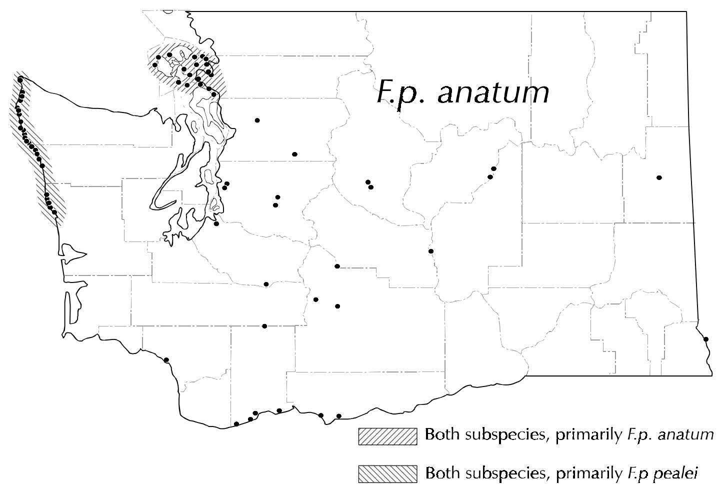

Figure 3. Current known distribution of nesting peregrines in Washington.

et al. (1953) also believed coastal breeding falcons to be Peale's. Beebe (1960) postulated Peale's bred, at least historically, along the Washington coast south to the mouth of the Columbia River. In contrast, Brooks (1926) examined 2 breeding adults from the northwestern coast of Washington and identified them as *anatum*, as well as specimens from the interior. Observations by biologists who conduct breeding peregrine surveys along the outer coast suggest that the Peale's falcon may hybridize with the American peregrine to an unknown extent in this region of the state (A. McMillan pers. comm., U. Wilson, pers. comm.). In addition, a Peale's falcon was reported paired with an American peregrine on the Oregon coast (J. Pagel, pers. comm.).

The same uncertainty in subspecies range extends to the San Juan Islands. Dawson and Bowles (1909) considered the peregrines breeding in the San Juan Islands to be American peregrines, whereas Jewett et al. (1953) believed these peregrines to be Peale's. Jewett et al. (1953) believed birds breeding east of the Cascades were American peregrines and those west of the Cascades were Peale's. However, ornithologists now recognize that Jewett et al. (1953) generalized many subspecies distributions (T. Wahl, pers. comm.). Currently, the American peregrine is known to breed in the San Juan Islands although it is uncertain if intergrades with Peale's occur in this region (C. M. Anderson 1993). Similarly, in British Columbia, the subspecies of peregrine breeding in the Fraser Lowlands and Gulf Islands in the Strait of Georgia is unknown (Campbell et al. 1990), although likely of the *anatum* subspecies (R.W. Nelson, pers. comm.). The comparatively dry climate of the San Juan Islands suggests that American peregrines breed in this region; Peale's are only known to occur in humid, coastal areas with heavy rainfall (Beebe 1960). The USFWS recognizes that *F. p. pealei* intergrades with *F. p. anatum* in western Washington (Sheppard 1983), whereas the American Ornithologists' Union (1957) recognizes the Queen Charlotte Islands as the southern limit of the breeding range for Peale's peregrines. The American peregrine is the only subspecies breeding in the interior of the state (See Appendix A for museum specimens).

Winter range. Western Washington is noted for its high density of wintering peregrines and other raptors (Anderson and DeBruyn 1979, Anderson et al. 1980, Anderson et al. 1984). The mild maritime climate and extensive habitat that supports high densities of prey, including shorebirds and waterfowl, attract large numbers of raptors to the region. Known peregrine wintering sites in western Washington include many of the estuaries of the Puget Sound region, Grays Harbor, Willapa Bay, the Columbia River estuary, the outer coastal beaches, low-lying agricultural lands, the marine waterfront, and even some urban areas (Anderson and DeBruyn 1979, Anderson et al. 1980, Anderson et al. 1984, Dobler and Spencer 1989, Dobler 1993, Buchanan 1996, Varland 2001). Both Peale's and American peregrines are found in these habitats (Anderson and DeBruyn 1979, Anderson et al. 1980, Anderson et al. 1984, Buchanan et al. 1986, Dobler and Spencer 1989, Dobler 1993). Peregrines also overwinter in the Columbia River Gorge (J. Pagel, pers. comm.). The tundra subspecies (*F. p. tundrius*) is generally considered a migrant in the region, but may be an extremely rare winter resident; an immature female overwintered on Long Beach Peninsula in 2000-2001 (Dan Varland, pers. comm.; T. Fleming, pers. comm.). The peregrine is also found in widely scattered localities in open habitats in eastern Washington (the channeled scablands, agricultural areas, etc.), but it is still considered rare there during winter (Stepniewski 1999).

NATURAL HISTORY

Reproduction

Age of first breeding. Mean age of first breeding is likely to be lower in increasing or decreasing populations than in stable populations, when there is greater competition for breeding sites (Hunt 1988). During the pre-DDT era it was rare to find birds in first year plumage at breeding cliffs; whereas, in recent times this is more common and more frequent among females than males (Newton and Mearns 1988). In North America, most wild females attain maturity at 2 years of age, but others not until a year later, while males usually attain breeding condition by 3 years of age, and sometimes not until 4 or 5 years of age (T. Cade pers. comm. cited in Ratcliffe 1993). In captivity, males reach physiological breeding condition a year after females. In the wild, there may be a time-lag between reaching physiological breeding condition and recruitment to the breeding population. Most peregrines in the expanding population in the midwestern United States begin nesting at age 2. Females may start at age 1 (range 1-4), while few males breed at this age (range 1-6) (Tordoff and Redig 1997). At Rankin Inlet, Northwest Territories, recruitment to the breeding population occurred at 3 years for males (range 2-6) and 2 years for females (Court et al. 1989). In Alaska, peregrines banded as nestlings and later trapped as breeders were a mean age of 2.8 years for females and 2.6 years for males (Ambrose and Riddle 1988). These estimates may have been somewhat high, since it was unknown whether these birds bred at an earlier age. In areas where trapping did not occur, subadult females bred and were usually successful if paired with an adult male, whereas subadult males were less successful (Ambrose and Riddle 1988). Only rarely do pairs comprised of first year falcons breed successfully (Wendt and Septon 1991).

Territoriality. Territorial behavior is an integral, but rather poorly understood, element of the breeding ecology of the peregrine. Territoriality typically limits breeding peregrine populations, except where nest sites are sparse (Cade 1982). Territorial behavior is thought to be associated with site selection, pair-bonding, competition for resources, and protection of the nest, eggs, and young from other predators (Newton 1979). The size of the defended territory appears to be a function of food supply and nest site availability (Newton 1979), and, except where nest sites are sparse, is likely influenced by population density (Beebe 1960, Ratcliffe 1993). Therefore, territoriality may hold the density of breeding pairs below environmental limits determined by food supply and availability of nesting sites (Cade 1982, Ratcliffe 1993).

During the breeding period, resident pairs of peregrines often defend the territory against conspecific intruders. The first line of defense consists of territorial advertising which usually consists of soaring flights and vocalizations (Ratcliffe 1993). When advertisement fails, the territory owner may resort to chasing, stooping at, and making physical contact with intruders (Cade 1960). The incidence of physical contact appears to vary among regions and may also vary according to the stage of the breeding cycle or proximity to the eyrie (Court 1986, Ratcliffe 1993). The frequency of physical contact may be greatest in areas where competition for resources is more severe (Ratcliffe 1993). Territorial conflicts rarely result in injury or death to the participants. Agonistic encounters are mostly between males, although resident females will attack intruders as well. Non-reproductive birds, referred to as “floaters”, occasionally occur in or at the periphery of territories and may be tolerated by the territorial pair (Ratcliffe 1993).

Home range size. Peregrine breeding-season home ranges vary in size. The largest home ranges were those documented in Colorado where the home ranges of 3 females averaged 450 mi^2 (1251 km^2), while those of 2 males averaged 405 mi^2 (1126 km^2) (Enderson and Craig 1997); hunting flights within these home ranges extended as far as 12-26 mi (20-43 km) from the eyrie. The home ranges of 2 females in the United Kingdom were 8.3 mi^2 (23 km^2) and 42.1 mi^2 (117 km^2) in size (Mearns 1985); a hunting female was observed 11 mi (18 km) from the nest. On Cape Peninsula, South Africa, 2 female and 2 male peregrines had an average home range size of 44.3 mi^2 (123.0 km^2) (Jenkins and Benn 1998); hunting excursions from the nest sites averaged 10 mi (16.7 km) per flight. Two other studies reported average hunting excursions of 12 and 16 mi (20 and 27 km), a potential indication of substantial home range size, but did not determine home range size (Porter et al. 1973, Kumari 1974 cited in Mearns 1985).

Courtship behavior. The timing of initiation of the breeding cycle is linked to temperature and photoperiod (Ratcliffe 1993). Courtship may begin during the fall and extend through the winter, with perhaps a brief interruption in mid-winter, but courtship activities are more noticeable and frequent in late winter. Beginning in January or February, the first signs of breeding season activities at sites occupied by seasonal residents are indicated by single birds observed at the nesting cliffs, and as time passes they are more likely to be joined by a mate. The extent to which these pairs represent the restoration of the pair-bond between a previously mated pair, change of partner, or change of pair needs further study using marked birds (Ratcliffe 1993). Limited data suggests both males and females have a tendency to return to the areas where they nested the previous year (Mearns and Newton 1984). Some Peale's falcons are year-round residents and are therefore present at the site with the other pair member during winter when courtship begins. In high latitude areas of the breeding range, both sexes may arrive on the breeding grounds simultaneously, but previously mated birds may arrive several days apart (Court et al. 1987). When a mate arrives at the cliff site before the other, it may engage in promiscuous courtship and mating with other birds, but when the mate arrives, these other falcons are driven off. Some pairs arrive at the cliff site together and courtship only involves reinforcing the pair-bond. At breeding sites that have been deserted for a period of time, single birds may occupy the site and remain unmated for a year or more, and a new pair may defer breeding for a year or more (Ratcliffe 1993). Cade (1960) found that the first indication of successful pairing or re-establishment of a pair bond was quiet perching and roosting of the two birds on the same cliff or other favorite perching place. This is followed by the development of a pattern of courtship behavior on the ledge and in flight.

Cade (1960) describes eight distinct phases in the pre-incubation activity of peregrines: (1) the attraction of mates to one another, (2) mutual roosting on ledge or cliff; (3) cooperative hunting excursions, (4) courtship flights, (5) courtship behavior on ledge or cliff, (6) courtship feeding, (7) copulation, and (8) nest scraping. Although this list represents the approximate order in which breeding activity develops, some of these activities may develop at about the same time. In Washington, peregrines engage in courtship activities in February and March, and involve cooperative hunting excursions between the female and male, followed by display flights (Anderson 1980). Display flights include *high-circling*, *undulating flights*, and *figure-eights*, usually performed by one bird alone; *high-circling* and *flight-play* are usually performed by the pair. Other variants include *flight-rolling* and *z-flights*. Display flights are only minor modifications of basic hunting flights and territorial defense tactics (Cade 1982). With the onset of ledge ceremonies, cooperative hunting transitions to courtship feeding in which the male presents food to the female (Ratcliffe 1993). Following this stage in the breeding cycle the pair roost together on the cliff-face and begin searching for possible eyrie ledges. Selection of ledges involves ritualized behavior that includes mutual ledge displays at the scrape. As the male's interest in nesting ledges declines, that of the female increases, and she continues to explore ledge sites and develop scrapes (Ratcliffe 1993). Like other members of the falcon family, peregrines do not build nests; pairs form a hollow, or a "scrape," in soil, vegetation, loose rock or gravel on a cliff ledge. Copulation begins about eight weeks after the onset of courtship and about three weeks prior to egg-laying.

Egg-laying, incubation, and brooding. The peregrine usually lays only one clutch of 3 or 4 eggs per year, with eggs laid at 2-3 day intervals (Johnsgard 1990). First-time breeders lay smaller clutches and lay later in the breeding period than experienced breeders (Court 1986). Effective incubation typically begins with the laying of the second-to-last egg (Nelson 1972). Both sexes participate, but the female does the majority of incubation; the male feeds the female during the incubation and early brooding period. The incubation period is about 33 days (Burnham et al. 1978). For the Peale's peregrine, the interval between laying of the last egg and the nearly synchronous hatching of all eggs is 32-34 days, and may be as long as 35 days (Nelson 1972). Similarly, Porter et al. (1973) reported the incubation period for the American peregrine in Utah as 32-34 days and hatching is essentially synchronous. Only in the arctic peregrine does hatching appear to be asynchronous (Court et al. 1987). Peregrines that lose their eggs before or about day 10 in the incubation period usually produce a second clutch (Newton 1979, Ratcliffe 1993). The interval between loss of the first clutch and start of the second clutch is usually 14 days if recycling occurs, and this may be accompanied by a shift to an alternate ledge or cliff (Cade et al. 1996). Re-nesting was often noted after egg collectors removed entire clutches of eggs during the heyday of egg collecting (Hickey and Anderson 1969). Anderson (1993, 1996) used data on fledging dates to estimate when egg laying and hatching occurred for peregrines breeding in the San Juan Islands. Egg laying dates were estimated to range from 1-7 April to 4 May and hatching dates were estimated to range from 5-9 May and 5-7 June. These dates are close to those reported for peregrines in coastal British Columbia (Campbell et al. 1990). Egg laying and hatching dates in the uplands in some years may be a month or more later than those reported above (J. Pagel, unpubl. data).

The female peregrine does most of the brooding of the young. Brooding is nearly continuous for the first three days and gradually diminishes thereafter; little brooding occurs after 10-20 days post-hatch (Hovis et al. 1985, Carlier 1993, Cade et al. 1996; R.W. Nelson, pers. comm.). During the early nestling stage, the female does the majority of the feeding. The male provides food and may brood the young in the female's absence (Cade et al. 1996). Later in the nestling stage, as the young slowly become able to tear apart meat and feed themselves, both the female and male hunt and feed the young (Cade et al. 1996). In the early stages of development, the sexes are similar in most body size attributes (Beebe 1960). From the time when the first feather tips are apparent on males, the sexes diverge in their development. Females increase in bulk for some days but remain in their downy feather stage, while males rapidly develop feathers and become active without much additional weight gain. This divergence in rate of development continues until the young fledge; males typically fledge 3-5 days before females (Beebe 1960).

Fledging. Fledging occurs at about six weeks of age (Nelson 1970, Sherrod 1983, Johnsgard 1990). In the San Juan Islands, peregrine falcons fledged between 3 June and 19 July; most fledging occurred between the third week of June and first week of July (Anderson 1993, 1996). Anderson also reported a tendency for newly established pairs to fledge young later in the breeding season than experienced pairs. On the outer coast of Washington, fledging dates were estimated to range from 2 June to 20 July (Wilson et al. 2000).

As the young approach the age of first flight they become more mobile and begin exercising their wings. The young falcons often move about the cliff face, hopping from ledge to ledge, and may travel up to 165 ft (50 m) from the nest ledge (Sherrod 1983). Although the adults occasionally return to assist with feeding, their presence at the nest is often brief because the young falcons can be dangerous to the adults at this age, as the siblings may aggressively compete for food while approaching the adults, and may even grab the adults. Sherrod (1983) speculated that sibling competition for prey items left by adults, and the sight of a sibling in flight stimulates the first attempts at flight.

Fledglings engage in various types of flight (perch-to-perch, soaring, stooping), pursue siblings and adults, engage in "mock combat," pursue and "capture" inanimate objects, and importantly, obtain prey from adults while in flight (Sherrod 1983). Although at-perch transfers of prey predominate for several days to 2-3 weeks after first flight, other prey transfer methods are gradually introduced. The first aerial prey transfer is often a direct transfer, whereby the fledgling takes a prey item directly from the beak or foot of the adult. The next transfer method to be introduced is the "aerial drop," whereby the adult, from a position above the in-flight fledgling, drops a living or dead bird that the fledgling will attempt to capture in flight. The most advanced transfer is the "family hunt" in which both adult and fledgling(s) pursue prey. In this behavior the adult stoops at prey species and the closely following fledgling(s) attempt to mimic the behavior or capture the prey as it attempts to escape the attack of the adult (Sherrod 1983). Most prey transfers occur in the general vicinity of the nest with the exception of the family hunt, which may occur at greater distances from the eyrie.

Young falcons begin pursuing invertebrate prey, such as dragonflies, as early as the first day of flight (Sherrod 1983). The first successful hunt of vertebrate prey usually occurs between about 27 and 42 days after the initial flight. Even after the young falcon has begun to capture its own prey it may continue to receive food from one or both parents (Sherrod 1983). This period of dependency on the adults, which may be influenced by a variety of environmental or other conditions, may last 3-6 weeks or longer (R.W. Nelson, pers. comm.).

Movements and Dispersal

Migration. Evidence from band returns and sightings of migrants indicate that all three North American subspecies of the peregrine falcon migrate in autumn along the Pacific coast of North America as far south as California (Anderson et al. 1988). Peregrines recovered in Washington have originated from breeding grounds in northern and interior Alaska, Yukon, and British Columbia (Anderson et al. 1988) (Fig. 4, Appendix B); these recoveries represent all 3 subspecies. Sightings of migrant peregrines are common at Grays Harbor and Willapa Bay, coastal wetlands that are important staging areas for shorebirds (Herman and Bulger 1981, Buchanan and Evenson 1997) which are important prey of migrant peregrines. Autumn migration begins by mid-August in the Pacific Northwest and continues through October (Beebe 1960, Anderson et al. 1988, Campbell et al. 1990). Beebe (1960) noted immature peregrines arriving in the Puget Sound region beginning in mid-August in association with the arrival of migrant flocks of shorebirds and waterfowl. Campbell et al. (1990) reported that immatures arrive in southern regions of coastal British Columbia (e.g., Fraser River Delta) in early August, generally followed about one month later by adults. In the interior, fall migration begins in August, but occurs mostly in September. There are comparatively fewer records of peregrines migrating through the interior, and the species was rarely seen in that region (LaFave 1961) until recent years, when it has been more regularly recorded. In western Washington, autumn migration of peregrines occurs principally along 2 routes, one along the outer coast, and the other through the Puget Sound basin. Although peregrines are known to migrate through eastern Washington, no discernable migration routes have been identified. Significant numbers of peregrine falcons have been observed along the outer coast in September and October. In 1984, 20 peregrines were sighted at Cape Flattery and in 1985, 38 were sighted at Long Beach (Anderson et al. 1988). Peak migration may occur from 1-10 October. Smaller numbers of migrant peregrines have been observed in the Puget Sound basin, such as the Skagit Flats (Anderson et al. 1988). Anderson et al. (1984) documented a steady increase in sightings of peregrines from September to December in the vicinity of Lummi Bay in north Puget Sound (Anderson et al. 1984). Beebe (1960)

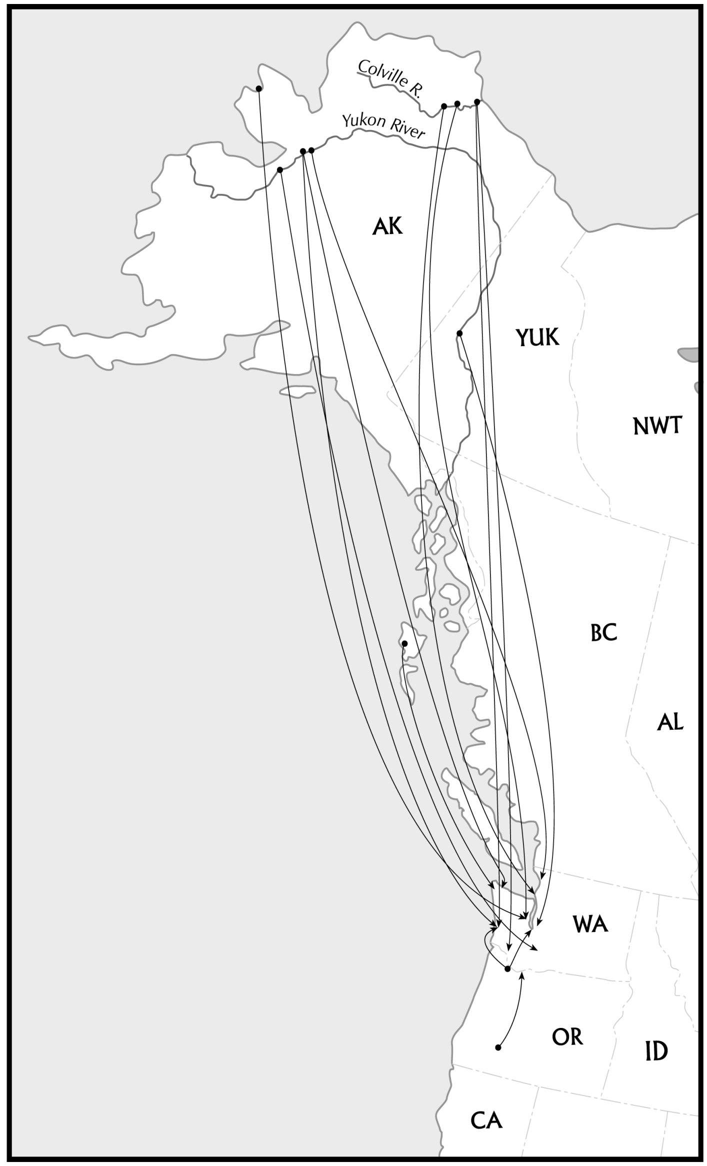

Figure 4. Recoveries or sightings of peregrines in Washington state during the non-breeding period that were banded as nestlings elsewhere.

commented on the increasing abundance of peregrines in the Puget Sound region, beginning in September and continuing through the winter months.

Whether there are specific corridors used by the different subspecies when migrating through Washington is uncertain. The Olympic and Cascade Mountains may act as barriers that funnel peregrines from breeding sites farther north through Puget Sound, whereas coastal breeding Peale's move primarily along the outer coast. The available data suggest that most peregrines migrating along the outer coast of Washington are Peale's falcons: 16 of 22 (73%) peregrines captured and banded along the Washington coast during spring and fall migration from 1984-86 (Anderson et al. 1988); 32 of 42 (76%) peregrines banded along the Washington coast during migration and winter periods from 1995-2000, and identified to subspecies (D. Varland, pers. comm.; T. Fleming, pers. comm.). Peale's falcons in Washington, Oregon and California seem to be restricted to coastal areas during fall migration; three Peale's peregrines banded as nestlings in British Columbia were recovered in California during winter, while no nestlings banded in Alaska have been recovered on the Pacific coast south of Alaska (Anderson et al. 1988). Peale's peregrines have been observed in coastal Sinaloa, Mexico, during winter (Enderson et al. 1991). An adult female banded at Ocean Shores on 12 March was sighted at a nest on Langara Island, British Columbia, and provides further support for movement by Peale's peregrines along the outer coast of Washington (Appendix B).

Our knowledge of movements of arctic and American peregrines in the west coast region of North America is limited. However, limited data from band returns suggest peregrines breeding in far northern areas migrate down Washington's outer coast, and use an inland corridor through Puget Sound during autumn migration. Arctic peregrines banded on the Colville River in northern Alaska were recovered during migration near Humptulips, Rochester, Bremerton, and Oak Harbor in western Washington (Anderson et al. 1988) (Fig. 4, Appendix B). Peregrines banded along the lower Yukon River in Alaska (and presumably *F. p. anatum*) have been recovered during autumn migration in the Puget Sound basin, along the northwestern shoreline of the Olympic Peninsula, and along the outer coast (Fig. 4, Appendix B). Some peregrines migrating along the outer coast of Washington travel to wintering sites in southern California or further south. Two peregrines banded on the outer coast during migration were recovered in southern California at Point Mugu and LaJolla; the subspecific identity of these birds was not determined (Fig. 5, Appendix B). The recovery at Point Mugu in early October indicates that this bird could have moved to points farther south of its recovery site.

Recoveries of peregrines banded as nestlings in Washington and recovered during the non-breeding period indicate movement during autumn migration to sites in southern British Columbia, within the Puget Sound basin, and to points south in coastal Oregon, and central and southern coastal California (Fig. 5, Appendix B). Movements of peregrines released at "hack" sites and recovered during the non-breeding period also indicate movement to sites in Oregon, California and as far south as Sonora, Mexico (Appendix B). To date, hacked birds have not been recovered in British Columbia.

In Washington, spring migrants have been observed along the outer coastline from late March through May. Observations by C. Anderson and J. Fackler in the 1970s and 1980s indicate significant numbers of peregrines pass the Cape Flattery area between early April and mid-May (Anderson et al. 1988). Significant numbers of peregrines are also seen between early April and early May at shorebird staging areas at Grays Harbor (Herman and Bulger 1981) and Willapa Bay (Anderson et al. 1988). Peregrines have been seen preying on migrant shorebirds at these sites, and likely focus on this resource while making their way to northern breeding areas. Peregrines equipped with radio transmitters generally left their wintering areas on the Skagit Flats in mid to late February (Anderson and DeBruyn 1979). Adult peregrines disperse from wintering areas in coastal British Columbia in early March, followed by immatures one month later (Campbell et al. 1990). A single American peregrine was radio-tracked from its wintering area on the Skagit Flats to its breeding site in southern British Columbia (Anderson et al. 1980). In interior British Columbia, spring migration occurs from late March to early April (Campbell et al. 1990).

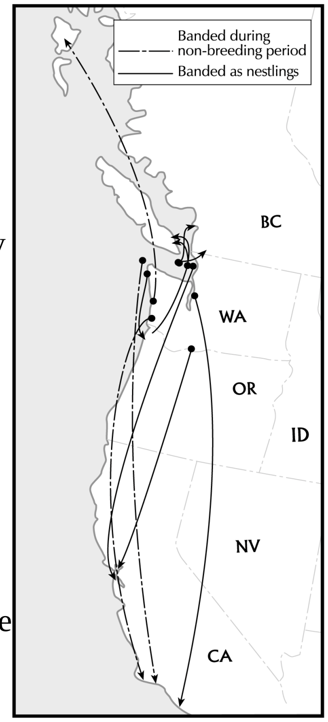

Figure 5. Peregrines banded as nestlings and during non-breeding period.

Intra-state movements. Movements of peregrines within Washington indicate that there is interaction of birds between different regions of the state. Banding and return data indicate at least the following general movements of falcons to or from breeding locations: a) from the outer coast to breeding areas in the Puget Sound area, b) from breeding locations in the Columbia River Gorge to the Puget Trough, c) from breeding locations in the San Juan Islands to Willapa Bay, and d) within the San Juan Islands (Fig. 6, Appendix B). Non-breeding season relocations indicate that birds are moving as follows: a) within the Puget Trough, b) among the outer estuaries and associated beaches, and c) from Puget

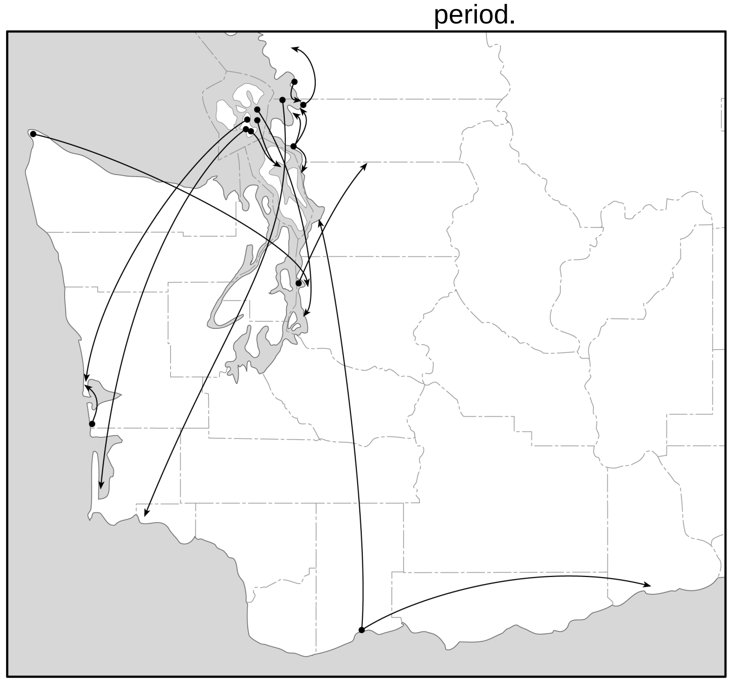
Figure 6. Movements of banded peregrine falcons in Washington.

Trough to the coastal estuaries (Fig. 6, Appendix B). Other movements probably occur but the lack of banding operations in most areas limits the number of intra-state relocations.

Natal dispersal. Natal dispersal is the movement between place of birth and the location where breeding occurs for the first time, and has important implications for exchange of genetic material between local and regional populations. To date there has been no documentation of dispersal distance of first year breeding peregrines that were banded as nestlings in Washington. In southwest Scotland, females dispersed farther from their hatch site than males, with median distances of 41 mi (68 km; maximum 111 mi [185 km]) and 12 mi (20 km; maximum 45 mi [75 km]), respectively (Newton and Mearns 1988). In Alaska, birds banded as nestlings were recaptured at breeding sites at mean distances of 73 mi (121 km) for females (range 1.2-222 mi [2-370 km]) and 41 mi (69 km) for males (range 2.4-124 mi [4-206 km]) (Ambrose and Riddle 1988). Peregrines usually returned to the same drainage in which they were hatched. In the Midwest, natal dispersal distance was not different between hacked and wild birds. Females (212 mi [354 km], n = 67) dispersed about twice as far as males (104 mi [174 km], n = 73) from hack or natal sites (Tordoff and Redig 1997). At Rankin Inlet, Northwest Territories, recruits never returned to natal territories; median distance dispersed from natal sites was 4 mi (6.6 km) for males (range 3.6-8.4 mi [6.0-14.0 km], n = 6), and a single female dispersed 12.3 mi (20.5 km) (Court et al. 1989). Results from these studies provide support for a female biased natal dispersal. Dispersal distances within a study area in Greenland were similar for males (mean = 17 mi [28.1 km], SD = 2.6, n = 21) and females (mean = 16.3 mi [27.1 km], SD = 2.6, n = 6), but the only long distance dispersal movement recorded was a female that was captured at a breeding cliff 414 mi (690 km) south of her natal site (Restani and Mattox 2000). Peregrines hacked in the midwestern USA dispersed an average distance of 73 mi (118 km; n = 23) to subsequent breeding locations (Tordoff and Redig 1988)

Dispersal between breeding sites. Peregrines seem to make their longest movements prior to attaining their first breeding territories, and once acquired, tend to return to the same general area in successive years. In Washington, most of the banding of peregrines is concentrated in the San Juan Islands, where C. M. Anderson of the Falcon Research Group has banded peregrine nestlings for several years. To date there are few data on movements of adults between nesting territories, although several movements are known to have occurred (Paul DeBruyn, pers. comm.; Fred Dobler, pers. comm.). In Scotland, 7 females moved distances of 1.8-20 mi (3-33 km) between breeding territories, whereas males were not observed moving between breeding territories (Newton and Mearns 1988). Similarly, at Rankin Inlet, Northwest Territories, females moved distances ranging from 0.8 to 3.2 mi (1.3 to 5.3 km; n=5) between breeding sites in successive years, whereas males were not reported making movements. Four of the 5 females that moved between breeding territories, failed in the prior year. In Alaska, 2 females moved distances of 3 mi (5 km) and 136 mi (226 km) in successive years between breeding sites (Ambrose and Riddle 1988).

Fidelity to breeding and wintering areas. Field observations indicate that some breeders are resident year round at breeding sites, at least in the San Juan Island population (Anderson 1993) and apparently in the Columbia River Gorge (J. Pagel, pers. comm.). Coastal breeders may also remain at the breeding sites year-round, as this is known from other parts of the range of the Peale's falcon (R.W. Nelson, pers. comm.). There are no other data on site fidelity in Washington. In Scotland, adult males were more likely to remain on the same territory in consecutive years than females (Newton and Mearns 1988). Of 68 females recaptured on territories in later years, 61 (90%) remained on the same territory, while 6 of 6 males (100%) remained on the same territory. One male nested at the same territory for 4 consecutive years. In Alaska, on 29 of 40 (72%) territories where females were captured in successive years it was the same individual the second year (Ambrose and Riddle 1988). In Colorado, Enderson and Craig (1988) used photographs to identify breeding peregrines at eyries. On 19 of 23 (83%) territories where adult females were identified in successive years it was the same individual, and on 26 of 34 (77%) it was the same male. At Rankin Inlet, Northwest Territories, at 34 of 40 (85%) territories where males were identified in successive years, it was the same individual the second year, and at 52 of 70 (74%) territories it was the same female in the second year (Court et al. 1989). One male occupied the same territory for more than 6 successive years, 2 for 3 years, 6 for 2 years, and 1 for 1 year. One female occupied the same territory for more than 6 successive years, 1 for 5 years, 2 for 4 years, 3 for 3 years, 3 for 2 years, and 6 for 1 year. The longest pair bond lasted 4 years. Some peregrines show fidelity to wintering areas. On the Skagit Flats, in north Puget Sound, an adult female is known to have returned to the same wintering area for four consecutive years (Anderson et al. 1980). Similarly, color-banded peregrines on coastal beaches have been observed in the same general areas in successive winters (Varland 2001). Of 37 peregrines banded between 1995 and 1999 on outer coastal beaches, 14 (38%) were resighted there at least once in a subsequent year (Varland 2001).

Diet and Foraging

The peregrine preys on birds ranging in size from the very smallest species weighing <0.3 oz (<10 g) to large waterfowl and herons weighing over 70 oz (2000 g) (Cade 1982). Sherrod (1978) provided a summary of prey items in the diet of the peregrine falcon in North America. Birds comprised the largest segment of the diet in total numbers (70-100%); the remainder was comprised of mammals and insects. Bird species represented in greatest numbers were rock dove (*Columba livia*), mourning dove (*Zenaida macroura*), crested auklet (*Aethia cristatella*), least auklet (*A. pusilla*), ancient murrelet (*Synthliboramphus antiquus*), common snipe (*Gallinago gallinago*), gray jay (*Perisoreus canadensis*), and lapland longspur (*Calcarius lapponicus*). Columbiform birds (pigeons and doves) are preferred prey species throughout the range of the peregrine (Cade 1982). Where these species occur in numbers, they form the bulk of the diet and typically account for 20-60% of total individuals captured during the breeding season.

Breeding. Peregrine falcons use a wide variety of prey species across their range during the breeding period. The most common prey species collected at or near peregrine nest ledges in the San Juan Islands were European starling (*Sturnus vulgaris*), rock dove, American robin (*Turdus migratorius*), and cedar waxwing (*Bombycilla cedrorum*) (Anderson 1995, 1996, 1997). On the outer Washington coast the most commonly taken prey noted by Paine et al (1990) were rhinoceros auklet (*Cerorhinca monocerata*), Cassin's auklet, savannah sparrow (*Passerculus sandwichensis*), northwestern crow (*Corvus caurinus*), glaucous-winged gull (*Larus glaucescens*), common murre (*Uria aalge*), and Leach's storm petrel (*Oceanodroma leucorhoa*). Peale's peregrines breeding in the Queen Charlotte Islands of British Columbia focused on Cassin's auklet, ancient murrelet, fork-tailed storm petrel (*Oceanodroma furcata*), and Leach's storm petrel (Beebe 1960). In contrast, in Utah,107 prey items were collected from 2 eyries that represented 20 species of bird and at least one species of mammal (Porter et al. 1973). Shorebirds comprised the largest segment of the diet in both total biomass (60%) and total numbers (44%); the American avocet (*Recurvirostra americana*) and willet (*Catoptrophorus semipalmatus*) were most frequently taken and comprised 37% and 12%, respectively of total biomass. Mourning doves and rock doves combined were of secondary importance in both total numbers (17%) and total biomass (19%) (Porter et al. 1973).

Migration and winter. During migration, Peale's peregrines from the Queen Charlotte Islands prey heavily on red phalaropes (*Phalaropus fulicaria*) and follow migrating shorebirds and waterfowl along the coast. Beginning in mid-August, Peale's peregrines are observed in the Puget Sound region associated with flocks of migrant shorebirds. Peregrines were observed at more inland areas in late August and early September when flocks of band-tailed pigeons (*Columba fasciata*) move out of the forest and are found in open agricultural fields (Beebe 1960).

During winter, peregrines hunting flooded lowlands favor waterfowl and other marine birds as prey: green-winged teal (*Anas crecca*), American wigeon (*A. americana*), American coot (*Fulica americana*), northern pintail (*A. acuta*), bufflehead (*Bucephala albeola*) (Beebe 1960, Dobler 1993, Dekker 1995). The larger marine ducks are largely ignored, but scaup (*Aythya* spp.), oldsquaw (*Clangula hyemalis*), goldeneye, and bufflehead are taken (Beebe 1960). Near Sequim, Washington, bufflehead, mallard (*A. platyrhynchos*), American wigeon, green-winged teal, and common goldeneye (*Bucephala clangula*) comprised approximately 1/3 of the diet, passerines approximately 1/3, and the remaining prey included mew gull (*Larus canus*) and cormorants (Dobler 1993). At Grays Harbor, peregrines preyed primarily on shorebirds (67% of prey items), and secondarily on passerines (16%) and waterfowl (10%) (Dobler and Spencer 1989). On the Skagit Flats, peregrines preyed primarily on wigeon and bufflehead (Anderson and DeBruyn 1979), and on the Lummi Flats favored green-winged teal (Anderson et al. 1984, unpubl. report). On Vancouver Island, British Columbia, the smaller-sized males primarily hunted passerines, particularly American robins and European starlings. Rock doves were common in the study area but were seldom captured (Dekker 1995). These same passerine species were important prey of peregrines breeding in the San Juan Islands (Anderson 1995, 1996, 1997), a short distance from southern Vancouver Island, B.C.

Prey selection. Prey selection differs between sexes; males typically select smaller sized prey (< 1 to 7 oz [20-200 g]) than females (3.5- 35 oz [100-1,000 g]) (Cade 1982). Prey partitioning may be the reason for reverse sexual size dimorphism in peregrines. Age is a factor in prey selection by peregrines. On Assateague Island, immature peregrines preyed on solitary migrant birds, especially northern flickers (*Colaptes auratus*), whereas adults took equal numbers of flocking shorebirds and other species. Explanations for these differences in prey selection among age classes included differences in diurnal hunting times, aerodynamics, hunting experience, and development of search images specifically for shorebirds (Ward and Laybourne 1985).

Vulnerability to attack by peregrines is an important factor in prey selection. Peale's peregrines in the Queen Charlotte Islands were observed hunting just prior to dark, and may have been waiting to attack the first seabirds departing the colonies and heading out to sea (Beebe 1960). A conspicuous behavior of prey species that makes them more vulnerable to attack by peregrines may explain the higher frequency of particular prey species in the falcon's diet. For example, prey species with color patterns that flash conspicuously in flight, like flickers, meadowlarks, American avocet, willet, red-winged blackbird (*Agelaius phoeniceus*), and blue jay (*Cyanocitta cristata*). Other species, like common snipe, rock ptarmigan (*Lagopus mutus*), willow ptarmigan (*Lagopus lagopus*), mourning dove, teal, Cassin's auklet, ancient murrelet, and shrikes (*Lanius* sp.) have courtship behaviors or patterns of flight that may make them vulnerable to attack by peregrines (Beebe 1960, Porter et al. 1973, Cade 1982).

Hunting technique. Hunting strategies of peregrines mainly involve "still-hunting" and aerial "waiting-on", although "still-hunting" may be the most frequent method of prey capture. Attacks are typically oriented at living birds, the majority of which are taken in flight. In still-hunting, perches that offer a high vantage point and wide view of open air space are used by peregrines to watch for prey that become vulnerable when they stray from cover. Typically, prey will fly into range at an altitude below that of the perched peregrine, allowing the falcon to fly out and establish a position above the potential prey before executing a fast dive or "stoop" at the prey. A peregrine in a stoop typically strikes the quarry with its feet, unless the prey is small (< 3.5 oz [100 g]), or unless the falcon and prey are traveling at similar speeds, in which case the falcon may grab the prey. If struck, the stunned prey either continues to fly, only to be attacked again, or it drops to the ground. If the peregrine misses on its first attempt, it may make repeated "stoops" or "tail-chases" until the prey is either caught or escapes (Beebe 1960, Cade 1982). Another mode of hunting associated with still-hunting is called "ringing up". These attacks are directed at high-flying birds that appear vulnerable to the peregrine scanning the sky from below. The falcon pursues the vulnerable bird by gaining altitude above it, and executes a number of short "stoops" and "tail-chases" until the quarry is either captured or it dives for the ground. The peregrine follows in a stoop and typically captures the quarry before it reaches cover. Aerial "waiting on" involves searching for prey while circling or soaring high in the air (Cade 1982). Peale's falcons nesting in the vicinity of large seabird colonies often "wait on" in stationary soaring flight, as they wait for seabirds to return to the colony to feed or care for the young (Beebe 1960). In "contour-hugging", peregrines use aspects of the terrain to conceal their approach. When hunting over the ocean, peregrines fly fast and low, sometimes using the waves to conceal their approach, and attempt to surprise surface-swimming waterbirds, which panic and either dive or attempt to fly (Cade 1982; Dekker and Bogaert 1997); sand dunes are similarly used for concealment by peregrines hunting shorebirds on coastal beaches (Buchanan 1996). Peregrines in the San Juan Islands often hunt by flying out to intercept landbirds (e.g., pigeons, woodpeckers, passerines) that fly between islands without the benefit of protective cover.

Peregrines hunting at the Skagit Flats primarily used low-level flight to surprise waterfowl (Anderson and DeBruyn 1979).

An effective anti-predator strategy employed by flocking birds in response to the appearance of a peregrine is to form a tight flying formation and to maneuver as a single body (Cade 1982, Buchanan et al. 1988). Shorebirds, pigeons, gulls, terns and other birds employ this strategy. A peregrine falcon will make a series of exploratory "stoops" at a flock in an attempt to isolate a bird (Cade 1982, Buchanan et al. 1988).

The peregrine has been revered for its impressive speed when in a stoop. Normal cruising speed for a peregrine, on a hunting flight or returning with small prey, is typically 27-33 mph (45-55 km/hr); in horizontal, continuously flapping, "ground effect" flight, a hunting male peregrine (followed by a helicopter) flew for 22 minutes averaging 43 mph (72 km/hr) and occasionally exceeding 67 mph (112 km/hr) (White and Nelson 1991). A peregrine in Colorado was twice observed flying 69 mph (115 km/hr) over a distance of 11.4 mi (19 km) (Enderson and Craig 1997). In a stoop, estimates of maximum flight speed are more variable, ranging from 99-273 mph (160-440km/hr). A peregrine in full stoop was recently clocked at about 200 mph (324 km/hr) by a parachutist who was filming the falcon's descent (Franklin 1999). In theory, a peregrine falcon in a stoop with closed wings should reach terminal velocity at between 228 and 238 mph (368-384 km/hr) (Cade 1982).

Hunting efficiency. Hunting efficiency reported for peregrines is highly variable (7-83%), but typically ranges from 10-40% in most studies. In a review of peregrine falcon hunting success, Roalkvam (1985) reported that juveniles were typically less successful than adults outside the breeding period (7.3 and 12.7% respectively), and breeding adults are typically more successful that adults outside the breeding period (34.9 and 12.7 %, respectively). Spacing and associated vigilance of prey, age and associated susceptibility to prey capture, and differences in availability of prey may be factors that explain the higher hunting efficiency of adults during the breeding season compared to the non-breeding period (Roalkvam 1985). Hunting efficiency also differs between the sexes; adult males are generally more successful than adult females (Cade 1982). Hunting efficiency may be influenced by habitat. In western Washington, wintering peregrines were more successful when hunting dunlins (*Calidris alpina*) at estuaries than at beaches (Buchanan et al. 1986, Buchanan 1996).

Interspecific Relationships

At coastal eyries in Washington, the bald eagle (*Haliaeetus leucocephalus*) commonly elicits responses from adult peregrines. Peregrines at two sites on the outer coast were observed attacking bald eagles nine times between 24 April and 2 June 1985 (J. Buchanan pers. obs.). These encounters occurred within about 1320 ft (400 m) of a nest site, although one continued for a distance of 2640 ft (800 m). Eight of the nine encounters were directed at eagles in flight; a single attack was directed at a perched eagle visible from the nest area (J. Buchanan pers. obs.). Nelson (1970) occasionally observed the latter behavior in coastal British Columbia. In attacks at flying eagles, the eagles typically rolled to one side and extended their legs and talons to fend off the diving falcon (Beebe 1960, Nelson 1970). Interactions with bald eagles in the breeding season like those described above likely occur at many peregrine eyries in western Washington. With the exception of eyries located in the upland and Columbia Basin regions, bald eagle nest sites were often quite close to peregrine eyries (Table 1).

The most significant breeding season interactions with other raptors in the Columbia Basin region involve the golden eagle and prairie falcon. The golden eagle is a known predator of young peregrine falcons (particularly hacked birds [see section below on predation)]; the level of predation on wild-reared fledglings is unknown. Both species likely compete with peregrines for nest sites on cliffs, although where the two falcons coexist in Utah there is a small degree of niche separation of nest sites with peregrines using more north-facing cliffs of slightly greater height (Porter et al. 1973). Additionally, the prairie falcon likely competes to a certain extent for prey (Porter et al. 1973). Both species occur in the vicinity of many of the known peregrine eyries in the Columbia Basin (Table 1). It is unknown whether or to what extent interactions with these potential competitors limit the peregrine falcon's distribution or abundance in the Columbia Basin.

Table 1. Nearest neighbor distance of bald eagle, golden eagle and prairie falcon nest sites within a 2.5 mi (4 km) radius of known peregrine nest sites.

	Mean nearest neighbor distance (mi)	Number (%) of peregrine eyries with other species within 2.5 mi
Bald Eagle		
Outer Coast	0.47	27 (96)
Puget Sound	0.48	18 (86)
Upland	-	0 (0)
Columbia Basin	2.17	1 (14)
Golden Eagle		
Columbia Basin	0.11	1 (14)
Upland[a]	0.75	1 (20)
Prairie Falcon		
Columbia Basin	0.24	3 (43)
Upland[a]	1.34	1 (20)

[a] Eastern Washington only.

Peregrines may interact with other avian species during the breeding season. For example, in the San Juan Islands double-crested cormorants may be a potential source of competition for cliff sites (M. Davison, pers. comm.; R. Milner pers. comm.).

On the wintering grounds, kleptoparasitism occurs between peregrines and other raptors. Red-tailed hawks (*Buteo jamaicensis*) and bald eagles were observed taking prey from peregrines on wintering grounds at Lummi Bay and vicinity (Anderson et al. 1984; see also predation section below). Common ravens have been observed stealing prey cached by peregrines (J. Pagel, unpubl. data). On the other hand, peregrines in Oregon have been observed stealing mammalian prey from red-tailed hawks and fish from ospreys (*Pandion halietus*) (J. Pagel, unpubl. data).

Mortality, Survival, and Longevity

Predation. There are few predators of the peregrine. Perhaps the most significant is the great horned owl (*Bubo virginianus*), which can take young or adult falcons from a roost ledge during the night (Ratcliffe 1993). Golden eagles are also known to kill peregrines, but may be a greater threat to young birds. Six of 28 (21%) peregrines released at a hack site in the Columbia Basin in 1993, 1994, 1996, and 1997 were taken by golden eagles. In all cases, golden eagles caught the young falcons either on or within a short distance (*ca*. 10 feet [3 m]) of the ledge while trying to escape. Other predators observed at hack sites in Washington include mountain lion (*Puma concolor*) (Burnham 1993) and American marten (*Martes americana*) (Burnham 1991), both of which are capable of taking a young pre-flight falcon if the eyrie ledge is accessible. Other potential predators, particularly of young falcons, include red-tailed hawk, prairie falcon, Cooper's hawk (*Accipiter cooperi*), common raven (*Corvus corax*), common crow (*Corvus brachyrhynchos*), coyote (*Canis latrans*), striped skunk (*Mephitis mephitis*), red fox (*Vulpes vulpes*), mink (*Mustela vison*), river otter (*Lutra canadensis*), racoon and bobcat (*Lynx rufus*) (USFWS 1982; Paul DeBruyn, pers. comm.; Tracy Fleming, pers. comm., J. Pagel, pers. comm.).

Survival. Newton and Mearns (1988) estimated a minimum survival rate of 91% for breeding females and 89% for both male and female breeders combined for an expanding population of peregrine falcons. In Alaska, maximum mortality of adult females averaged 23% over a 4-year period (Ambrose and Riddle 1988). Enderson and Craig (1988) used photographs of adults observed at breeding territories in subsequent years to estimate a maximum mortality rate of 13% for males, 18% for females, and 16% for both sexes combined. In the Midwest, annual adult survival was 79% for males and 93% for females (Tordoff and Redig 1997). At Rankin Inlet, Northwest Territories, maximum annual mortality was estimated at 15-24% for adult males and 19-24% for adult females, based on observations of banded adults at breeding territories in subsequent years (Court et al. 1989).

Reproduction may entail a physiological cost that may affect survival of breeders. In the Queen Charlotte Islands, British Columbia, adult peregrine falcons raising larger broods (3 or 4 nestlings) experienced a higher mortality rate than those rearing smaller broods (0, 1 or 2 nestlings; Nelson 1988).

Longevity. The oldest known wild peregrine falcon was an adult female breeding on the Sun Life Building in Montreal that was ≥18 years of age (Hickey and Anderson 1969). The oldest banded bird was in its 17th year (Hickey and Anderson 1969). Falconers have had birds that lived >20 years (reviewed in Mearns and Newton 1984). The oldest known adult breeding on territories at Rankin Inlet, Northwest Territories was ≥7 years of age for both a male and female (Court et al. 1989). A 10-year old female and 2 males 9 years of age were reported still alive in a mid-western population of peregrines (Tordoff and Redig 1997).

Diseases. Many different infections, diseases and parasites are known from captive or wild peregrines. Although many of these conditions can result in mortality, it has not been demonstrated that any occurs at a scale that would reduce populations (Ratcliffe 1993, Cooper 1993a). Disease is one of the leading causes of death among raptors, and in the absence of factors such as chemical poisoning and trauma resulting from human persecution or collisions, may be a very significant source of mortality (Greenwood 1977). Disease is viewed as a population problem only when it results in a mortality rate higher than that normally associated with a stable population (Ratcliffe 1993). Infections and diseases (including parasites) associated with peregrine falcons are summarized in Table 2. Other diseases and parasites known from raptors, and which may occur in the peregrine, are summarized by Cooper 1993b).

Many diseases are transmitted from, or hosted by other species, most notably by prey species. Avian cholera in a falconer's gyrfalcon was thought to have been acquired from known infected ducks or geese in an area where it had escaped and fed before being recaptured (Williams et al. 1987). A similar mode of transmission is found in botulism (Lloyd et al. 1976). Avian malaria, which has been documented in peregrines and gyrfalcons, is transmitted by mosquitoes, but is hosted by a variety of species, including sparrows, blackbirds, thrushes, falcons, corvids, waterfowl, shorebirds, and columbiformes (Redig et al. 1993). Some of these diseases, for example botulism, may locally or regionally reduce populations (White 1963).

Parasites can be classified as either ectoparasites, the ticks and mites, fleas, flies, and lice, or endoparasites, the roundworms, tapeworms, flukes, and protozoa (Cooper 1978). Ectoparasites can cause irritation of the skin, infection, anorexia, and death; the most extreme cases tend to be found in pre-fledging birds at nest sites characterized as having poor hygiene. Heavy ectoparasite infection at a site may require periodic shifting from one nest ledge to another, although definitive data are lacking. There are no data to determine whether ectoparasite loads inflence nest site selection (Ratcliffe 1993). Endoparasites may cause infection, anorexia or death (Cooper 1978), but neither ectoparasites nor endoparasites are likely to limit populations.

Table 2. Infections and diseases (including parasites) known from either wild or captive peregrine falcons. Information taken primarily from Cooper (1993a; *in* Ratcliffe 1993).

Organism	Reported effects on peregrines
Ticks	Local morbidity and mortality in nestlings
Lice (e.g. *Colpocephalum* spp.)	Occasional morbidity
Flies (e.g. *Lucilia, Calliphora*)	Infestation of wounds; sometimes fatal
Hippoboscids	Anemia; transmission of blood parasites
Mites	Local morbidity and mortality
Nematodes	
(*Serratospiculum* spp.)	Occasional mortality; requires intermediate host
other species	
(*Capillaria, Ascaridia*)	Occasional morbidity and mortality
Protozoa	
(*Trichomonas gallinae* - 'frounce')	Mortality of captive and wild birds (T.Fleming, pers. comm.)
(*Plasmodium relictum* - malaria)	Lethargy in captive birds
Coccidia	Morbidity and mortality
Bacteria	
(*Salmonella* spp.)	Mortality of captive birds; unknown effects on wild falcons
(*Escherichia coli*)	Occasional morbidity and mortality in captive falcons; possible reduction in hatchability
(*Mycobacterium avium*)	Mortality of captive falcons
(*Pasteurella multocida* - avian cholera)	Unreported; associated with mortality of a gyrfalcon that likely consumed infected ducks or geese (Williams et al. 1987)
Mycoplasmata (species uncertain)	Not clear
(*Chlamydia psittaci* - 'Psittacosis')	Not clear; possibly widespread and significant
Fungi	
(*Aspergillus fumigatus*)	Common cause of mortality
(*Candida albicans* - 'thrush')	Occasional morbidity and mortality
Viruses (avian pox)	Morbidity and occasional mortality
(Falcon herpesvirus)	Mortality in captive falcons
(Paramyxovirus - 'Newcastle disease')	Morbidity and mortality in captive falcons
Bacterial toxins (botulism)	Mortality; usually associated with disease in waterfowl

Weather. The effects of adverse weather may have little effect on overall survival rates of peregrines, but may affect reproductive success. Poor weather conditions during winter or migration periods may force peregrines to switch to alternate prey or use less efficient hunting techniques (Ratcliffe 1993). During the breeding season, however, weather effects can reduce the net productivity of a region (Ratcliffe 1993). Several days of rain may reduce the hunting efficiency of adults and lead to starvation of the young (Mearns and Newton 1988). Reproductive success may be lowered during years of excessive rainfall due to flooding of ledges and addling of eggs, as well as mortality of young from exposure (Mearns and Newton 1988). In the San Juan Islands, periods of heavy rain and cold temperatures were attributed to the excessive nest failure in 1996 (36%) and 2000 (53%) (Anderson 1996, 2001). Along the outer coast, reproductive success was lower during years of warm oceanic conditions associated with El Nino episodes (Wilson et al. 2000); during warm water episodes, successful pairs had smaller broods. In addition, falcons that carry high contaminant loads may metabolize fats during adverse weather and this may release DDE or other contaminants into the blood stream and potentially result in the formation of thin eggshells.

Shooting. Shooting has long been a factor associated with mortality of the peregrine falcon. During World War II, peregrines were shot in an attempt to protect passenger pigeons that carried important military information across western Europe (Ratcliffe 1980). Farmers and game area managers also shot peregrines because they were seen as 'varmints' that consumed prey of economic or recreational value to humans (Ratcliffe 1993).

Although the magnitude of shooting as a cause of mortality of peregrines in Washington is unknown, recent information indicates that shooting still occurs. Peregrines were reportedly shot at two potential breeding sites, in 1964 (Knight et al. 1979) and in the late 1960s (Buchanan 1988). At least two birds banded or recovered in Washington had been shot. Other birds recovered dead (Appendix B) may have been shot as well. A falcon found dead of undetermined causes on Olympia's waterfront in 2000 carried two lead shot pellets, one beneath the pectoralis muscle against the sternum, and the other in the foot (WDFW, unpubl. data).

Scientific Collecting. Peregrines and their eggs were taken for permanent use in scientific museums or other collections. The carcasses of at least 80 peregrine falcons from Washington now reside in scientific vertebrate museums or other collections across the country (Appendix A); with the exception of a few birds obtained after collisions with vehicles or buildings, the majority of these falcons were shot by museum curators or their associates. Peregrine eggs were greatly valued by collectors and many were removed from the wild in various parts of the world, particularly in western Europe (Ratcliffe 1993). The number of eggs taken from eyries in Washington is unknown, but was likely rather low due to the scarcity of known sites in this state.

Collisions. Peregrine falcons attain very great speeds and not surprisingly they are somewhat prone to physical trauma which can be fatal (Cooper 1978). Various types of physical trauma can result from high-speed collisions with prey, moving vehicles, moving aircraft, windows, and with towers or support wires (Cooper 1978, Balgooyen 1988, Sweeney et al. 1997). Eyasses suffer trauma when they fall from ledges prior to development of flight skills. With the exception of collisions with prey, which is difficult to document in the wild, each of these factors has been associated with peregrine falcon mortality in Washington state (WDFW, unpubl. data).

Some traumatic injuries are not immediately fatal, but may eventually result in death. For example, traumatic injuries may result in ocular lesions, common among raptors examined by veterinarians (Murphy 1993), which may lead to blindness. Bumblefoot can be caused by self-inflicted talon punctures and animal bites and may result in severe infection or death following bacterial invasion (Redig 1993). Similarly, respiratory conditions such as sinusitis or air sacculitis (Cooper 1978) may result and lead to death. It is unlikely that collisions and other forms of traumatic injury currently limits population size.

Electrocution. Peregrines have been known to be killed by electrocution in several western states (Williams and Colson 1989). Electrical tower and line designs have been improved over recent decades in an attempt to address mortality of birds that are attracted to the towers as perch or nest sites, or that collide with power lines (Olendorff et al. 1981). It is unlikely that electrocutions currently limit population size.

Contaminants. Peregrine falcons ingest and accumulate contaminants that are present in their prey. Falcons breeding in relatively pristine regions with little presence of organochlorine pollutants (e.g. the Aleutian Islands, the Arctic) may accumulate high levels of contaminants by consuming migrant prey species that have themselves accumulated burdens of contaminants on wintering grounds or during migration. On the other hand, peregrine falcons also migrate to relatively contaminated regions, including areas in Washington, where they consume contaminated prey. Either way, contaminants move up the food chain and are accumulated by this high-level predator.

DDT received its first widespread use during World War II. Its value as a pesticide became obvious and it was used widely in agriculture soon after the war (Hickey 1969). DDT remained a commonly-used pesticide until 1972, when the chemical's use was banned in the United States (Peakall et al. 1990). An emergency use of this chemical was cleared by EPA in 1974, when about 425,000 acres (171,998 ha) of forest were sprayed for tussock moth control in the Pacific Northwest (Henny 1977, Herman and Bulger 1979). Despite the fact that DDT use has been restricted in North America for nearly three decades, there is evidence of unauthorized post-restriction application in Arizona, New Mexico, New York, Texas, and possibly California and Washington (Clark and Krynitsky 1983, White et al. 1983, DeWeese et al. 1986, Schick et al. 1987, Stone and Okoniewski 1988). In addition, miticide dicofol, (4-chloro-alpha(4-chlorophenyl)-alpha (trichloromethyl) benzenmethanol), also known as Kelthane, used primarily in the southern USA, is made from DDT (Risebrough et al. 1986, Clark et al. 1990).

The primary threat of DDT to peregrine falcons is that its primary (and persistent) metabolite p, p'-DDE (hereafter referred to as DDE) impairs eggshell development. The mechanism by which DDE affects the eggshell is through its biochemical interference with enzyme systems involved in the transport of calcium and carbonate, two principal components of eggshell, from the maternal circulation in the shell gland to the shell membrane of the egg (Bitman et al. 1970, Peakall 1970, Miller et al. 1976). DDE is also known to cause behavior abnormalities (Risebrough and Peakall 1988) and may cause outright mortality, as was demonstrated using American kestrels fed prey containing low levels of DDE (Porter and Wiemeyer 1972).

Eggshell thinning impacts peregrine falcon populations when large proportions of females produce eggs that are too thin to survive the laying and incubation periods. Eggshell thinning of 15-20 %, relative to thickness values from the pre-DDT era, was associated with severe reproductive failure and decline in a breeding population (Peakall and Kiff 1979). After World War II eggshell thinning of 15-20% was documented in breeding populations in the United

Kingdom, Sweden, Finland, Siberia, North Africa, Zambia, Australia, Alaska, and eastern United States (Peakall and Kiff 1979).

Other chemical compounds that could be detrimental to peregrines include: PCBs, (polychlorinated biphenyls), dieldrin, and heptachlor epoxide (Risebrough et al. 1968, Risebrough and Peakall 1988). Heptachlor epoxide reduced egg hatchability and resulted in mortality of adult American kestrels in Oregon (Henny et al. 1983). Little additional information is available to indicate whether these compounds cause eggshell thinning individually; each, however, was typically present in contaminated raptors in the past and each was thought to have synergistic effects with other organochlorine contaminants.

There are two schools of thought regarding impacts of organochlorine contaminants on peregrine falcon populations. One perspective, generally held by biologists from western Europe, is that DDE caused impaired reproduction in peregrine falcons whereas dieldrin contributed significantly to direct mortality that caused the population decline (see Risebrough and Monk 1989). Another perspective, widely supported in North America, emphasized DDE as the primary cause of the peregrine falcon's population decline (Risebrough 1994). Aldrin and dieldrin were widely used in the United States and the United Kingdom during the period of the peregrine's population decline and were associated with many incidences of wildlife mortality (Nisbet 1988). Moreover, Nisbet (1988) argued that population crashes documented in certain parts of North America were far too rapid to have resulted from reproductive failure alone; he felt that excessive adult mortality must have occurred as well (see Olsen et al. 1992). Although raptors are known to have died of toxic exposure to dieldrin and aldrin, Nisbet (1988) concluded that the available data were only circumstantial and were inadequate to demonstrate decisively whether these compounds contributed significantly to the population crash. Risebrough and Peakall (1988) demonstrated, however, that reduced productivity alone could account for a drastic population decline in only 18-20 years.

PCBs and dioxin were known to impact raptors, but a direct link between these contaminants and population performance has not been made. PCBs are known to depress learning behavior in birds, monkeys and humans, and have caused physical abnormalities in laboratory chickens, and embryonic mortality and deformity in other laboratory birds (Risebrough 1994). Dioxin has similar effects and has been linked with development of an edema-producing disease found in chickens (Risebrough 1994). PCBs and other contaminants appear to impair immunosuppression in some wildlife (Calambokidis et al. 1991).

In the years since DDT was implicated in the decline of peregrine falcon populations, organochlorine pesticides have, in some countries and in some applications, been replaced with organophosphorus (OP) and carbamate pesticides. These compounds are less persistent in the environment than the organochlorines but are generally far more toxic (they inhibit cholinesterase function). Perhaps the most well-documented case of lethal effects of OP chemicals was the discovery of thousands of dead Swainson's hawks in and near fields that had been treated with OPs to kill grasshoppers on Argentine wintering grounds (Goldstein et al. 1996). The OP fenthion, commonly used in “Rid-a-Bird” perches (used to control pest species such as European starlings), has been implicated in the death of at least six peregrine falcons in North America (Mineau et al. 1999). This and other OP compounds are used widely in North America.

Other chemicals used in various management activities may be lethal to raptors but are typically used locally and would not likely impact populations. For example, cyanide used in mining (Henny et al. 1994), strychnine used to control pigeons (Redig et al. 1982), and brodifacoum used to control pests in orchards (Hegdal and Colvin 1988) are all capable of impacting raptors.

Information on chemical contaminants in peregrines in Washington is very limited. An adult female *pealei* banded on the Washington coast in autumn 1976 contained 0.73 ppm (parts per million; all values presented below are expressed on a wet weight basis, unless indicated otherwise) DDE in its blood plasma (C. Henny and T. Fleming, unpublished data). In addition, Wilson et al. (2000) reported a mean of 4.3 ppm DDE in 9 addled eggs collected from four nest sites along the Washington coast. These levels were below those known to influence productivity.

A number of potential peregrine prey species have been identified in northern or western North America that carried elevated levels of DDT. In eight western states, samples of black-necked stilt (*Himantopus mexicanus*), killdeer (*Charadrius vociferus*), white-throated swift (*Aeronautes saxatalis*), yellow-headed blackbird (*Xanthocephalus xanthocephalus*), meadowlarks, Brewer’s blackbird (*Euphagus cyanocephalus*), cliff swallow (*Hirundo pyrrhonota*), barn swallow (*H. rustica*), tree swallow (*Tachycineta bicolor*), violet-green swallow (*T. thalassina*), rough-winged swallow (*Stelgidopteryx serripennis*), American robin, and western tanager (*Piranga ludoviciana*) were highly contaminated, carrying more than 2 ppm DDT and/or metabolites in 1980 (DeWeese et al. 1986); the highest reported levels were from individual killdeers (58.8 ppm), Brewer’s blackbirds (32.64 ppm), and tree swallows (58.63 ppm). Cliff swallows and spotted sandpipers (*Actitus macularia*) collected in northern Canada in 1966 (Enderson and Berger 1968), and white-throated swift, killdeer, and red-winged blackbird collected in Arizona in 1981 (Ellis et al. 1989), contained >2 ppm DDE. Sanderlings (*Calidris alba*) in coastal California in 1982-83 contained a geometric mean of 1.7 ppm with an extreme of 32 ppm DDE (Schick et al. 1987). Even though the species mentioned above also have populations that occur in Washington, there are no data to indicate whether the contaminant levels reported are or were representative for those prey populations in this state, although species such as sanderling migrate through this state.

In Washington there is little information on contaminant levels in peregrine falcon prey species. Schick et al. (1987) reported levels of DDT (and metabolites) in overwintering dunlins in western Washington ranging between 0.02 and 0.2 ppm in 1980-81. The same study found PCBs and HCB in all samples evaluated, with mean site values ranging from 0.06 to 0.5 ppm; chlordane isomers, dieldrin, and heptachlor epoxide were found in samples from Samish Bay and Bowerman Basin (Schick et al. 1987). DDE and PCB levels in dunlin tissues decreased between March 1978 and December/March 1980-81 at Samish Bay, and PCB levels decreased at Bowerman Basin between November 1975 and November/March 1980-81 (Schick et al. 1987). In a later study, dunlins collected in two periods during winter 1984-85 at Grays Harbor contained mean values of 0.3 and 0.4 ppm DDT/DDE, and five single black-bellied plovers (*Pluvialis squatarola*) from Samish Bay had a mean of 0.4 ppm DDT/DDE (Custer and Myers 1990). Small samples of western sandpipers (*Calidris mauri*) indicated presence of DDT/DDE and variable levels of PCBs (highest reported = 0.62 ppm) (Schick et al. 1987). Samples of sanderlings and black-bellied plovers also contained DDE (mean for sanderlings = 0.26) and PCBs (mean for sanderlings = 0.38) (Schick et al. 1987).

Spring migrant shorebirds in western Washington exhibited a broad range of contaminant levels. A sample of eight western sandpipers had low levels of DDE (all single or geometric mean values $\leq$0.05 ppm) and only slightly higher levels of PCBs (range = 0.03-0.17 ppm). Two dunlins, a red knot (*Calidris canutus*) , and a ruddy turnstone (*Arenaria interpres*) had slightly higher levels of DDE, but similar levels of PCBs. On the other hand, a sanderling (417 ppm DDE, 50 ppm PCBs), a semipalmated plover (*Charadrius semipalmatus*) (4.5 ppm DDE), and a black-bellied plover (20 ppm DDE and 1.0 ppm PCBs) were very contaminated (Schick et al. 1987).

Other contaminant data from the region are from samples of marine birds. A sample of four fork-tailed storm petrel eggs from the Washington coast had elevated mean values of DDE (3.49 ppm), DDT (0.35 ppm), and PCBs (3.4 ppm) in 1982 (C. Henny and U. Wilson, unpublished data). These values were lower than from a single egg of this species from the Oregon coast in 1979 (12 ppm DDE and 5.1 ppm PCBs; Henny et al. 1982). Eggs of other potential prey species evaluated in 1979 included black oystercatcher (*Haematopus bachmani*) (0.08 ppm DDE, 0.32 ppm PCBs), pigeon guillemot (*Cepphus columba*) (0.26 ppm DDE, 0.33 ppm PCBs; see Calambokidis et al. 1991 for additional data on the latter species), tufted puffin (*Fratercula cirrhata*) (0.62 ppm DDE, 0.51 ppm PCBs), common murre (0.87 ppm DDE, 0.52 ppm PCBs), and Leach's storm petrel (2.5 ppm DDE, 1.1 ppm PCBs; Henny et al. 1982).

Heavy metals found in raptors and which are thought to impair health include lead, mercury, cadmium, and selenium. Mercury and selenium levels have been documented in peregrine falcon shorebird prey collected in Washington. Custer and Myers (1990) reported low levels of mercury (<0.9 ppm dry weight) and elevated levels of selenium (>26.9 ppm dry weight) in wintering black-bellied plovers from Totten Inlet and Samish Bay. Lead is generally toxic to raptors at concentrations (in blood, liver, or kidney) above 1-3 ppm and is considered "compatible with death" at concentrations >5 ppm (Franson 1996, Redig et al. 1980). American kestrels fed a diet with high levels of lead experienced impaired growth and higher mortality rates (Hoffman et al. 1985, Franson et al. 1983). Lead exposure most likely occurs when falcons ingest lead shot or bullet fragments present in prey items (e.g. lead shot present in waterfowl directly captured or scavenged by a falcon). Lead is also emitted from mining activities and metal smelters (Henny et al. 1994, Franson 1996); rock doves, a common prey species of the peregrine falcon, carried levels of lead strongly correlated with the amount of vehicle traffic (DeMent et al. 1986, Drasch et al. 1987).

As was noted above for some of the organochlorine contaminants, toxic effects of mercury are difficult to identify in wild populations. Mercury is a naturally-occurring metal that is also released into the environment at levels higher than background through a variety of industrial processes (Thompson 1996) and as a seed dressing (Fimreite et al. 1970). Mercury has been linked to human deaths and its use as a seed dressing has resulted in mortality of wildlife (Thompson 1996). Although a variety of raptor species have been found to carry substantial burdens of mercury (Thompson 1996), Fyfe et al. (1976) found no relationship between the concentration of mercury in the eggs and the productivity of prairie falcons and merlins in the Great Plains. Similarly, Newton et al. (1989) were unable to demonstrate a relationship between brood size and mercury concentration alone in peregrine falcon eggs. It was demonstrated, however, that merlin clutches with >3 ppm mercury were more likely to fail than those with less mercury from sites in mainland Britain, although the relationship was not noted elsewhere (Newton and Haas 1988). Newton et al. (1989) concluded, however, that the presence of mercury may have increased the affect of DDE and contributed to a lower brood size. Mercury levels have been reported in feathers (in Sweden; Lindberg and Odsjö 1983) and eggs (North Carolina; Augspurger and Boynton 1998) of peregrine falcons but these studies were not designed to evaluate possible effects of this heavy metal. In short, it is difficult to differentiate effects of mercury from those of many other environmental contaminants (Thompson 1996).

The effects of cadmium and selenium on raptors is less clear and apparently is negligible. Both compounds are used for a variety of industrial uses. Cadmium tends to accumulate more in mollusc-eating bird species; it is usually found only in very low concentrations in most other species and is rarely associated with raptors (Furness 1996). Selenium impairs reproduction and can result in embryo abnormalities when present at >3 ppm in eggs. Selenium is rarely associated with raptors (Heinz 1996).

Pollution from oil spills has not been reported to impact peregrine falcons although it is likely that falcons have been sickened or killed from oiling. In areas where peregrine falcons prey on oiled birds it is likely that oil could impair falcon health. Following an oil spill in Port Angeles in December 1985, 3 peregrines were seen to have fouled plumage (Falcon Research Group newsletter No. 2, 1987); the effects of the oiling were not determined, however. Populations of prey species reduced due to direct mortality from spilled oil could potentially lead to reduced productivity or site abandonment. These impacts, should they occur, could impact multiple sites along the outer coast or in the San Juan Islands.

HABITAT REQUIREMENTS

Breeding Range

The presence of prominent cliffs is the most common habitat characteristic of peregrine nesting territories. Prominent cliffs function as both nesting and perching sites, and provide unobstructed views of the surrounding landscape. Nest site suitability requires the presence of ledges that are essentially inaccessible to mammalian predators, that provide protection from the elements, and that are dry (Campbell et al. 1990, Johnsgard 1990). A source of water, such as a river, lake, marsh, or marine waters, is typically in close proximity to the nest site and likely is associated with an adequate prey base of small to medium-sized birds (Cade 1982, Johnsgard 1990). However, peregrines may nest at locations other than cliff sites, such as at the apex of steep, grass-covered slopes (Beebe 1960), tall buildings and bridges in urbanized or industrial environs (White et al. 1988, Johnsgard 1990), rock quarries (White et al. 1988), and very rarely, in trees (Campbell et al. 1990).

The quality of a breeding site is dependent on features of the nest site and surrounding foraging area which influence nesting success and adult survivorship (Hunt 1988). Important aspects of the nest site include adequate substrate for egg incubation and activities of nestlings, favorable temperature regime, favorable directional exposure, defendibility, and isolation from predators and parasites. Important aspects of the foraging area include abundance of prey, physiographic features and foliage profiles that make prey vulnerable to peregrine attacks, and the presence of competitors or predators (Hunt 1988). Large, imposing cliffs may be favored sites because of the energetic advantages associated with hunting and defense of nest sites not realized at small cliffs (Newton 1988). Falcons using large cliffs can do most of their hunting from a perched position while they watch large areas for vulnerable prey, and utilize the great height and updrafts when initiating a hunting flight (Newton 1988). From a perched position, a falcon can also advertise its presence and guard the nesting place. In contrast, falcons using a low cliff or one at a low point in the landscape have a restricted view and prey are often at a higher level than the cliff. This may require finding other suitable perches from which to hunt, or using flapping or soaring flight to achieve sufficient elevation to hunt effectively. Newton (1988) stated that use of tall or prominently-situated cliffs effectively increased food availability, and such sites were therefore occupied more regularly and were likely to fledge more young than small cliffs. It is not clear that this generality applies in all areas (Ellis 1982). Despite a likely preference for large and imposing cliffs, peregrines also use smaller cliffs and cut-banks, but these are considered lower quality sites (Hickey 1942).

Attributes of eyries. Peregrine falcon eyries are found at a wide range of elevations throughout their range. This is true in Washington state as well. On the outer coast, where falcons nest on coastal headlands or offshore rocks and islands, the estimated elevation of eyries ranges from about 45 feet (14 m) to about 175 feet (53 m); the range of elevations in the Puget Sound region is slightly greater, from about 50 feet (15 m) to about 770 feet (235 m). With the exception of a few sites in western Washington, particularly those in urban settings, eyries in the forested upland region are found at much higher elevations compared to the coastal sites; 12 of the 15 sites are above 1000 feet (305 m), including 10 above 2000 feet (610 m) and 6 above 3000 feet (915 m). The highest known site in the state is found at 5500 feet (1676 m) in this province. Eyries in the Columbia Basin are between 666 and 1865 feet (203-568 m) in elevation (WDFW, unpubl. data). These elevation values are approximate due to the difficulty in obtaining accurate data for a nest ledge on a vertical rock face. The data for Washington eyries are roughly equivalent to data reported from the coast and interior of British Columbia (Campbell et al. 1990).

Peregrines often select cliff sites that are adjacent to broad valleys, lakes, streams or other geographical settings that allow for a commanding view of the surrounding terrain (Ratcliffe 1993). Data from all parts of the state indicate that, on average, peregrine eyries are about 200 feet from a source of fresh water (WDFW, unpubl. data). There are only a few sites, all in the uplands region, that are more than 1000 feet (305 m) from a creek or a body of water >3 acres (1.2 ha) in size (WDFW, unpubl. data).

A small number of peregrine falcons nest in the Columbia Basin of Washington (see Fig. 2), and the habitats used by those falcons have not been well described. All of the eyries were on relatively large cliffs (except for one site on a bridge) situated near a large body of permanent water. Eyries in Utah were located relatively near water, some as far as 9.7 miles (15.5 km) from a marsh, lake or river where the falcons hunted for prey (Porter et al. 1973). The average size of the marsh nearest 14 eyries in the Utah and Great Salt Lake valleys was about 151 acres (61 ha; the smallest marsh was about 61 acres [24.7 ha]) (Porter et al. 1973). These data indicate an apparent preference for peregrines in arid environments to nest relatively near major sources of water near hunting areas; some nests, however, can be far removed from either, indicating an ability to adapt to a range of local conditions.

Across their range peregrines generally show no apparent preference for a particular aspect of site orientation. The exceptions to this, pointed out by Ratcliffe (1993), are that sites along coastal shores strongly coincide with the particular shoreline geography and some sites in mountainous or arid regions indicate a preference likely related to micro-climate at the eyrie. In Washington, there were tendencies for a particular aspect of orientation depending on the region of the state, but with the exception of the outer coast, none were statistically significant (Rayleigh's tests, all z scores < 1.77, all P values > 0.2; Appendix C). Sites along the outer coast were oriented predominantly to the south or west. Not surprisingly, this trend was particularly pronounced for the ledges located on the mainland (mean angle = 239^{o}; Rayleigh's test, $z = 9.9$, $P < 0.001$; Appendix C); ledges located on islands and offshore rocks, however, tended to be uniformly distributed (Rayleigh's test; $z = 1.54$, $P > 0.2$) (Appendix C), which is logical given the conceptually greater number of choices for situating a nest ledge on an island.

Migration and Winter Range

Home range. Peregrines range over extensive areas when hunting prey. In the vicinity of Sequim, where three birds were monitored for most of a single winter, home range size was 23.7 mi^2 (65.8 km^2) for an immature female and 30.9 mi^2 (85.7 km^2) for an immature male (Dobler 1993). Core areas were 4.9 mi^2 (13.5 km^2) and 9.1 mi^2 (25.3 km^2) for an immature female and immature male, respectively. At Grays Harbor, an immature male peregrine had a home range of 28 mi^2 (78 km^2) and core area of 7.1 mi^2) 19.8 km^2 during a single winter (Dobler and Spencer 1989).

Habitat types. Habitats used by peregrines during the non-breeding season support high densities of shorebirds, waterfowl and other small to medium-sized birds (Anderson and DeBruyn 1979, Campbell et al. 1990). Coastal and estuarine habitats include beaches, tidal flats, islands, and marshes. Human-altered habitats and environs include flooded agricultural fields, airports, and cities where rock doves are abundant (Anderson and DeBruyn 1979, Campbell et al. 1990). Roost sites are an important element of wintering habitat. Radio telemetry has shown that peregrines show fidelity to roost sites, using them repeatedly during the winter, and flying great distances (15 mi) from foraging areas (Anderson et al. 1984). In north Puget Sound, islands offshore of mainland foraging areas are important winter roost sites (Anderson et al. 1984).

Two studies in Washington provided insight into habitats used by peregrine falcons during winter. The home range of an immature peregrine at Grays Harbor consisted of 53% tide flats, 27% open water, 12% forested uplands, 4% residential areas, and 3% crops and pasture areas (Dobler and Spencer 1989). Primary hunting areas were tide flats and open water with occasional use of forest where the falcon likely perched and roosted. Dobler (1993) investigated habitat use by two falcons in the vicinity of Sequim, Clallam County. Those falcons made distinctly different use of available habitats. The home range of an immature female included significantly more open water (72%) than expected; significantly less conifer forest, mixed forest, and shrub woodland than expected (13%); and grass and cropland (15%) in equal proportion to availability. Conversely, the home range of an immature male included significantly more grass and cropland (65%) than expected, open water (23%) less than expected, and conifer forest less than expected (12%). Within the core area of the female's home range, open water was used less than expected, and grass/cropland, sparse grass, and beach-bare ground habitats were used significantly more than expected (Dobler 1993). These studies indicate variability in the areas used by wintering peregrines, but also emphasize use of open habitats and occasional use of forest areas, likely for roost sites.

Perch sites. Selection of perches by peregrines has not been well quantified in most parts of the species' range. In Washington peregrines use a variety of artificial and natural perches with selection most likely related to the proximity to foraging habitat. Perches used by peregrine falcons during October through December at Lummi Bay included trees (55% of observed perches; 78% of these were in conifers), beach or mudflat (including logs or other objects; 21%), and the ground (fields; 15.8%) (Anderson et al. 1984). When the perch observations are reported as the proportion of perch time, the values above changed very little; about 62% of the total perch time was spent in trees, followed by beach or mud flat (22%), and the ground (13%) (Anderson et al. 1984). Anderson et al. (1984) identified 11 different perch types used by feeding falcons on 33 occasions. These perch types can be summarized into five categories: ground locations (grass fields, corn-stubble fields, gravel beach; 39%), mud flats (18%), pilings (18%), logs (on mud flats or on ground; 18%), and trees (6%). The perches were all in open terrain that allowed the falcons to scan for predators or other birds that might attempt to pirate their captured prey (Anderson et al. 1984).

At Samish Flats in 1979, fence posts were the most regularly used perch type in an agricultural farmland area adjacent to an estuary (Anderson and DeBruyn 1979). Other perch sites included trees (28%), ground (20.9%), utility poles (6.2%), log (5.5%), and pilings in the bay (0.8%)

(Anderson and DeBruyn 1979). At the same study site, in 1980, fence posts were again the primary perch type used (34%), followed by coniferous trees (23%), ground (21.5%), and cottonwood trees (9%) (Anderson et al. 1980). At Grays Harbor, peregrines used driftwood logs on tideflats (23% of 298 visual locations of perched falcons), navigation towers in the bay (18%), a small island bluff (15%), driftwood on an island in the bay (10%), pilings (9%), conifer snags (6%), Sitka spruce trees (5%), and various other locations that comprised <5% of the total (Dobler and Spencer 1989). At Sequim peregrines usually perched on snags (59% of 636 visual locations), most often conifers (93%); particularly Douglas-fir or western redcedar (Dobler 1993). Peregrines also perch on coastal cliffs and bluffs (F. Dobler, pers. comm.; J. Buchanan, unpubl. data) and on outer coastal beaches perch on drift logs and "root balls" (37% of 46 known perch sites), branches or boards (22%), or on sand (41%)(J. Buchanan, unpubl. data). Finally, peregrines perch on sailboat masts, industrial cranes, and buildings along the Puget Sound waterfront (J. Buchanan, unpubl. data), on "sky-scrapers" in urban settings and on large bridges (Bell et al. 1996, Cade et al. 1996), on navigation towers and utility poles (J. Buchanan, unpubl. data), and on large ships, grain elevators, and water towers (T. Fleming, pers. comm.).

Roost sites. Information on nocturnal roost site location generally comes from the same regions and studies cited above. Peregrine falcons at Samish Flats typically roosted on islands between 2.5 and 9 miles (4-14.4 km) from day use areas (Anderson et al. 1980). An adult female peregrine wintering at Lummi Bay typically roosted between 2000 and 2300 feet (671-771 m) elevation, likely in coniferous forest, on one of the San Juan Islands that was up to 15 miles (24 km) from day use areas (Anderson et al. 1984). Roost sites used at Grays Harbor included a shoreline bluff and a navigation tower in the bay (Dobler and Spencer 1989). Peregrines at Sequim used shoreline or island bluffs (eroded, north-facing surfaces), a navigation tower, and on occasion, the ground (Dobler 1993). It is likely that falcons associated with urban areas or bridges select roost locations on skyscrapers and bridges.

POPULATION STATUS

Decline, Protection, and Recovery in North America

Stability. Prior to World War II, breeding populations of peregrines were considered stable. Habitat deterioration and/or destruction caused by human occupation of the land led to some abandonment of eyries prior to WWII (Hickey 1942, Cade 1982). As of 1940, Hickey (1942) reported about 400 known nesting sites in North America east of the Rocky Mountains, of which 210 were known to be occupied. Based on reports of deserted eyries, he speculated that a 10-18% decline in occupancy may have occurred in this region, although he did not regard this as a major decline in numbers. Observations of rapid replacement of missing birds at breeding sites and constant occupancy among years at breeding sites in the eastern states, suggested a surplus of non-breeding birds and a stable population. Hickey (1942) estimated a breeding population of 350 breeding pairs for the eastern states, although the population was likely far greater given the amount of habitat that had yet to be surveyed systematically. In the same time period, Bond

(1946) reported 328 known peregrine eyries in western North America, 136 of which were in the United States, although he provided few details on specific locations. Bond speculated that "*the breeding population was more than twice the known population (328)*" (Bond 1946:113), although peregrine breeding habitat was not systematically surveyed, and the effort was less intensive than that of Hickey (1942) for eastern North America. There was no evidence to suggest that peregrine populations were declining in the early and mid-1940s in North America.

Period of decline. The decline in breeding peregrine populations was first recognized at regional levels. Complete reproductive failure was documented in 1953 for breeding populations in the Hudson River Valley and Massachusetts (Hickey and Anderson 1969). At the same time in Britain, broken eggs were observed more frequently in eyries than in prior years, and there was evidence of a decline in productivity and increase in desertion of eyries along a part of the outer coast (Hickey and Anderson 1969). By 1962 it was rumored at the International Ornithological Congress that there was complete reproductive failure of peregrines in the northeastern states. This news led Joseph Hickey, in 1964, to re-run his 1939-40 survey of peregrines in eastern North America to document the extent of the decline. Berger et al. (1969) found no peregrines at 143 nest sites between Alabama and Nova Scotia in 1964. These dramatic results prompted an international conference at Madison, Wisconsin, in 1965 to discuss the plight of the peregrine (Hickey 1969). Based on reports, presented at the conference, on the status of peregrines in various parts of its breeding range as of 1965, it became apparent that peregrines had been declining in North America as early as the late 1940s to early 1950s in Massachusetts (Hagar 1969), along the Hudson River (Herbert and Herbert 1969), and in Pennsylvania (Rice 1969). In California, successful breeding could not be verified in the southern coastal region after the mid-1950s, and the once dense breeding population of the Channel Islands was drastically reduced if not extirpated by this time (Herman et al. 1970). In Oregon, peregrine populations declined gradually during the 1930s and 1940s, but the majority of sites were abandoned during the 1950s, with a few still occupied through the 1970s (Henny and Nelson 1981). Declines in peregrines were also documented in the Rocky Mountain region (Enderson 1969). Further north, peregrine populations were deemed stable in the Queen Charlotte Islands of British Columbia (Beebe 1969), although they certainly had declined there (Nelson and Myres 1976); peregrines had also vanished from the British Columbia portion of the Okanagan Valley by that time (Beebe 1969). Breeding populations in Alaska (White 1969) and arctic Canada (Fyfe 1969) were stable at that time. Declines in breeding populations in these regions occurred later, although Ambrose et al. (1988) suggested a decline may have been underway in Alaska in the early 1950s. The dramatic decline in the breeding population on the Colville River came in 1970; an estimated 72% of the known eyries failed in that year (Cade et al. 1971). By 1965 the peregrine was essentially extirpated east of the Mississippi River in both the United States and Canada south of the boreal forest (Berger et al. 1969). In the Rocky Mountain region an estimated 33% of known eyries were still occupied (Enderson 1969) and in the northwestern states of Washington, Oregon, Idaho, Utah and western Montana and Wyoming, 80 to 90% of the traditional nesting sites were abandoned at that time (Nelson 1969).

The cause. In Britain, populations had returned to pre-WW II levels by the early 1950s. After 1955, a decline in breeding pairs and productivity was observed, and by 1962 the total population had been reduced to half the prewar level (Ratcliffe 1969). The pattern of decline was similar to that in North America, with a decline spreading from the south to the north. The increased use of agricultural pesticides, particularly persistent organochlorine compounds, showed a close correlation in both space and time with the decline of peregrines in Britain. Concentration of these contaminants in both adults and eggs were suggested to increase adult mortality and lower breeding success. Egg breakage became the most common cause of nesting failure after 1951. Widespread contamination of peregrines, their eggs, and their prey with residues of organochlorine pesticides such as DDT, DDE, and the more toxic compounds aldrin, dieldrin, and heptachlor, provided circumstantial evidence that these pesticides contributed to the decline of peregrines in Britain (Ratcliffe 1969). The consensus at the conclusion of the Madison Conference was that peregrines over much of North America and Europe had declined and persistent pesticides were suggested as the primary cause.

Researchers in both Britain and the United States revealed the significance of agricultural pesticides in the decline of peregrines in North America and western Europe. In Britain, Ratcliffe (1967) provided evidence of a correlation between the frequency of egg breakage, scale of decrease in eggshell weight, subsequent status of breeding peregrine populations, and exposure to persistent organochlorine pesticides. Population "crashes" in peregrines after 1955 were attributed to increased adult mortality that may have been linked to the introduction into general use of dieldrin, aldrin, and heptachlor in Britain. In North America, Hickey and Anderson (1968) related the severe declines in three species of raptorial birds, including peregrines, and associated decreases in eggshell thickness specifically to increases in DDE residues. Cade et al. (1971) demonstrated a highly significant negative correlation between eggshell thickness and DDE content in peregrine eggs. By measuring the amount of DDE in the dried membranes of eggshells, Peakall (1974) was able to show that DDE was present in peregrine eggs shortly after the introduction of DDT to the environment, and in sufficient concentration to account for eggshell thinning. Levels of 15-20 ppm wet weight DDE in egg contents is the critical level at which hatching failure occurs in peregrines due to DDE induced eggshell thinning (Peakall et al. 1975, Peakall 1976, Peakall and Kiff 1988).

In November of 1969 a follow-up conference was held at Cornell University to more clearly define the decline in North America. Peregrines were reported as extirpated from the southern part of California and northern part of Baja California, and major declines occurred in the western United States, much of southern Canada, and the Northwest Territories (Kiff 1988). The decline began in southern regions and spread northward. As a result of recommendations put forth at the Cornell Conference in 1969, continental surveys were begun in 1970 to monitor population status and reproductive performance at 5-year intervals. Surveys conducted in both 1970 (Cade and Fyfe 1970) and 1975 (Fyfe et al. 1976) documented the continued decline of populations in North America. Pacific maritime peregrine (Peale's) populations were considered stable at this time. A number of developments occurred in the early 1970s that were favorable to peregrine conservation in North America. First, in 1970, FWS listed the American and arctic peregrines as endangered under the Endangered Species Conservation Act of 1969 (Public Law 91-135, 83 Stat. 275) and subsequently under the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.). Second, captive breeding facilities and programs were established in both the United States (1970) and Canada (1972) that eventually were successful in the production of captive bred peregrines for release to the wild. Finally, DDT was essentially banned from use in the U.S. (1972) and greatly restricted in Canada (1969). These actions were timely in preventing the likely extirpation of this species from North America.

Period of recovery. Populations began a period of recovery in North America in the late 1970s. Trends in migration counts on barrier islands (Ward et al. 1988) support the summary by Cade (1982) that peregrine populations breeding in the American arctic began to increase in the late 1970s. The 1980 continental survey indicated recovery or at least stabilization had occurred in most parts of North America. Arctic populations had mostly stabilized and boreal forest populations had mostly increased. However, peregrines in southern Canada were not doing well (White et al. 1990). The 1985-86 survey was conducted only in Canada. Northern and west coast populations were stable or increasing. However, numbers remained low in southern Canada (Murphy 1990). At the same time in the United States, populations continued to increase in Alaska (Ambrose et al. 1988). In the Rocky Mountain region, peregrine numbers remained low in Montana, Wyoming, and Idaho (Enderson et al. 1988). In the western states, peregrine numbers were increasing, but eggshell thinning remained a concern for populations in California and Washington (Walton et al. 1988). Regional surveys conducted annually by resource agencies and periodic extensive surveys, indicate the "crash" in peregrine populations was most pronounced during the 1950s, but the decline continued through the 1960s and into the early 1970s (Cade 1982, Kiff 1988). The decline in peregrines in North America appears to have bottomed out in most areas about 1973-75.

Since the late 1970s, peregrine populations have shown a trend of continuing recovery in most parts of North America, although the species remains extirpated in some parts of its range. Between 1980 and 1990 the number of known pairs on territories in North America tripled from 499 to 1540 (Enderson et al. 1995). Banning of DDT use in the United States and Canada was instrumental to the recovery of populations, but critical levels of DDE in peregrine eggs declined gradually rather than abruptly, on into the mid-1980s (Peakall et al. 1990). Direct management of peregrines through fostering and releases of young from both captive-bred birds, and to a lesser extent wild eggs hatched in captivity, contributed substantially to this recovery (Kiff 1988, Enderson et al. 1995, Holroyd and Banasch 1996). In the late 1970s and early 1980s the USFWS developed recovery plans for four regions of the United States: East (1979), Rocky Mountains and Southwest (1984), Pacific (1982), and Alaska (1982). Releases were a major component of management strategies identified in regional recovery plans for species recovery. Peregrine releases in the United States totaled 4,680 birds during the period 1974-94, and reached a maximum in the late 1980s. In the western United States, 2,722 peregrines were released from 1974 to 1994 (Enderson et al. 1995). Recovery criteria for total pairs were met by 1995 and population trends continued to increase, leading Enderson et al. (1995) to recommend de-listing the peregrine in this region.

Down-listing and de-listing. The Peale's peregrine was not listed under the Endangered Species Act. This decision was made because the subspecies was reproducing at comparatively higher levels than the other two North American subspecies and had moderate, declining levels of DDT. The primary reasons cited for the original listing of the arctic and American peregrine falcon were range-wide population declines in North America and population extirpation east of the Mississippi River due to the negative impacts of DDT, and its metabolite DDE. Trends of increases in productivity and decreases in contaminant loads of arctic peregrines, in combination with trends of higher counts along migration stopover sites, led the USFWS, on March 1, 1983, to propose reclassifying the arctic peregrine falcon from endangered to threatened (Sheppard 1983). In addition, all free-flying *Falco peregrinus*, not otherwise identifiable as a listed subspecies, were considered to be endangered under the similarity of appearance provision in the lower 48 coterminous States. On March 20, 1984 a rule finalizing the proposal was published in the Federal Register and became effective on April 19, 1984 (Sheppard 1984).

In northern North America, both arctic and American peregrine populations continued a trend of recovery from the mid-1980s through 1990. Pesticide residues in eggs gradually decreased and pesticide-induced reproductive failure became rare or absent. On June 12, 1991, USFWS announced in the Federal Register that it was undertaking a status review of the arctic and American peregrine falcon in northern North America. Census data indicated the arctic peregrine falcon, throughout its range, and American peregrine falcon in Alaska, and the Yukon and Northwest Territories, was no longer endangered or threatened with extinction (Swem 1991). The arctic peregrine was de-listed on October 5, 1994, but was still protected from direct take in the lower 48 States due to the similarity of appearance provisions of the ESA (Swem 1994).

In June of 1995, USFWS proposed to remove the American peregrine from the list of Endangered and Threatened Wildlife (Mesta et al. 1995). The recovery plan for the Pacific Population of American peregrine was approved by the USFWS in October of 1982, and called for captive-rearing and release of falcons to the wild to increase populations (U.S. Fish and Wildlife Service 1982). The first release in Washington of captive-bred American peregrines occurred in 1982 and the last release occurred in 1997. Only pure American peregrines were released to the wild in the western United States. To reclassify the American peregrine from endangered to threatened status, the Pacific Coast Recovery Plan recommended a minimum of 122 pairs be established in a geographic distribution comprised of 22 management units in the states of California, Washington, Oregon, and Nevada, and which reflected the historic range of the Pacific Coast peregrine falcon population. Each management unit had a specified number of active pairs to attain before reclassification to threatened status occurred. Management units (minimum numbers of active pairs) in Washington (*minimums shared with adjoining state) included the Outer Coast and Olympic Peninsula (n = 6), Puget Sound and San Juan Islands (n = 2), Cascade Mountains (n = 5), Okanogan Highlands (n = 1), Selkirk Mountains (n = 1), Blue Mountains (n = 4*), and the Columbia River Gorge (n = 3*). For de-listing to occur, the Pacific Coast Recovery Plan recommended that in addition to meeting the minimum distribution numbers within the Pacific States region, a minimum of 185 self-sustaining pairs of American peregrines be distributed in the states of Washington (n = 30), California (n = 120), Oregon (n = 30), and Nevada (n = 5) and maintenance of an average productivity of $\geq$1.5 young/territorial pair per year for a 5-year period. An evaluation of population status by USFWS in 1998 determined that de-listing criteria were met. In 1998, there was a minimum population of 270 pairs in the Pacific States region. Distribution goals were met in the 4 states, and average productivity from 1993-98 was 1.5 young/pair.

After reviewing regional recovery objectives and recent status information for population size, reproductive performance, pesticide residues in eggs, and eggshell thinning, the USFWS proposed to de-list the American peregrine falcon on August 26, 1998 (Mesta 1998). The proposal generated considerable discussion in the scientific community on both sides of the issue (Pagel et al. 1996, Cade et al. 1997, Pagel and Bell 1997, Millsap et al. 1998, Pagel et al. 1998). On August 25, 1999, the American peregrine was de-listed and the similarity of appearance provision for free-flying peregrines in the conterminous United States was removed (Mesta 1999).

Washington: Past

Beginning with an observation by Lewis and Clark in 1806 that may have been a peregrine falcon along the Columbia River (Hall 1933:69), and observations and collection of peregrines at Willapa Bay and Puget Sound in the 1850s by Suckley and Cooper (1860; and see Baird 1858), the status of this species in Washington has been described by many naturalists. Dawson and Bowles (1909) in their book, "The Birds of Washington," considered the American peregrine as "*not common* resident throughout the state" and acknowledged a population of Peale's falcons at least on the outer coast. They considered the American peregrine *uncommon* in eastern Washington, due to supplanting by prairie falcons, and no nest sites were known east of the Cascade Mountains. Abert Reagan, listed the Peale's falcon as *common* on the Olympic Peninsula (Reagan 1911). Nesting pairs were known on the mainland and offshore-islets. The nest sites on the offshore-islets were previously identified as inhabited by nesting Peale's by William Dawson (1908a), Jones (1909) and Pollock (1925). Edson (1908, 1929) considered the peregrine a rare breeder in the northern Puget Sound and San Juan Islands. Hoffmann (1927) in "Birds of the Pacific States" considered American peregrines as resident but *probably rare* west of the Cascade Mountains, outside of the coast. Peale's was listed as resident along the coast. In "Birds of the Olympic Peninsula", Kitchin (1949) considered the American peregrine resident, but *rare*, and the Peale's falcon to be resident along the coast. Kitchin made reference to nest sites mentioned by Dawson and Bowles (1909) and referred to two pairs he observed at the coast. Jewett et al. (1953), in their book, "Birds of Washington State" considered the American peregrine as a *rare* resident in eastern Washington. They reported "a few pairs near the bluffs near Dayton" based on observations of Lyman (1922) and a nest site in the Snake River canyon near Asotin; Larrison et al. (1967) mentioned the possibility of nesting in the latter area. The Peale's peregrine was considered a resident along the outer coast and extending eastward to the Puget Sound region. It was described as *common* on the off-shore islets from Cape Disappointment to Flattery Rocks, and nesting on the nearby mainland. A probable nest site was reported along the Washington coast in 1959 by Kenyon and Scheffer (1961).

Estimates of historic population. W. L. Dawson and J. M. Eason documented the first peregrine eyrie in Washington, in the San Juan Islands on 23 June 1905 (Dawson and Bowles 1909, Anderson 1980). Bond (1946) knew of 136 peregrine nesting sites in the western United States and Nelson (1969) indicated that 40 peregrine eyries were known for Idaho, Washington, Oregon, western Montana and Wyoming. These known eyries had been compiled by Richard Bond and colleagues dating before 1948, but neither Bond nor Nelson provided state totals. Regions of the state where peregrines nested in "some numbers" prior to 1948 included the outer coast, the Columbia River basin, and the Okanogan River (Nelson 1969). Cade (1975) estimated 33-38 eyries for Washington and Oregon combined. Steve Herman summarized data from Bond's data and other sources and estimated 20-25 historic eyries in Washington (pers. comm.1976; cited in Porter and White 1977). Anderson (1980) researched historic nest site records for Washington and documented 12 historic nest sites. These sites were distributed along the outer coast (4), in the San Juan Islands, (4), the Columbia Gorge (2), and the Snake River Canyon (2). In Washington, historical baselines were poorly known and count techniques were not standardized. Historical records, such as Bond (1946) and Anderson (1980) were derived from early published checklists, specimen records, egg collectors, falconers, and other sources. These historical records were better indicators of distribution than of abundance. As is true for many uncommon or inconspicuous species, the historical accounts from Washington suggest that peregrines were generally rare, but the accounts likely resulted in underestimates of pre-decline population sizes over large areas (Enderson et al. 1995).

In 1957, Beebe (1960) checked historic eyrie sites along the outer coast and on the islands of Puget Sound, but reported they were all vacant. However, he commented that eyries were still occupied in the Columbia River Gorge and at some lava cliffs of interior Washington. Richard Bond mentioned to Morlan Nelson in 1948 that he had checked several of the 40 known sites in this region (Idaho, Washington, Oregon, western Montana and Wyoming) at the time and noted steady declines in peregrines. Bond had followed the nesting pairs along the Columbia River very closely for several years, and these were the sites he was likely referring to. Another observer, L.L. Shramm of Portland, also confirmed a steady decline in nesting pairs at the time along the Columbia River and Oregon coast. Nelson followed-up with visits in 1952 to some of the sites known to Bond, and noted additional declines at nest sites along the Columbia River and Oregon coast. Nelson observed no peregrines in the mid-1950s along the Okanogan River in Washington and British Columbia, an area where Bond reported the peregrine as common prior to 1948. Visits to sites along the Washington side of the Columbia River and Washington coast that Nelson checked for Bond, did not reveal any nesting peregrines. Of the 13 pairs once observed along the Columbia River, Nelson could only account for one or two pairs.

Craighead et al. (*in* Fyfe et al. 1976) summarized what was known of the peregrine falcon populations in the northwestern U.S. (Washington, Oregon, Idaho, and western Montana) based on a 1973 survey they conducted, and reports by falconers and other observers in 1974-75. They indicated that "our information on current nesting activity in the region is limited because no concerted effort has been made to locate active nests or even to check all the formerly occupied sites. As a result, our coverage of the region is very scattered, and much of our data is second-hand in nature." In Washington they had reports of 9 occupied nest sites, but were able to confirm only 2. In 1975, Porter and White (1977) indicated possibly 2-3 active, although unverified, eyries in Washington. In 1976, C. M. Anderson and J. Fackler visited all historic eyries and reported no activity at any of them, although a new active site was found along the outer coast (Walton et al. 1988). Surveys conducted in the 1970s or 1980s along the mid-Columbia River (Olendorff 1973, Knight et al. 1982,), the lower Snake River (Fleming 1982), and the Yakima River Canyon (Monk 1976) produced no observations of peregrines.

Surveys. Intensive and extensive surveys have been conducted, primarily in the last two decades, to search for nesting peregrines, to observe and evaluate potential nesting habitat, or to identify potentially suitable hack sites. Between 1949 and 1959, aerial, boat-based, and ground surveys were conducted along the northern outer coast (Kenyon and Scheffer 1961). Although a probable peregrine nest location was discovered during the boat-based effort in 1959, the aerial surveys were conducted at air speeds (>130 mph [208 km/hr]) which may have precluded detection of occupied sites had they been present; also, the emphasis of many of surveys was to observe marine mammals. In the 1970s and early 1980s several breeding season raptor surveys were conducted along the mid-Columbia River, the lower Snake River, and the Yakima River Canyon (Olendorff 1973, Beery 1974, Monk 1976, Fleming 1982, Knight et al. 1982), but no peregrines were observed. Beginning in 1980, WDFW and USFWS jointly conducted annual surveys along the northern outer coast (Wilson et al. 2000). From 1980-88 nest searches and productivity surveys were conducted using a variety of methods including, walking accessible beaches or making observations from headland overlooks. Islands and mainland cliffs also were surveyed from an inflatable boat, and occasionally by helicopter. Annual helicopter seabird surveys of all islands, sea stacks, rocks and mainland cliffs along the outer coast were conducted from 1984-1998. Beginning in 1989 peregrine nesting surveys along the outer coast were conducted exclusively by helicopter, and covered the entire shoreline from the vicinity of Neah Bay to near the mouth of the Quinault River. During April and May all known peregrine eyries were checked to count the number of nesting pairs or single adults associated with nesting territories and the number of pairs with eggs. This activity survey usually required two flights. During "activity surveys", new potential nesting sites were checked for peregrine activity. Between late May and July two or more "productivity" surveys were conducted to determine number of young produced at nest sites.

Following these initial survey efforts, additional surveys, using various methods, were initiated in other parts of the state. Surveys in the San Juan Islands initially involved WDFW, but for much of the last decade have been conducted primarily by the Falcon Research Group. Surveys were conducted in the North Cascades and in the eastern interior of the Olympic Peninsula in the early- to mid-1980s (Björklund 1984, Moorhead 1984). By 1990, surveys (aerial or ground-based, and including assessments for hacking purposes) had been conducted in many areas of the Cascade Mountains, Okanogan County, and southeastern Washington. As of 2000, surveys had been conducted in most physiographic provinces of the state and at least 460 cliffs had been assessed and entered into the WDFW database (Fig. 7). In the Columbia Basin, surveys that identified

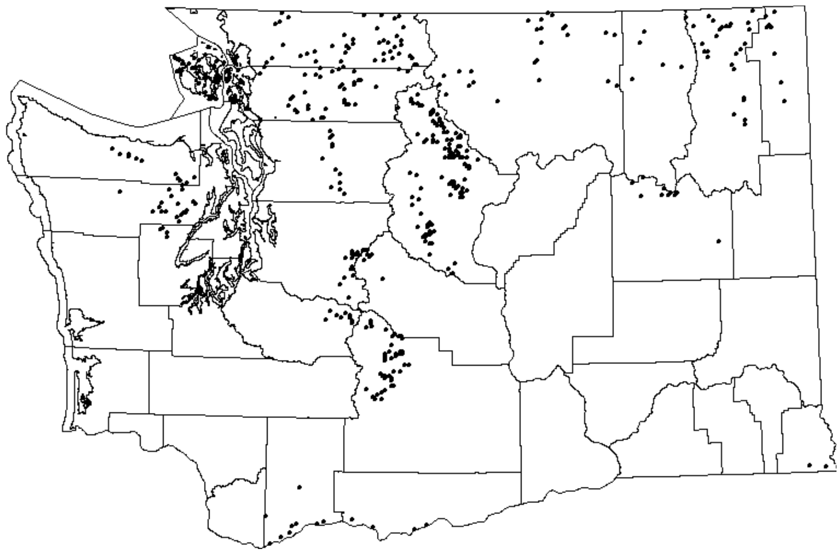

Figure 7. Survey coverage of potential nesting habitat in Washington.

locations of about 267 prairie falcon nest sites failed to produce new locations of peregrine nest sites (WDFW database). Many of those prairie falcon sites have not been monitored annually.

Trends. Population trend information is based on annual surveys which began in 1980. The most rapid "recovery" has occurred in the San Juan Islands and the outer coast (Wilson et al. 2000) where a nucleus of breeding pairs fledged young over several successive years due to natural production. Nesting pairs have steadily increased along the outer coast since 1980, and more rapidly after 1988 (Wilson et al. 2000). At Tatoosh Island, on the outer coast, there were no observations of peregrine falcons during periodic visits to the island during breeding seasons between 1956 and 1978, after which the proportion of visits during which a falcon was observed increased steadily until falcons were seen on nearly all trips to the island between 1983 and 1988 (Paine et al. 1990). During the period from 1980-2000 the number of known peregrine territories in the state has steadily increased from 8 to 73 and number of occupied territories increased from 4 to 56 (Fig. 8), though some of this increase is likely due to increased survey effort.

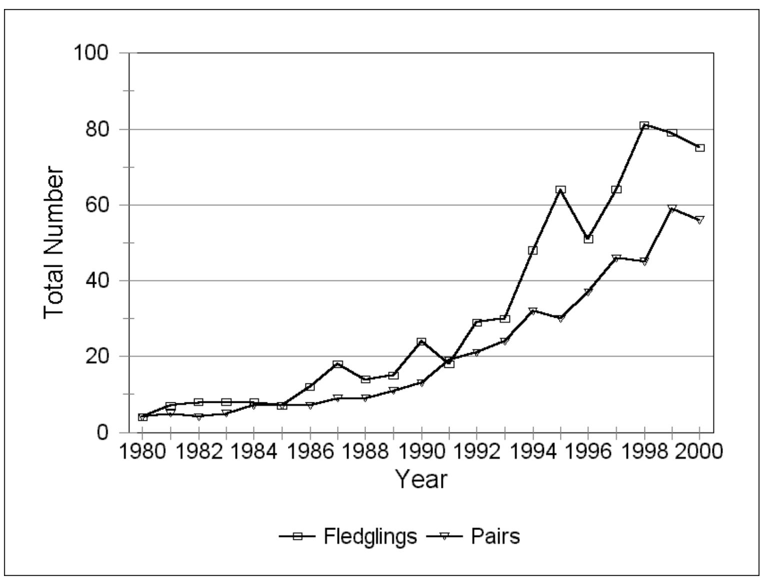

Figure 8. Number of peregrine falcon pairs and fledglings in Washington, 1980-2000.

Winter population trends. Following the development and widespread application of DDT, the population decline experienced by the peregrine falcon was also evident in the results of Christmas Bird Counts (CBCs) conducted each winter over much of the North American continent. Analysis of CBC data (Appendix D) indicated a very strong and linear relationship between number of peregrine falcons observed and the year of the CBC effort (F-Ratio = 181.8; r^2 = 0.88; P <0.0001). Regression analysis cannot be used to identify cause and effect relationships (Neter et al. 1990); however, it is reasonable to conclude that more peregrines are being detected during CBCs as a function of an increasing number of years since DDT use was restricted in North America (Fig. 9).

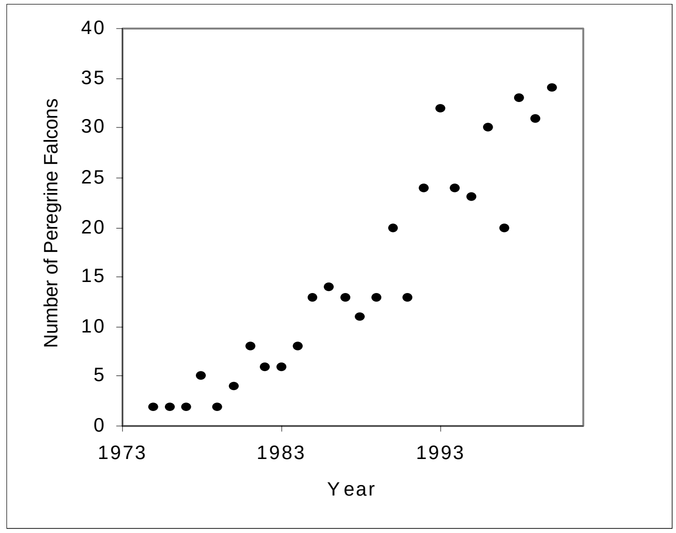

Figure 9. Number of peregrine falcons observed during Christmas Bird Counts at 6 locations in western Washington.

Eight of the 18 Christmas Bird Count locations with ≥5 years of counts in the period 1990-1999 supported an average of ≥2 peregrine falcons per year (Table 3). The highest mean counts during that period were from Grays Harbor, Padilla Bay, Sequim-Dungeness, Everett, and Skagit Bay CBC locations. Peregrines were observed less frequently at all other CBC sites (and were unrecorded at two locations) (Table 3). Only those sites with counts conducted during ≥5 years in this period were included. Reported values are for years when counts were actually conducted.

Table 3. Mean number and range of peregrine falcons observed at Christmas Bird Count locations in western Washington, 1990-1999.

Location	Mean	Range
Grays Harbor	7.3	3 - 12
Padilla Bay	7.1	0 - 12
Sequim - Dungeness	5.0	3 - 8
Everett	3.8	2 - 7
Skagit Bay	3.2	1 - 4
Columbia River Estuary	2.8	1 - 5
Bellingham	2.4	1 - 7
San Juan Islands Archipelago	2.0	0 - 6
Olympia	1.9	0 - 4
Tacoma	1.9	0 - 6
Oak Harbor	1.5	0 - 5
Kent - Auburn	0.9	0 - 3
Edmonds	0.6	0 - 2
Port Townsend	0.6	0 - 2
Port Gamble	0.2	0 - 2
East Lake Washington	0.1	0 - 1
Cowlitz - Columbia	0.0	-
Kitsap County	0.0	-

Peregrine falcons are rare during winter in eastern Washington. A review of Christmas Bird Count data from eleven sites (Camas Prairie-Trout Lake, Chelan, Ellensburg, Grand Coulee, Moscow-Pullman, Moses Lake, Spokane, Toppenish National Wildlife Refuge, Tri-Cities, Walla Walla, and Yakima Valley) indicated only eleven records in a total of 198 count years (i.e. a count year is a single year's count at a site) (data from Cornell Laboratory of Ornithology website); the highest cumulative totals were from Ellensburg (two records since 1979) and Toppenish National Wildlife Refuge (two records since 1984). No peregrines were observed by Fleming (1981) over the course of three winters (December 1978 through February 1981) during surveys conducted along 18,957 miles of road transects in the Columbia Basin of Washington and Oregon. Stepniewski (1999) and Jewett et al. (1953) also reported very few winter records of peregrines in the region.

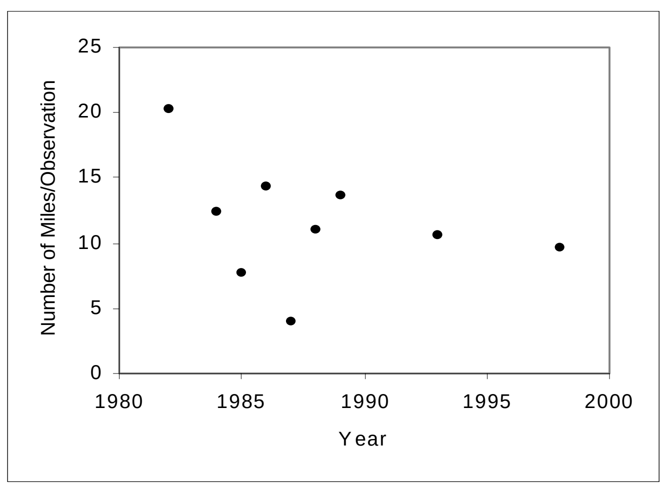

Figure 10. Number of miles per peregrine along coastal beaches of western Washington in winter (1982-99).

Other winter surveys have been conducted along coastal beaches in Washington and provide insight into trends. The number of beach miles traveled per peregrine falcon observation varied from 10.9 to 49.7 (17.4 km to 79.5 km per observation) in the nine winters of the study between 1982-83 and 1998-99 (J. Buchanan, unpubl. data). There was a slight tendency for more recent beach surveys to require comparatively fewer miles of beach travel per peregrine falcon observation although the relationship (using linear regression analysis) was not significant (Fig. 10).

Eggshell thinning. Eggshell thickness data are available from both the outer coast and the Puget Sound regions. The sample of 32 eggshells from the outer coast spans the period 1980 through 1991 and represents seven sites (see Appendix E for eggshell measurement techniques, use of fragments and whole eggs, correction factors and baseline values). The mean eggshell thickness of these samples was 0.308 mm (SD = 0.0262). This equates to a mean thinning of 15.2% from the pre-DDT era. An eggshell thickness of 0.3 mm equates to approximately 17.4% thinning compared to the pre-DDT era. Thirteen eggs (41% of the sample) from 5 sites exhibited ≥17% thinning, the value generally associated with reduced reproductive performance at a population level; nine of these eggs, however, were from a single site, perhaps indicating the presence of a highly contaminated female at that site. Excluding the nine samples from the same site, the mean level of thinning was 12.6% (n = 23). There was no obvious association between level of eggshell thickness and the number of young produced at a given site the year the eggshell sample was collected from that site (Fig. 11), in contrast to findings by Porter and Jenkins (1988). There was a very slightly positive, but statistically non-significant, relationship between year and eggshell thickness ($r^2 = 0.02$, F = 0.86, $P = 0.36$) (Fig. 12). In other words, eggshell thickness values appear to be increasing over time, but at a gradual rate.

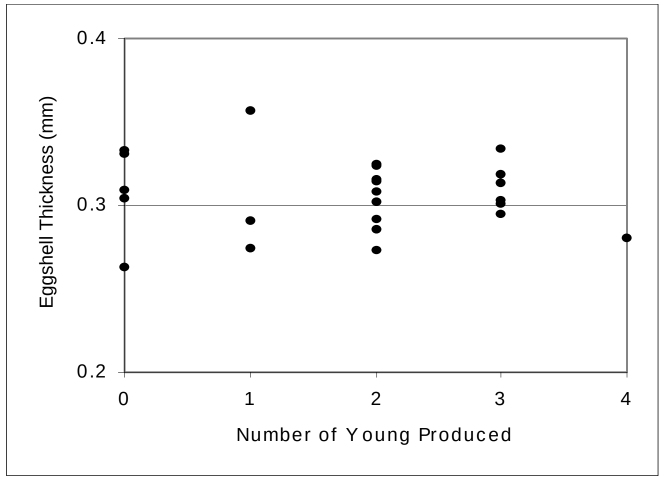

Figure 11. Eggshell thickness and productivity of peregrine falcons nesting on the outer coast of Washington, 1980-91.

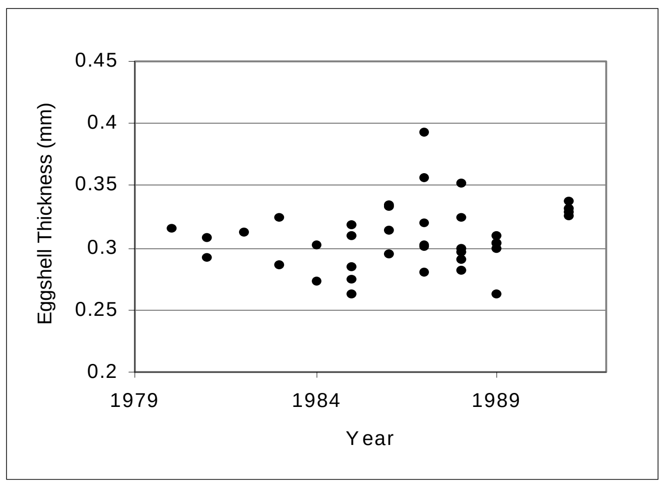

Figure 12. Trend in thickness of peregrine falcon eggs from sites on the Outer Coast, Washington, 1980-1991.

The eggshell thickness data from the Puget Sound indicate patterns similar to those exhibited by the samples from the outer coast. The Puget Sound sample consists of 106 eggs collected from

13 sites between 1983 and 2000 (WDFW, unpubl. data; C.M. Anderson, unpubl. data). These eggshells had a mean thickness of 0.324 mm (SD = 0.026). This represents a mean reduction of eggshell thickness of 11.4% compared to eggs from the pre-DDT era. An eggshell thickness of 0.3 mm equates to approximately 17.8% thinning compared to the pre-DDT era. Twenty-one eggs (20% of the sample) from 10 sites exhibited ≥17% thinning. There was no obvious association between level of eggshell thickness and the number of young produced at a given site the year the eggshell sample was collected from that site (Fig. 13). In addition, there was a very slightly positive, but statistically non-significant, relationship between year and eggshell thickness ($r^2 = 0.013$, $F = 1.37$, $P = 0.24$) (Fig. 14). Again, the data indicate that eggshell thickness values appear to be increasing, but at a very gradual rate.

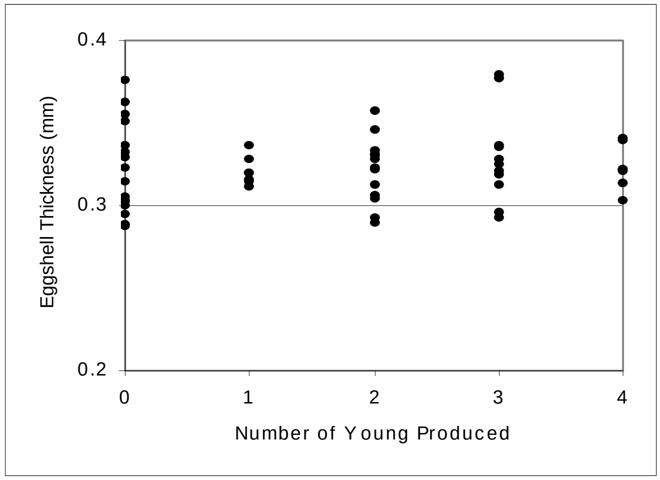

Figure 13. Eggshell thickness and productivity of peregrine falcons nesting in the Puget Sound region, Washington,1983-2000.

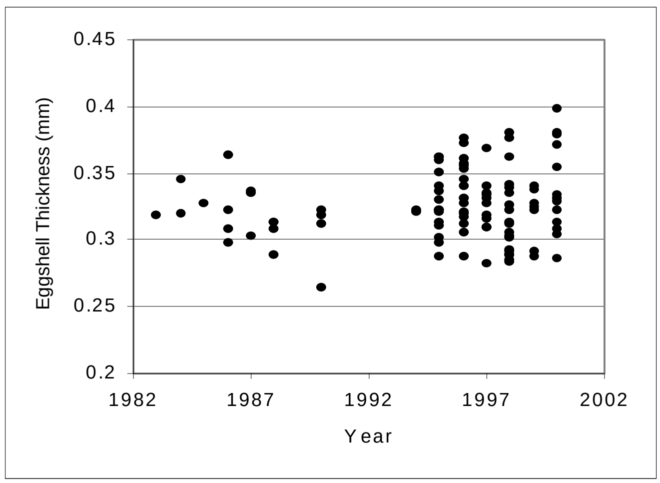

Figure 14. Trend in thickness of peregrine falcon eggs from sites in the Puget Sound region, Washington, 1983-2000.

A small sample of eggshells from the Uplands and Columbia Basin regions indicated levels of thinning similar to those described above. Fifteen samples (14 from the Uplands, one from Columbia Basin) from 5 sites between 1994 and 1998 had a mean eggshell thickness of 0.319 mm (SD = 0.015) (J. Pagel, unpubl. data). This thickness value equates to an average amount of eggshell thinning of 12.6% from the pre-DDT era. Four eggs (27% of the sample) from 2 sites (3 were from 1 site) exhibited thinning of ≥17%.

Care should be taken when interpreting these data. The sample of eggshells is rather small and this is particularly relevant because the collected samples may not be representative of the entire population (L. Kiff, pers. comm.). For example, there would be a sampling bias if the sample was inordinately weighted to reflect less successful adults (i.e., more contaminated and therefore inclined to lay thinner eggs) in the local population. A bias in the other direction seems less likely because we found no apparent relationship between eggshell thickness and the number of young produced.

Washington: Present

In 2000, there were 73 known territories, of which 56 were known to be occupied by peregrines. To determine if there were eco-regional differences in occupancy and reproductive parameters, eyries were grouped according to four eco-regional provinces: Outer Coast, Puget Sound, Upland Forested (predominantly forested areas away from the marine zone), and Arid (Columbia River basin). These eco-regions may reflect differences in weather variables (e.g., heavy rainfall years along the coast and Puget Sound), climate (e.g., arid interior, cool coastal and estuarine environments), or prey base (e.g., seabirds along outer coast and Puget Sound, landbirds in upland forested regions), that may affect variability in reproductive parameters (Corser et al. 1999). Survey effort has likely been more intensive and extensive in the Outer Coast and Puget Sound eco-regions than in other eco-regions. Different eco-regions of the state contribute disproportionately to the total known territories: outer coast 38%, Puget Sound 29%, forested uplands 23%, and the arid region of the Columbia Basin 10% (Appendix F).

Occupancy rate. The breeding "territory," or "breeding site," refers to an area containing one or more scrapes within the range of one mated pair of birds. The rate of territory occupancy is defined as the percentage of total known territories where activity patterns indicate presence of a mated, territorial pair of potential breeders. These activity patterns include: young were raised, eggs were laid, incubation observed, two adults observed attending a nest, or an adult/subadult pair associated with a nest (Postupalsky 1974).

Overall, the rate of occupancy of eyries has been high. The occupancy rate was ~80-90% for most of the past 20 years, except in the late 1970s and early 1980s (33-56%) and from 1988-90 (65-72%) (Table 4). Since 1991, occupancy rates state-wide have been >75%; they are highest in Puget Sound region (95%), lower along the outer coast (81%) (Appendix F). Foul weather conditions along the outer coast may result in greater nesting failures in some years due to ledge exposure to the elements. Occupancy rates since 1993 have usually been >80% and compare well with occupancy rates of 80-90% for populations not in decline (Herbert and Herbert 1969, Rice 1969). Since 1991, occupancy rates have been lower in the forested upland regions (64%). Occupancy rates in the Arid region (80%) have been comparable to rates in the Puget Sound and Outer Coast (Appendix F). In eastern Washington, where far fewer nest sites are known, occupancy rates have been more variable among years.

Table 4. Occupancy and productivity of breeding peregrines in Washington, 1978-2000.

		Occupancy		Reproductive Success			
Year	No. Sites Checked	Single Adults	No. Occupied Territories[a] (%)	Nest Success (N)	No. Young[b]	No. Terr. with Known Outcome	Young Per Territorial Pair[b]
1978	3	0	1 (33)	100 (1)	2	1	2.00
1979	3	0	0 (0)	-	-	0	-
1980	8	1	4 (50)	50 (2)	4	4	1.00
1981	9	0	5 (56)	75 (3)	7	4	1.75
1982	5	0	4 (80)	100 (4)	8	4	2.00
1983	7	2	5 (71)	100 (4)	8	4	2.00
1984	9	1	7 (78)	71 (5)	8	7	1.14
1985	9	1	7 (78)	43 (3)	7	7	1.00
1986	9	1	7 (78)	71 (5)	12	7	1.71
1987	10	0	9 (90)	78 (7)	18	9	2.00
1988	13	2	9 (69)	67 (6)	14	9	1.56
1989	17	4	11 (65)	60 (6)	15	10	1.50
1990	18	3	13 (72)	69 (9)	24	13	1.85
1991	24	3	19 (79)	42 (8)	18	19	0.95
1992	28	3	21 (75)	52 (11)	29	21	1.38
1993	29	2	24 (83)	59 (13)	30	22	1.36
1994	35	0	32 (91)	61 (19)	48	31	1.55
1995	39	4	30 (77)	80 (24)	64	30	2.13
1996	46	5	37 (80)	59 (22)	51	37	1.38
1997	53	1	46 (87)	59 (27)	64	46	1.39
1998	55	2	45 (80)	76 (32)	81	42	1.93
1999	66	1	59 (89)	62 (36)	79	58	1.36
2000	72	1	56 (78)	62 (32)	75	52	1.44

[a] Occupied territories had two adults, adult/sub-adult pair, young or eggs on ledge, or adult in incubating posture.
[b] Productivity estimates are inflated because they are based on the number of young observed in the eyrie regardless of age. Productivity was calculated based on occupied territories of known outcome.

Nest success. Nest success is defined as the percentage of occupied territories (for which the outcome of nesting is known) which produce one or more young to an advanced stage of development (Postupalsky 1974). Nest success is a population parameter used to evaluate the reproductive success of a population. Values for this parameter based on Washington data are somewhat inflated because measures of reproductive success are based on the number of young observed in the eyrie regardless of age, not at the optimum period just prior to fledging.

Since surveys began nest success has varied between 42 and 100%, with no apparent trends for the population overall (Table 4) or by eco-region (Appendix F). Since 1993 nest success has been >59%. Peregrine nest success in Washington compares well with observed rates for populations recovering in the eastern United States (Corser et al. 1999) and the Midwest (Tordoff and Redig 1997), but lower than a stable population in the Queen Charlotte Islands with a mean nest success of 84% (Nelson 1990).

Productivity rate. Productivity rate is defined as the number of young (fledging or advanced age of development) per occupied nest (with known outcome) and is another measure of reproductive success (Postupalsky 1974). Productivity rates have varied between 0.95 and 2.13 young per occupied nest from 1978-2000 (Table 4). Since 1992 productivity has typically been about 1.36-1.39 young per territorial pair, with higher rates in 1995 and 1998 (Table 4). Productivity was below 1.00 young per territorial pair along the outer coast in 1985, 1991, 1997 and as recently as 1999 (Appendix F). Annual mean productivity at the 5 known urban sites was 2.05, and ranged from 1.0 to 3.33. Years with low productivity also were associated with low nest success (40-52%). Overall productivity rates compare well with recovering peregrine populations in the eastern United States (Corser et al. 1999) and the Midwest (Tordoff and Redig 1997). Only when productivity drops to very low levels (<0.7-0.8 young/pr) and remains low for a period of years is reproduction depressed enough to affect recruitment into the breeding population (Ratcliffe 1993).

Productivity is affected by prey and weather. At Rankin Inlet, Northwest Territories, an increase in the proportion of laying pairs and average productivity in one year were associated with an increase in the abundance of microtine rodents available to breeding peregrine falcons (Court et al. 1988). Populations in extreme cold or wet regions (arctic Alaska, Aleutian Islands, Britain, European Alps) often exhibit marked year to year variation in reproductive success (Newton 1988). In southern Scotland, productivity varied greatly between years (range 0.6-1.45 young/territorial pair) and was attributed to variation in the proportion of clutches producing young, which was associated with rainfall during the incubation and early chick stages. Mortality of young was also associated with rain spells and mist that may have reduced hunting success by adults and young may have succumbed due to starvation. At Rankin Inlet, Northwest Territories, productivity was very low (0.54 young/territorial pair) during a year when poor spring weather coincided with the early incubation period (Court et al. 1988). Climatic events, like El Niño, can have direct and indirect effects on peregrine productivity resulting from adverse weather and reduction in seabird populations (Wilson 2000, for discussion of El Niño effects on wildlife populations, see Buchanan et al. 2001). Heavy rainfall and cold spring temperatures occurred in the San Juan Islands during 1996 and 2000 and resulted in lower productivity due to nest failure (flooding of nest ledges) (Anderson 1996, 2001). Wilson et al. (2000) reported lowered reproductive success (number of young per successful pair) for peregrines along the outer coast associated with years of warm oceanic conditions, however there was little overlap with years when productivity was less than 1.00 young per territorial pair, likely an indication of excessive exposure of eggs or nestlings to harsh conditions. The effect of cold or wet springs on reproduction can also be manifested through increased lipid mobilization in the adult female and subsequent deposition of organochlorine contaminants in eggshells or embryos. Ledge or substrate conditions, and physical condition of the nesting female are other factors that may influence productivity (Newton 1988).

Examination of newly discovered eyries and corresponding levels of productivity show eco-regional trends. Sites along the Outer Coast and within Puget Sound eco-regions show a trend of decreasing productivity over time, with the exception of an increase in 1992-95 (period 4 in Fig. 15). This suggests that newly discovered sites in the early 80s had higher productivity than newly discovered sites found in recent years (1996-99; period 5). There are no apparent patterns in productivity of newly discovered eyries through time with sites found in the Upland Forested and Columbia Basin eco-regions (Fig. 15). Factors such as weather and climatic events, trends in prey populations, and changes in habitat quality may explain these patterns in productivity through time. Heavy rainfall events in recent years in the San Juan Islands may explain the lower productivity in the Puget Sound eco-region (period 5, Fig. 15). Seabird prey species may have experienced population declines as a result of oceanic warming along the Outer Coast, although this has not been adequately documented in Washington. Another explanation for these patterns may be that higher quality habitats were available early on, when peregrine numbers were low along the outer coast and in Puget Sound, and that in recent years more marginal habitats are available and of lower quality as populations approached saturation (Fretwell and Lucas 1970). Newly discovered sites in the Upland and Columbia Basin eco-regions continue to demonstrate high relative productivity, perhaps related to the high quality of these sites and greater availability of higher quality sites in these eco-regions.

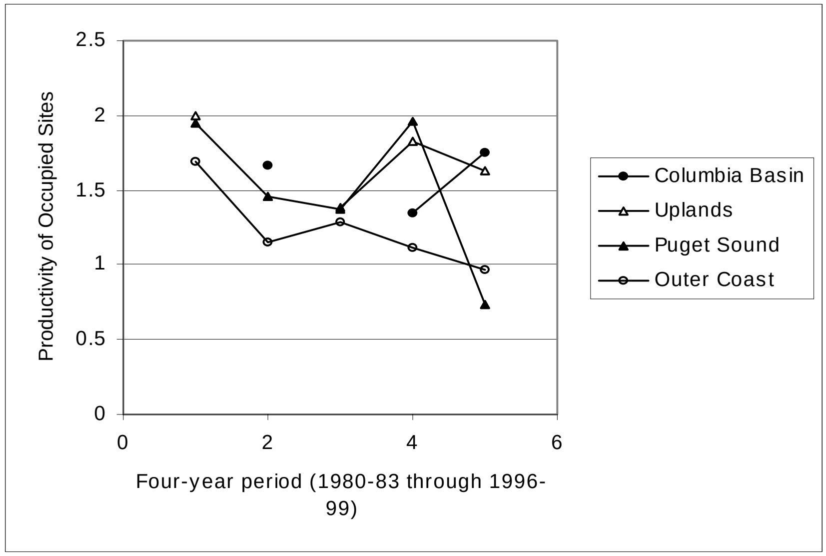

Figure 15. Relationship between newly discovered territories and corresponding productivity through time (4 year time intervals).

Nesting density. The current density of peregrine falcons in Washington is quite variable from one region to another. Densities, measured in terms of "nearest-neighbor distances," were higher along the outer coast (1.8 mi [3.0 km]) than in the San Juan Islands (3.8 mi [6.3 km]), the only two areas where peregrine eyries tended to be clustered. These mean nearest-neighbor distances are comparable to mean nearest neighbor values reported from local breeding populations in other parts of the world (Table 5).

Table 5. Summary of mean nearest neighbor distances among active nest sites of peregrine falcons.

Area	Nearest-Neighbor Distance (mi)	Reference
Main and Neckar Rivers, Germany	1.3-2.3	Mebs 1969
Outer Coast, Washington	**1.8**	WDFW, unpubl. data
Normandy Coast,	1.8	Terrasse and Terrasse 1969
Rankin Inlet, Hudson Bay	2	Court 1986
New South Wales, Australia	2.1	Olsen and Olsen 1988
Yamal Peninsula, Soviet Union	1.8-3	Glutz et al. 1971 *in* Ratcliffe 1993
Cape Peninsula, South Africa	2.8	Jenkins and Benn 1998
Spain	2.9-12.2	Heredia et al. 1988
Eastern France	3	Formon 1969 *in* Ratcliffe 1993
Colville River, Alaska (below Umiat)	3.6	White and Cade 1971
San Juan Islands, Washington	**3.8**	WDFW, unpubl. data
Saxsonian Alps, Germany	5.1	Ratcliffe 1993
Colville River, Alaska	5.7	Cade 1960
Colville River, Alaska (above Umiat)	7.8	White and Cade 1971
Yukon River, Alaska	12	Cade 1960

Washington: Future

It is difficult to make projections of future population levels of peregrines in Washington because of our limited knowledge of its population demography and carrying capacity. While we have data on productivity, estimates of survival rates of first-year birds and adults, mean life expectancy, and recruitment rates are lacking. Wooton and Bell (1992) modeled the peregrine falcon population in California and determined that adult survivorship was the most important population parameter affecting population growth. Therefore, factors that affect adult survivorship are likely to have the greatest overall effect on current peregrine populations in Washington. Factors that dramatically reduce productivity could lead to reduced populations in a short period of time, as documented by Risebrough and Peakall (1988) (Tables 6, 7). They indicated that a population of 100 pairs could be decimated in less than 20 years if productivity rates were reduced to levels corresponding to widespread application of DDT. Consequently, the effects of similarly toxic chemicals could substantially influence population performance.

Evidence in the literature suggests that stable populations have a non-breeding component (“floaters”) and are limited by the availability of “serviceable breeding locations” (Hunt 1988). The availability of serviceable breeding locations is limited by the number of secure cliffs in association with abundant prey. In Washington, surveys of potential nesting sites have been conducted since monitoring of known eyries began. However, we have yet to develop an adequate understanding of the variables that affect the quality of a nest site to be able to predict the number of “serviceable breeding locations” in the state. Obvious nest site features, such as cliffs with suitable ledges, may appear to be widely available in eastern Washington, an area where few pairs are currently known, and where peregrines and prairie falcons may compete for eyries. This region of the state appears to be able to support a much larger population of peregrines than currently exists. However, other factors associated with the nest site (e.g., temperature regime, isolation from predators and parasites) and foraging area (e.g., sufficient abundance of prey and landscape features that make prey vulnerable to peregrines or their competitors) may be limiting. The influence of various limiting factors will change through time and some factors will exert their greatest influence on population size as the actual population becomes larger (Lack 1954).

Statewide survey data indicate a continuing upward trend in known and active breeding sites with no indications of "leveling off." The greater density and recovery of peregrines observed in western Washington may be attributable to concentrated migration movements and high quality winter habitat found in this region of the state. Since the Puget Sound and Outer Coast eco-regions may be approaching saturation, we expect the greatest number of new nest sites to be discovered in the Cascades and eastern Washington, although at a relatively slower rate compared to the west-side. Peregrines appear to migrate through and winter in eastern Washington to a lesser extent, and this may lead to a lower "discovery rate" of nest sites in this region of the state.

Based on the known distribution of potentially suitable nest sites (Fig. 7; WDFW database), it was possible to develop estimates of the potential future population of peregrines in Washington. It should be noted that these estimates were based only on the physical characteristics (vertical cliffs with ledges) and not on other factors which determine occupancy, and for which we had no data (e.g., prey populations, predators, etc.). It is suspected that the Outer Coast and San Juan Islands (Puget Sound eco-region) are approaching carrying capacity.   It is likely that 2-5 additional sites could become established in each of these regions. The carrying capacity for peregrines in the Forested Upland eco-region is much less certain, but perhaps as many as 30-60 additional sites could become established. In this eco-region we expect the greatest increase in number of sites to occur in the more mountainous areas. Finally, peregrines will likely occupy additional lower elevation areas in the Columbia Basin along major watercourses, like the Columbia, Snake, Okanogan and Pend Oreille Rivers, and along some lakes and reservoirs in the vicinity of large cliffs. We expect 20-40 sites in the Columbia Basin.   In summary, it is possible there could be an increase of from 54 to 110 additional peregrine falcon sites in the state in future years.

While we lack a complete understanding of the population dynamics and habitat preferences of this species to reliably predict future population numbers, certain statements can be made regarding species conservation. The current trend of increasing numbers of nesting pairs, high occupancy, and productivity >1.4 young per territorial pair will likely continue based on current conditions. How much longer the increase in number of territorial pairs will continue is unknown. Although the population is increasing, Washington's peregrine population remains small; only 56 pairs were active in 2000. In general, the probability of extinction is inversely related to population size. While optimism about the peregrine's population status is warranted, it will be essential to monitor it closely because a change in the population could happen very rapidly.

Table 6. Results of a modeled population decline of the peregrine falcon. The model, developed by Risebrough and Peakall (1988), assumes adult and yearling mortality rates of 16.7% and 66.7%, respectively, and a reduction in productivity from 1.5 young per active pair to 0.3.

Year	No. breeding pairs	No. fledglings	No. 2nd year birds	No. sites with single adults	No. floating adults	Total adults
0	100	150	50	0	50	250
1	100	30	50	0	50	250
2	100	30	10	0	50	250
3	100	30	10	0	17	217
4	92	28	10	6	0	189
5	72	22	9	17	0	166
10	23	7	3	36	0	83
15	8	2	1	24	0	39
18	4	1	1	16	0	24
20	3	1	0	12	0	17

Table 7. Projections of peregrine falcon population performance given different values of productivity and mortality.

			Predictions at Various Years from Year 0								
			No. breeding pairs			No. adults			No. territories with single adults		
% adult mortality	% 1st year mortality	Productivity (young/pair)	5	10	18	5	10	18	5	10	18
16.7	66.7	0.3	72	23	4	166	83	24	22	36	16
16.7	66.7	0.0	53	18	1	145	48	14	39	37	13
20.0	66.7	0.3	54	13	1	142	57	11	34	32	9
15.0	50.0	0.3	100	82	27	294	178	82	0	13	28
20.0	50.0	0.3	100	36	6	224	106	26	0	33	16
25.0	50.0	0.3	75	14	1	168	57	8	19	28	8

HABITAT STATUS

Past

Historically, peregrine prey, such as seabird, waterfowl, and shorebird populations were likely more abundant in wetland and marine habitats along the outer coast, Puget Sound, and the large rivers of Washington than they are today. During the breeding season, historic populations of Cassin's auklets, ancient murrelets and fork-tailed storm petrels may have been more abundant on offshore islands along the outer coast prior to the influx of humans and associated introduction of exotic species (e.g., rats and raccoons) and increasing populations of native nest predators (e.g., gulls). Seabird populations may be lower in more recent times due to El Niño events and general oceanic warming (Nelson and Myres 1976). Passerine populations also were likely more abundant than they are today, given the level of human development that has occurred at low elevations. During migration and winter, shorebird and waterfowl populations were likely far more abundant in the more extensive wetlands that existed prior to dredging and conversion of these habitats to other uses. While some prey populations were likely more abundant historically in Washington, populations of other species (e.g. rock doves, starlings) are greater now. It is unknown if peregrine populations were historically limited by prey abundance, and were therefore more abundant historically. However, a decline in the breeding peregrine population on Langara Island, British Columbia was attributed to a corresponding decline in the nesting ancient murrelet population, the principal prey species of the peregrine (Nelson and Myres 1976). This is not surprising, as availability of prey can limit populations of predators Newton 1979, Nelson 1983, Ratcliffe 1993). Naturally-occurring nesting habitat for the peregrine was not likely much more available historically, than it is today.

Present

Nesting habitat. Peregrines nest in a variety of places including cliffs and bluffs in forests, along coastlines and in arid regions; skyscrapers and bridges in urban or other areas; and rock quarries. Rock climbing, hiking, and road blasting are activities that may negatively impact some natural cliff-nesting sites by disturbing breeding pairs. At some bridge and skyscraper nesting sites, loss of young has occurred when eyasses fall from the nest or fledgling-aged birds fall or fly into traffic, buildings, or the water.

Foraging habitat. Peregrines hunt for prey in a variety of habitats including wetlands, marine waters, coastal barrier islands, and river valleys. As human populations have increased, foraging habitats have been destroyed or degraded, for instance by the draining of wetlands (Buchanan 1999). During the same period, humans have provided foraging habitat for this species in urban areas where pigeon populations can be abundant. Peregrines are seen with greater frequency in urban areas preying on pigeons during breeding, migration and winter periods. The net effect that human modification of foraging habitat has had on peregrines in Washington would be difficult to determine because the peregrine is a prey generalist. The wide variety of habitat types and prey species used by the peregrine and the increasing population trend, suggest that foraging habitat and prey populations are not currently limiting the population, at least in Washington.

Land ownership. A majority of eyries are located on federal and state lands (68%), with a smaller component on private, tribal, county and municipal lands (32 %) (Table 8). FWS (16 sites) and Department of Natural Resources (11 sites) are the primary federal and state landowners, respectively. Private landowners own 13 sites. An analysis of landownership in close proximity to eyrie sites (0.5 mi radius) provides insight into potential future management opportunities for conservation. Specifically, private (36%), FS (21%), DNR (13%), and NPS (10%) represent the major land ownership near peregrine sites (Table 8). Although FWS owns the highest number of sites, their landownership represents a relatively smaller component of the overall land base. Twenty- nine of the 30 (97%) nest sites located on federal lands (NPS, FS, BLM, and FWS), 18 of the 20 (90%) sites located on state lands (DNR, DFW, and DOT), and 17 (74%) of the sites on private, municipal, county and tribal lands are considered secure (65 of 73 total sites; 89%).

Some of the remaining 8 sites may be secure, but we lack sufficient information to determine future potential disturbance. At three of 8 sites, rock climbing is a disturbance issue and will require active monitoring and implementation of management agreements with these landowners. At some of the other sites there appears to be a threat of human development, and at one site the operation of the drawbridge where the nest site is located.

Table 8. Land ownership of peregrine falcon eyrie sites and area within a 0.5-mile (0.8 km) radius circle centered on the eyrie.

	Ownership			
	Eyries (ledge)		0.5 mi radius of eyrie	
Ownership Category	No.	%	Ac	%
Federal				
National Park Service	6	8	1865	10
U.S. Forest Service	6	8	4049	21
Bureau of Land Management	2	3	472	2
U.S. Fish and Wildlife Service	16	22	49	0.3[a]
Bureau of Reclamation	-	-	54	0.3
Sub-total	**30**	**41**	**6489**	**34**
State				
Dept. Nat. Resources	11	15	2406	13
Dept. Fish and Wildlife	4	5	269	1
Dept. Parks and Recreation	3	3	725	4
Dept. Transportation	2	3	-	-
Sub-total	**20**	**27**	**3400**	**18**
Other				
Private	13	18	6915	36
Tribal	7	10	1556	8
County	1	1	85	0.4
Municipal	2	3	587	3
Sub-total	**23**	**32**	**9143**	**48**

[a]FWS land ownership is under represented in analysis due to insufficient data on outer coastal islands.

Future

The breeding population of peregrines in Washington will be limited by the number of "serviceable breeding locations." These "serviceable breeding locations," represent the suitable sites with a favorable balance of risk to breeders and probable nest success. The upper limit to the number of suitable nesting sites is unknown. The fact that new territories are still being found indicates that Washington's peregrine population is not currently limited by nest sites; this will occur at some point in the future, however. At what point the number of occupied breeding sites will level off is not known.

As the human population increases in Washington, human disturbances are likely to increase at nest sites, and foraging habitat is likely to be degraded or destroyed. Concomitant with increases in the human population will be greater human use of our public lands where people will go for recreational activities. Hiking, rock climbing and boating on these public lands may lead to greater disturbance to breeding peregrines. This may become more of an issue in the Cascade Mountains as new eyries are discovered in this eco–region. Human development in the San Juan Islands may lead to greater disturbance at known and future sites. Human alterations to key wetland areas may be detrimental to Washington's wintering peregrine population. Introduction of exotic wetland grasses (*Spartina* spp.) in estuaries is limiting the availability of mudflats to feeding shorebirds and likely will lead to declines in their populations. Similarly, degradation and loss of agricultural lands to human development in the Samish Flats and Lummi Bay areas will likely impact wintering prey populations and may lead to a decline in wintering peregrines in the state. Wetland loss in Washington has been substantial over the past century (Buchanan 1999). The waterfowl and shorebird populations supported by these wetlands are crucial for peregrines; a reduction in prey habitat may equate to a reduction in prey populations.

Nest sites may be created or lost due to natural ecosystem processes. Anderson (1980) found that an eyrie occupied by peregrines in 1927 was no longer being used because forest cover had grown up in front of the potential nest ledges. Some areas in the eastern Cascade Mountains that formerly supported sparse forests of ponderosa pine (*Pinus ponderosa*) are now densely forested with fire-intolerant species; some of these forests are now more prone to stand-replacement fire (Agee 1993). If such fires in steep terrain do not destroy so much forest that prey populations are greatly reduced, peregrines may nest on large rocks and cliffs that are exposed by fire. A nest site in the eastern Cascades may have become suitable after the 1994 wild fires that burned hundreds of thousands of acres.

Reports of peregrines using rock quarries provide another example of effects of management on habitat availability. A reclaimed rock quarry may have little value to nesting peregrines, whereas one managed at negligible cost to provide a nest ledge (Pagel 1989, Bell 2001) may result in establishment of a new site. Few quarries in the Pacific Northwest are currently being used by peregrines; some quarries in other regions are used while still active (White et al. 1988).

LEGAL STATUS

Federal laws and international treaties. Peregrines are protected by the Migratory Bird Treaty Act which prohibits take, possession, import, export, transport, selling, purchase, barter, or offering for sale, purchase or barter, any migratory bird, their eggs, parts, nests, except as authorized under a valid permit. FWS has finalized a management plan for the authorized take of nestling peregrine falcons in the United States for falconry. FWS has not authorized the take of passage birds, the majority of which originate in Alaska, Canada and Greenland, and migrate through the United States. However a management plan that will address take of passage birds is being prepared (Federal Register 64:53686).

State laws. The Washington Fish and Wildlife Commission has the authority to classify wildlife as endangered under RCW 77.12.020 (Appendix E). In April 8, 1980 the peregrine falcon was listed as endangered in Washington. A forest practices rule (WAC 222-16-080) was adopted on June 26, 1992, effective August 1, 1992, to buffer nest locations on state and private lands from adverse impacts from forest practice activities during both the breeding and non-breeding periods. Forest Practices Rules identify and provide protection of critical habitat for endangered and threatened species, but not sensitive species.

Falconry. It is currently illegal to take peregrines from the wild for falconry purposes. Falconry in Washington is regulated by a number of permanent rules. WAC 232-12-101 allows for the "taking and possession of a raptor for the purpose of falconry...". This regulation is expanded and clarified in several other regulations. For example, WAC 232-12-107 and WAC 232-12-114 specify license requirements and dates of legal capture of raptors. Importantly, WAC 232-12-114 (1) states that "it is unlawful for any persons to capture from the wild, any state or federal endangered or threatened species for the purposes of falconry." The latter regulation also specifies limitations placed on different categories of falconers: Apprentice, General, and Master. WAC 232-12-107 requires that permit applicants pass a supervised examination.

MANAGEMENT ACTIVITIES

Management Plans

The U.S. Forest Service recently developed policy for management of peregrine falcons on their lands within U.S. Forest Service Region 6 (which includes Washington; 19 July 1999 letter to Forest Supervisors from N. Graybeal, Acting Regional Forester). The policy states that site management plans will be developed to guide management decisions for the vicinity of peregrine nest sites. The site plans will be designed to address potential impacts of a) various forms of human disturbance, and b) effects of habitat alteration on prey populations, within three disturbance management zones (<0.5 mile, 0-5 - 2.0 miles, and 2.0 - 3.0 miles [0.8 km, 0.8-3.2 km, and 3.2-4.8 km]) around the nest site that vary in size based on site-specific topography. Although the policy provides little further guidance, it does acknowledge the peregrine falcon as a sensitive species, clearly states that the peregrine will be protected in order to prevent a future re-listing, and that its status as a sensitive species will be assessed in the near future.

WDFW conducted telephone interviews with nine wildlife biologists representing National Forests, National Parks, and Washington State Department of Parks and Recreation, to identify potential provisions for protection of peregrine falcon sites on lands managed by these agencies. Although the agencies have generally not developed formal plans for protection of specific eyries, the peregrine is a high priority and all biologists interviewed felt that efforts would be taken to protect known sites from potentially adverse disturbance. One biologist stated that the USFS would abide by standards and guidelines of the Northwest Forest Plan to protect raptor nest sites. A USFS Ranger District developed a site-plan to address potential disturbance from rock climbers (Bill Gaines, Wenatchee National Forest, pers. comm.). Other biologists reported that site plans would be developed as needed. Several biologists commented that current or possible future eyries were largely (or would likely be) in areas far removed from human activity and the need for site plans was therefore minimal. In summary, it appears that sites on government lands will be largely protected from human disturbance if the peregrine falcon is down-listed to threatened or sensitive status.

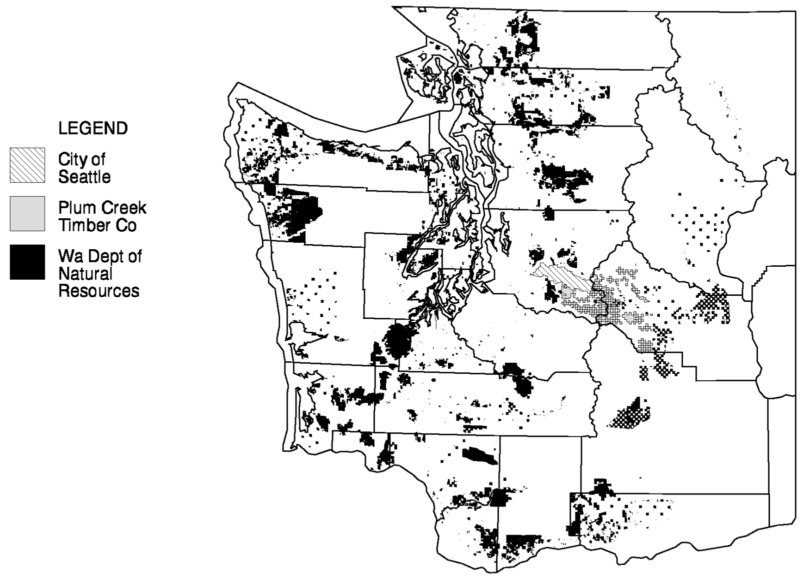

Figure 16. Location of approved Habitat Conservation Plans pertaining to peregrine falcons in Washington.

Several Habitat Conservation Plans have been negotiated between state and private timberland owners and the U.S. Fish and Wildlife Service (USFWS). A Habitat Conservation Plan (HCP) is a binding agreement that allows the landowner to incidentally “take” a listed species during the course of otherwise lawful management activities. The USFWS usually requires mitigation to offset the anticipated incidental “take”. Three approved HCPs in Washington (Fig. 16) addressed the peregrine falcon in some way in exchange for incidental take assurances. The conservation measures negotiated for each HCP include aerial surveys of cliff habitats, observing timing restrictions to minimize disturbance near known nest sites, retention of forest buffers at or adjacent to the nest site, and deferral of rock quarrying activities at known sites. Not all of the activities are being implemented in each HCP (Table 9). It is noteworthy that only one of the planning areas has a known nest site at present, although each area contains one or more cliffs with a vertical or nearly vertical face that may be suitable for nesting falcons. Three additional HCPs developed to address timber management issues (Beak Consultants 1995, 1996; Simpson Timber Company 2000) did not seek incidental take assurances for the peregrine falcon

Table 9. Summary of conservation measures implemented under Habitat Conservation Plans developed by timberland owners and the USFWS.

Landowner[a]	Plan Area (ac)	Conservation Measures							No. of known sites
			Known Sites			Potential Sites			
		Conduct Surveys	disturbance avoidance[b]	no harvest buffer	no rock extraction	disturbance avoidance	no harvest buffer	no rock extraction	
Crown Pacific[c]	northwestern Cascade Mountains	Yes	Yes	No	Yes	No	No	Yes [d]	0
IP Pacific Timberlands[c]	southeastern Cascade Mountains	Yes	Some	Yes	Yes	No	Yes	Yes	0
Plum Creek	eastern and western central Cascade Mountains (131,000)	No	Yes	No	unk.	No	No	unk	0
City of Seattle	western central Cascade Mountains (90,000)	No	Yes	unk	Yes	No	No	Yes	0
Tacoma Water[c]	western central Cascade Mountains	No	Yes	Yes	unk	Some	Some	unk	0
Wash. Dept. of Nat. Resources[e]	western Washington (1,630,000)	No	Yes	No	unk	No	No	unk	9

[a] References in order of listing: Beak Consultants, Inc., and Cairncross and Hempelmann (1999); IP Pacific Timberlands (1999); Plum Creek Timber Co. (1996); City of Seattle (1998); Tacoma Public Utilities et al. (1999); WDNR (1997);

[b] Disturbance avoidance generally equal to Forest Practices Rules.

[c] Plan under development.

[d] Extraction will not occur until after two surveys (scheduled for years 5, 10, 15) have been conducted.

[e] WDNR's plan refers to optional site review, survey and protection measures to be implemented at their discretion.

because cliffs were not present or the landowner felt the likelihood of future nesting by falcons was negligible; these landowners will be required to observe state Forest Practices Rules, as long as they are in effect, if peregrine falcons should nest in those areas.

A number of initiatives have lead to strategies that provide benefits to peregrine falcons through habitat management. It has been well documented that the loss of estuarine and freshwater wetlands has been substantial in Washington over the last 100 years or more (Buchanan 2000). These habitats are particularly important for waterfowl and shorebirds, two important prey groups of the peregrine falcon. Recent enhanced protections of these habitats, and efforts of organizations such as the Pacific Coast and Inter-mountain West Joint Ventures (i.e., these two organizations facilitate conservation of wetland and other habitats through purchase, conservation easements, etc.) to purchase sites for protection, should result in longer-term protection of habitats that support prey of the peregrine falcon.

Peregrine falcons in many parts of North America have situated their nests on large buildings, bridge spans, and other human-made structures. These individual falcons have become somewhat habituated to human activity and are able to take advantage of the presence of secure nest ledges on sky-scrapers - and other human-made structures - and an abundance of prey (typically rock doves, an abundant species in most urban areas). These human-made structures currently provide nesting habitat for a small portion (5, or 7% of the known sites) of the state's population of falcons. Additionally, there are at least 5 sites on similar structures in northwestern Oregon (Tracy Fleming, pers. comm.). Management of these sites, often including private parties, municipal governments, and the Department of Transportation, has allowed for enhancement of the state's population of falcons (e.g, Martell et al. 2000).

Peregrine falcons occasionally nest in active or abandoned rock quarries, creating an opportunity to use quarry management to enhance the regional population. Current state law requires, at least in some situations, that quarry operators shall develop reclamation plans. RCW 78.44.141 (4)(b) also requires that:

> Slopes in consolidated materials shall have no prescribed slope angle or height, but where a severely hazardous condition is created by mining and that is not indigenous to the immediate area, the slopes shall not exceed 2.0 feet horizontal to 1.0 foot vertical. Steeper slopes shall be acceptable in areas where evidence is submitted that demonstrates that the geologic or topographic characteristics of the site preclude reclamation of slopes to such angle or height or that such slopes constitute an acceptable subsequent use under local land use regulations.

Consequently, although traditional reclamation often occurs (Norman 1992), there are opportunities for maintaining, or even creating, habitats beneficial to nesting falcons (Norman et al. 1997, Bell 2001). In fact, quarry reclamation projects have been approved that included provisions for creation of nest ledges on vertical quarry high-walls (D. Norman, pers. comm.).

WDFW Priority Habitat and Species (PHS)

Wildlife species requiring protective measures for their perpetuation due to their population status, their sensitivity to habitat alterations, or their recreational importance are listed as Priority Species by WDFW. The PHS unit of WDFW provides management recommendations to governments, developers and landowners as a proactive measure to protect vulnerable breeding and foraging areas.

Hacking and Fostering

An important component of efforts to recover peregrine populations in North America involved reintroduction of falcons to the wild. In Washington, these reintroduction efforts involved hacking and cross-fostering of peregrines (Table 10). Hacking is the process where young peregrines, raised in captivity to about the age when they would normally fledge, are released to the wild. The releases occur on remote cliffs and the birds are typically fed and monitored for several weeks by hack site attendants (Sherrod et al. 1982). Cross-fostering involves placing captive-bred young falcon chicks in the nest of another species, such as the prairie falcon. This allows the chicks to be fed and cared for by adults and later, the fledglings learn to hunt and avoid predators in the company of wild falcons (Sherrod et al. 1982).

Hacking and cross-fostering efforts occurred primarily east of the Cascade crest between 1982 and 1997. Peregrines were colonizing western Washington naturally, therefore hacking was used to speed the rate of recovery in eastern Washington. During that period, 141 fledgling peregrine falcons (64 females and 73 males [and 8 of currently unknown sex]), raised in captivity (including The Peregrine Fund, the Santa Cruz Predatory Bird Research Group) were hacked from nine general locations in the Columbia Gorge, Cascade Mountains, and Columbia Basin. Four eyasses were cross-fostered at prairie falcon nests at one location in the interior of the state. Based on information in Heinrich (1994), annual reports summarizing hacking efforts, and agency field notes, 100 (69%) of the releases were considered successful (i.e., success was assumed if the hacked falcon was observed ≥3 weeks after release; William Burnham, pers. comm.). Release success was higher in the Columbia Gorge (21 of 28; 75%) and Cascade Mountains (42 of 54; 78%) than in the interior (37 of 63; 59%), probably due to higher predation rates by golden eagles in the interior region. In 1982, when hacking began, there were no occupied nest sites in the Columbia Gorge and eastern Washington, although one historic site was known along the Snake River. In 2000, after 16 years of hacking, 16 nest sites became occupied in this region, including 5 former hack sites and 8 additional sites in the vicinity of where falcons were hacked. The establishment of these sites was likely attributable to this management.

Little is known of the fate of released birds in Washington. Some falcons were never seen again after their initial flight from the hack site, whereas others were known to have been killed by

Table 10. Number of peregrine falcons released through hacking or cross-fostering programs in Washington.

Hack Site	Year																Total	References[a]
	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97		
Columbia Gorge																		
Beacon Rock	3																3	17
Table Mtn.		3		3	4	5											15	1, 13, 14, 16
Dog Mtn.								5	5								10	3, 4
Cascade Mountains																		
Divide Ridge								5	5	5							15	3, 4, 5
Tongue Mtn.										6	5	5					16	5, 6, 7
Fife's Ridge										6	6	6	5				23	5, 6, 7, 8
Columbia Basin																		
Rock Creek[b]		2	2														4	14, 15
Grande Ronde							5	4	5								14	2, 3, 4
Spokane							3		3	5							11	12
Roosevelt												11[c]	6	6	5	6	34	7, 8, 9, 10, 11
Total for Year	3	5	2	3	4	5	8	14	18	22	11	22	11	6	5	6	145	

[a] References. 1: Burnham 1987, 2: Burnham 1988, 3: Burnham 1989, 4: Burnham 1990, 5: Burnham 1991, 6: Burnham 1992, 7: Burnham 1993, 8: Burnham 1994, 9: Burnham 1995, 10: Burnham 1996, 11: Burnham 1997, 12: Demers 1991, 13: Heinrich 1994, 14: Walton and Thelander 1983, 15: Walton and Thelander 1984, 16: Walton and Thelander 1985, 17: WDFW notes.

[b] Cross-foster site.

[c] This total represents three separate releases at the site.

predators, most notably golden eagles. A small number of birds were injured in some way during the hacking period and were taken back into captivity for treatment. Although unbanded adult or sub-adult falcons were occasionally observed at hack sites (Burnham 1990, 1994), only twice were previously hacked falcons seen to return to a site in a subsequent year (in 1991, when an adult hacked falcon was observed with another adult at one of the sites in the Cascade Mountains [Burnham 1991]; this or another falcon returned in 1992 and nested). A falcon hacked in the Columbia Gorge in August 1985 was found dead, apparently along a roadside, in Snohomish County in early September 1985 (Walton and Thelander 1985). A falcon hacked from a site in Oregon nested in the San Juan Islands in 1992 and another hacked from an undetermined location nested at another site in the San Juan Islands in 1993 (P. DeBruyn, pers. comm.). Three peregrines hacked in Washington were recovered in California and one was recovered in western Mexico (Appendix B).

Because of difficulties in observing breeders and determining their identification from their bands, it is not known what numbers of the released birds became established as breeders and contributed to the recent population increase in Washington. Intensive site monitoring was conducted in the Rocky Mountains region following hacking efforts there, and it was reported that "... the majority of nesting pairs have one or both member with a band signifying a released bird" (Platt and Enderson 1989:114). Similarly, much of the population increase documented in Yellowstone National Park in the 1980s was attributed directly to hacked birds (McEneaney et al. 1998; B. Oakleaf, pers. comm.). It is likely that hacking efforts in the mid-west and eastern portions of North America were largely responsible for the dramatic increase in populations in a vast region from which peregrine falcons had been extirpated; Cade et al. (1988) present a model that suggests that many of the birds present as breeders in 1983 could have originated as hacked birds.

Falconry

The falconry community, with 2,600-2,800 members of the North American Falconers' Association (D. Knutson, pers. comm.) and about 144 members of the Washington Falconers Association (B. Kellog, pers. comm.), has played an important role in the conservation and management of the peregrine, and this group has a strong interest in the recovery of the species. Falconers who had for years monitored peregrine eyries were instrumental in calling attention to the population crash that occurred across North America. Subsequently, falconers were involved in captive breeding efforts that eventually were used to supply falcons for reintroduction efforts in North America and abroad. In addition to their desire to see the population of this species restored from a conservation perspective, falconers also wish for recovery so that restrictions on taking birds from the wild might be relaxed.

Peregrine falcons are greatly desired by falconers because of their strength, agility, speed, beauty, grace, and outstanding hunting ability. Falconers obtain their birds, directly or indirectly, from one of three sources: young birds taken from a nest, passage birds (migrants), or from certified captive breeding programs. Because of their endangered status, peregrine falcons currently cannot be taken from the wild for falconry purposes. Consequently, peregrine falcons flown in this state for falconry come from captive-bred populations. Of the 206 Washington falconers with active permits as of October 2000 (WDFW, unpubl. data), at least 59 (29% of those with active permits, and 41% of the WFA membership) possessed one or more peregrine falcon(s) in at least one year between 1991 and 1999 (WDFW, unpubl. data). In addition to hunting with the birds, some falconers highly value the experience of capturing and training a falcon taken from the wild.

At least 23 individuals or organizations breed raptors in captivity in Washington (WDFW, unpubl. data); a comparatively small number of these individuals or organizations have bred peregrine falcons. Some captive-bred falcons are of mixed genetic stock (e.g. a cross between two subspecies) or are hybrids with other falcon species. Some falconers prefer birds that are as "genetically pure" as possible, and such birds are therefore the goal of some captive breeding programs. Even within the genetically pure subspecies, however, breeders and falconers desire genetic diversity in the captive stock. Consequently, there is an interest in mixing wild genes with the more limited gene pool currently represented in the captive population. Captive-bred peregrine falcons are costly to raise and are in high demand. A Peale's falcon raised in Washington may sell for $800.00 to $2,000.00 locally (depending on sex) and for as much as $1,500.00 to $6,000.00 overseas (depending on sex), where the subspecies is prized for its uniqueness (B. Wood, pers. comm.). Locally-bred *anatum* falcons currently sell for about the same price in the United States; pure *anatums* cannot be exported (B. Wood, pers. comm.).

FACTORS AFFECTING CONTINUED EXISTENCE

Adequacy of Existing Regulatory Mechanism

Federal protection. Peregrines are currently protected at the federal level under the Migratory Bird Treaty Act and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Regulations authorize the issuance of permits to take, possess, transport and engage in commerce with raptors for falconry and for propagation. Prior to issuance of these permits, criteria need to be met, including a requirement that the issuance will not threaten a wildlife population. USFWS is working with the states to develop separate management plans that address take of nestlings (USFWS 2000) and passage (migrating first-year) peregrines in the United States (Federal Register 64:53686). Take of nestling peregrines is currently authorized by FWS, but cannot exceed 5% of annual production. Take will be regulated by the States up to the limit determined by the FWS, and states can be as or more restrictive than the federal guidelines. Take of passage birds has not been authorized by FWS, and the management plan remains to be completed. These existing regulatory provisions will protect against excessive take of peregrine falcons in the absence of ESA protections.

Since the Migratory Bird Treaty Act does not make provisions for protection of habitat for the peregrine falcon, there are no other existing federal laws that specifically protect the habitat of this species. Loss of habitat was not identified as a limiting factor in peregrine recovery (Mesta 1999) and was not a factor identified as contributing to the species' listing.

An important regulatory mechanism affecting peregrine falcons is the requirement that pesticides be registered with the Environmental Protection Agency (EPA). Under the authority of the Federal Insecticide, Fungicide and Rodenticide Act, the EPA requires environmental testing of all new pesticides. Testing the effects of pesticides on representative wildlife species prior to registration is required, although this testing does not include evaluation of the combined effects of multiple legal pesticides which may have detrimental effects. The requirement to test pesticides is not altered by de-listing the species (Mesta 1999).

The American peregrine population should be monitored for a five-year period following de-listing as required by the Endangered Species Act. However, FWS has not yet developed a final monitoring plan as required (Mesta 1999). Take of peregrines under the Migratory Bird Treaty Act pursuant to the management plans should be evaluated during the ESA monitoring period.

On July 1, 1975, the peregrine falcon was included in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). This treaty was established to prevent international trade that may be detrimental to the survival of plants and animals. Import and export permits are required by the importing and exporting countries before an Appendix I species can be shipped, and Appendix I species may not be imported for primarily commercial purposes (Mesta 1999). Although CITES does not regulate take or domestic trade, CITES permits may not be issued if the specimens were not legally acquired. This regulatory protection will not be altered by de-listing the peregrine under the Endangered Species Act.

Peregrines are still afforded some protection by land management agencies under the National Forest Management Act and the Federal Land Management and Policy Act. National Forest Management Act regulations specify that "fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area." Regional foresters with the U.S. Forest Service are responsible for identifying sensitive species occurring within their region. Sensitive species are those that may require special management emphasis to ensure their viability and to preclude trends toward endangerment that would result in the need for federal listing. Currently, the peregrine falcon is on the Region 6 Regional Forester's Sensitive Species List. As a sensitive species, evaluation of impacts of proposed actions on the peregrine falcon follows the process described in FSM 2673.4 and must be documented in the Biological Evaluation. If a proposed action may potentially impact the species or its habitat, surveys using the regional protocol (Pagel 1992) will be conducted. Nest Site Management Plans will be developed as needed for current and future sites during the monitoring period. Nest site management plans are used to guide evaluation of activities in primary, secondary, and tertiary management zones surrounding nest sites. Impacts of disturbance during the nesting period and effects of vegetation changes on habitat for prey species are concerns that should be addressed in nest site management plans. The species' status as a sensitive species will be re-evaluated at the end of the monitoring period developed by the

USFWS. The Federal Land Management and Policy Act requires that public lands be managed to protect the quality of scientific, ecological, and environmental qualities, among others, and to preserve and protect certain lands in their natural condition to provide food and habitat for fish and wildlife.

State laws. Federal de-listing of the peregrine falcon does not require the removal from state threatened and endangered species lists, or suspend any other legal protections provided by state law. States may have more restrictive laws protecting wildlife, including restrictions on take for falconry, and may retain state threatened or endangered status for the peregrine. Should WDFW permit some level of falconry take of nestlings and/or passage birds, harvest would be determined and monitored by WDFW in cooperation with USFWS in accordance with ESA de-listing requirements and to ensure sustained recovery of peregrine populations in Washington.

Washington state forest practices rules. Current Forest Practices rules provide limited, but potentially important, protection for peregrine falcons in forested regions. In the forested areas of the state, timber operators are required to observe Forest Practices regulations relative to proposed timber harvest activities. WAC 222-16-080 identifies critical habitat (for species listed as endangered or threatened) for the peregrine as a buffer surrounding known active nest sites within which forest management activities are subject to review by DNR. The buffer around the nest site is greater during the breeding period (March 1 and July 30; 0.5 mile radius) than during the winter period (0.25 mile radius). If a landowner proposes any forest practices, such as timber harvest, road construction, aerial application of pesticides, or site preparation within the buffer area, it is considered a "Class-IV special" forest practice and can trigger a SEPA review. Landowners can avoid "Class-IV special" determinations by developing a landowner conservation plan (WAC 222-16-080 (6)). If approval for the "Class-IV special" is sought, DNR could make one of the following findings: 1) a determination of significance (i.e., the proposed activity would have an impact and would therefore not be permitted as described), 2) a determination of non-significance (i.e., the proposed activity would not have an impact and would therefore be permitted), or 3) a mitigated determination of significance (i.e., stated impacts would be allowed if they were offset by specified mitigation). Forest practices formerly considered "Class-IV specials" would not be subject to SEPA review, should the peregrine be down-listed to "sensitive" status or de-listed by the Washington Fish and Wildlife Commission.

Contaminants, Human Disturbance, Habitat, and Other

Contaminants. As peregrines are known to accumulate contaminants in wintering areas (Henny et al. 1982), or by consumption of prey that overwinter in those areas (Fyfe et al. 1990), the continued use of DDT south of our border is a concern. This concern will be addressed to some degree in Mexico with the implementation of the North American Agreement for Environmental Cooperation, signed in 1997 by the United States, Canada and Mexico. Provisions of this agreement will involve a reduction of DDT use in Mexico (Mesta 1999b). Specifically, Mexico will reduce the level of DDT use by 80% by 2001, eliminate illegal use of DDT in agriculture, and contribute to development of controls on DDT production and application (Mesta 1999b).

Although use of DDT, the primary chemical associated with the global decline of peregrine falcon populations, has been restricted in the United States, and may soon be restricted in Latin American countries (Mesta 1999b) where peregrines or their prey over-winter, the potential impacts from chemical use remain a management concern. Studies of chemical contaminants in prey of the peregrine falcon indicate generally low, but occasionally high levels of contaminants present in samples collected in the early- to mid-1980's (e.g. Schick et al. 1987). Conversely, migrant peregrines along the Texas coast showed decreasing levels of DDE in blood plasma between 1978 and 1994 (Henny et al. 1996).

Of concern in Washington is the presence of high concentrations of DDT and its metabolites - including DDE, which causes eggshell thinning - in river and streambed sediments in the Columbia Basin (Munn and Gruber 1997), a region characterized by elevated levels of organophosphate contaminants in streambed sediments and fish (Gruber and Munn 1998). Sediments from the Yakima River contain the highest levels of DDT of any river in the United States (S. Halstead, pers. comm.). These findings indicate high persistence of this compound in the environment.

The level of contaminants present in soils, river sediments and estuaries is quite high and will likely increase in the years ahead. In 1999, over 170,000 acres (68,799 ha) planted to apples in Washington were treated with over 5 million pounds (2.268 million kg) of insecticides, including azinphos-methyl, carbaryl, chlorpyrifos, endosulfan, malathion, methyl parathion and other compounds (information from http://usda.mannlib.cornell.edu/reports/nassr/other/pcu-bb/). Insecticides used on other crops (asparagus, carrots, corn, onions, green peas, and the orchard crops) and cattle include some of the compounds listed above as well as disulfoton, diazinon, permethrin, and lambdacyhalothrin. Most crops, including 1.85 million acres (748,695 ha) planted to winter wheat, are also treated with herbicides. A variety of fungicides and rodenticides are also applied to certain crops. Additionally, recent results from monitoring efforts in the Puget Sound Basin indicate the presence, in sediment and water samples, of numerous compounds - chlordane, DDT, DDD, DDE, PCBs, PAHs (polycyclic aromatic hydrocarbons), BHC, diazinon, lindane, and carbaryl - at levels exceeding criteria established for protection of aquatic wildlife in other states or Canada, or at levels thought to be hazardous to aquatic life (Bortleson and Ebbert 2000, Voss and Embrey 2000, Black and Silkey 1998, MacCoy and Black 1998, PTI Environmental Services 1991). The potential biological significance of these and other chemical compounds on peregrines or their prey is unknown.

It is likely that the amount of DDE in the environment in Washington is below critical thresholds attributed to reproductive impairment, but the extent of this reduction is uncertain. However, peregrine falcons from the Pacific Northwest and elsewhere in North America regularly overwinter throughout the western hemisphere, in regions where DDT/DDE and/or other potentially deleterious chemicals are still used. Although eggshell thickness data indicate that some female peregrines have recently produced substantially thinned (>17%) eggs in Washington, the general thickness of eggs has apparently increased from the unrecorded levels that must have characterized the population during the height of the population crash. It appears that eggshell thinning is no longer occurring at the critical level likely to result in population-level impacts. Although peregrine populations have increased dramatically over the past two decades, this does not mean that peregrines exist in a pristine environment. Their position in the avian community as a top predator in the food chain exposes them to elevated levels of contaminants. Should DDT or a similarly harmful chemical become widespread in the environment another population collapse would be possible.

Other chemicals may also pose a hazard to peregrine falcons. Organophosphate chemicals, PCBs, heavy metals, and oil pollution all have the potential to impact peregrines. In addition, it has long been recognized that combinations of various compounds may have far more deleterious effects on wildlife than the individual chemicals themselves. The significance of these synergistic effects is impossible to quantify at present because they are species-specific and also vary as a function of the types and amounts of chemicals present in animal tissues. Needless to say, widespread presence of harmful chemicals or an oil spill off the Washington coast that decimates prey populations could have significant local or regional impacts on the peregrine population.

Rock climbing. Rock climbing in the vicinity of peregrine eyries is known to cause disturbance (Lanier and Joseph 1989). Disturbance from rock climbing has been a concern at some sites (H. Allen, pers. comm.) and may become more of a management issue in the future at eyries that are popular climbing destinations. This seems likely given that the sport of rock climbing has gained in popularity in recent years and will likely become more popular in the future. Gauging the potential future impact of climbing is difficult, however, because the total number of climbers in Washington is not known. *The Mountaineers* currently has a roster of 3,200 climbers who are eligible to register for climbing events they sponsor (Steve Firebaugh, pers. comm.), but the number of climbers not affiliated with this organization is unknown. Some organizations, such as *The Mountaineers*, promote a "leave no trace" ethic in their climbing guidelines, require that climbing parties respect wildlife and "avoid wildlife and sensitive areas during susceptible times ...", and supported seasonal closures of 5 cliff faces in Washington that were used by peregrines or other cliff-nesting raptors (Steve Firebaugh, pers. comm.). Not all climbers, however, share these perspectives.

A variety of management actions have been used to address the issue of human disturbance from rock climbing. At sites in Washington where rock climbing is a concern, signs have been erected to advise climbers of climbing route closures or closure periods. These seasonal restrictions to specific cliff faces are also published in *Vertical Times*, a newsletter published for climbers by the Access Fund (Attarian and Pyke 2000). Use of a viewshed, a concept similar to a buffer zone, has been proposed in Colorado (Camp et al. 1997). Outreach activities in other regions have been initiated through publication of climbing handbooks that address disturbance of cliff nesting raptors (Access Fund 1997) and development of site management plans (Boise Climbers' Alliance and Idaho Department of Fish and Game 1999). It will be important to monitor sites for potential climbing conflicts and to engage in outreach activities such as providing speaking engagements at recreational rock climbing clubs and distributing educational materials explaining conservation and management concerns. Site management will require monitoring of climbing and falcon reproduction and development of site plans or other conservation agreements.

Falconry. Hybridization, human disturbance at eyries, and legal or illegal take of falcons are factors related to falconry that may affect peregrine populations in Washington. Hybridization occurs when two closely-related species successfully reproduce. In birds, the resulting offspring often possess morphological or plumage features that possess elements of both species. The manifestation of these features can be expressed along a broad gradient characterizing the full range of differences between the two species. In some cases hybrids are less capable or incapable of reproducing, whereas in others reproduction may occur commonly. Although hybridization in the wild between peregrines and other falcon species is apparently quite rare (see Oliphant 1991), hybridization among peregrine subspecies is likely a regular occurrence in zones where the subspecies' ranges meet or overlap. Moreover, peregrines reintroduced into mid-western and eastern North America (the eastern portion of the *anatum* subspecies range) were derived from seven peregrine subspecies (Tordoff and Redig 2001) and it is widely recognized that the re-colonizing eastern population differed from the genetically pure subspecies that once occupied that range (Mesta 1998). Hybridization within captive raptor populations has become quite common (Haak 1980) and is expressed by many types of cross-breeds involving peregrines (Table 11). A concern expressed about such hybridization is that some of these birds eventually escape (or are released) and enter the wild population (WDFW, unpubl. data), thereby facilitating the potential introduction of "exotic" genes to the regional gene pool (Parrish and White 1997). Concerns about hybridization usually are greatest where one species, through hybridization, essentially alters the genetic structure of a significant portion of another species' population, such as is occurring between the mallard and the American black duck (*Anas rubripes*) in parts of North America.

The ecological significance of concerns about hybrid peregrines reproducing in the wild is unknown, but several factors indicate that the issue has little likelihood of influencing populations in Washington. The number of peregrines that escape or are released from captivity is small. A mean of 2.3 peregrines and 0.5 hybrids (peregrines mixed with gyrfalcon, merlin or prairie falcon) escaped from falconers in Washington each year between 1991 and 2000 (WDFW database); hybrids cannot be intentionally released (50 CFR 21.29 (14)). Among the escapees, most are non-hybrids, and there will be little concern about their genetic origin (although some of these falcons may be a mix of various subspecies). Of the hybrids that escape, a certain proportion will perish of natural causes, possibly because their genetic composition or lack of experience in the wild places them at greater risk of mortality. Surviving hybrids are very rarely observed alive in the wild (T. Fleming, pers. comm.). Importantly, federal regulations require that hybrid falcons be imprinted on humans or surgically sterilized before they are flown for falconry purposes (50 CFR 21.29 (12)). Such actions would prevent the falcons from breeding in the wild, although their occupancy at an eyrie could preclude reproduction at a particular site. Although this regulation will remain in effect following federal de-listing the rate of compliance with the imprinting/sterilization regulation is unknown.

Table 11. Examples of peregrine falcon hybrids used by falconers in Washington state. Information in table provided by Brad Wood (pers. comm.).

Species crossed with peregrine[a]	Composition of hybrid
gyrfalcon	50 / 50 *or* 75% gyrfalcon / 25% peregrine
merlin	50 / 50
gyrfalcon/merlin hybrid	25% merlin / 25% gyrfalcon / 50% peregrine
prairie falcon	50 / 50
saker falcon (*F. cherrug*)	50 / 50 *or* 75% saker / 25% peregrine

[a] The gyrfalcon-peregrine cross is the most common hybrid used by falconers in Washington. The other hybrids listed are much less common. Other species are very rarely crossed with peregrines for falconry purposes in the United States and have included American kestrel, lanner falcon (*F. biarmicus*), laggar falcon (*F. jugger*), and bat falcon (*F. rufigularis*) (B. Wood, pers. comm.; Haak 1980).

Few studies have examined the effect of legal falconry harvest on raptor population parameters. Conway et al. (1995) examined the effects of long-term nestling harvest on prairie falcons by comparing subsequent territory occupancy, nesting success, productivity, and breeder and nestling return frequencies between experimentally harvested and non-harvested territories in southwestern Wyoming from 1982-89. Experimentally harvested territories had higher occupancy rates but similar nesting success and productivity compared with non-harvested territories when all years were pooled. However, among year comparisons revealed lower nest success in 2 of 7 years, and lower productivity in 1 of 7 years. Higher occupancy rates on harvested sites may have been caused by increased fledgling survival (as a result of decreased sibling rivalry and greater parental investment in fewer young), resulting in an increase in local recruitment of philopatric young; return rate of fledglings from harvested territories was higher compared to non-harvested territories. While harvest never caused abandonment in the year of harvest, disturbance to the site may result in abandonment the following year. Breeders on harvested territories had a lower return rate compared to non-harvested territories. Nesting raptors may still fledge young when disturbed, but may not return to the territory the following year (White and Thurow 1985). Additional research and monitoring is needed to examine the effects of harvest on peregrine population parameters (occupancy rates, nest success, productivity, site fidelity of breeders in subsequent years and dispersal), including the effect of human disturbance associated with harvest at sites. Illegal take of falcons is not currently recognized as an issue.

Human disturbance. Rock climbing; other outdoor recreational activities, such as hiking and beach walking; falconry; and industrial activities, such as blasting, can be significant sources of disturbance to nesting peregrines. The effects of rock climbing and falconry were discussed above. Hiking and beach walking that occurs in close proximity to eyries, particularly from above, may lead to disturbance and potential abandonment of sites. However, the potential impacts of these activities on nesting peregrines in Washington has not been evaluated.

Limited work has been conducted on the possible effects of blasting or other industrial activities on nesting raptors. Information from Australia indicates that peregrines have occasionally nested in active rock quarries (Pruett-Jones et al. 1980). Conversely, peregrines near blasting activities in Alaska abandoned their nest sites (USDI 1976). In Idaho, nesting prairie falcons near blasting areas reproduced as well as falcons at control sites the year after the blasting, although 3 of 4 sites near the blasting activity were abandoned in the second year following blasting (Holthuijzen et al. 1990). The limited information suggests that blasting in the vicinity of nests may lead to abandonment, but that more distant blasting or those activities producing noise at lower decibel levels may have less impact (Holthuijzen et al. 1990, USDI 1976). Future blasting activities in Washington may disturb nesting peregrines, but will not likely limit population performance.

Inbreeding. Small population size, like that of the peregrine falcon in Washington, increases the probability of inbreeding, or reproduction among closely-related falcons. Inbreeding is a potential problem because it increases the likelihood of manifesting recessive genes in individuals. Only one study has examined the incidence of inbreeding in peregrines. Tordoff and Redig (1999) found that seven pairs of closely-related falcons (half-siblings, full siblings, or parent-offspring pairs) in the midwestern USA produced 2.2 young per nesting compared to the population mean of 2.1 young per nesting. The young were considered healthy and normal, although there was no follow-up on their reproductive success or longevity. Tordoff and Redig (1999) believed that the low rates of inbreeding in their study population did not have deleterious effects on individuals or the population. They speculated that the peregrine falcon population, generally small in size and sparsely distributed, has evolved to accommodate a small amount of inbreeding without manifestation of deleterious attributes.

Shooting. Shooting of peregrines still occurs to a small degree in Washington, as it does elsewhere (Kiff 1988). Peregrines were reportedly shot at two potential breeding sites, in 1964 (Knight et al. 1979) and in the late 1960s (Buchanan 1988). The extent to which shooting is a significant source of mortality to Washington's breeding and or wintering populations is unknown.

Disease. Although most diseases impact only individuals within populations, some diseases have emerged in recent years that have the potential to effect populations. For example, populations of the Indian white-backed vulture (*Gyps bengalensis*) and Indian long-billed vulture (*G. indicus*) have collapsed to < 5% of their former abundance on the Indian subcontinent in the last 5 years alone (Friend et al. 2001). Preliminary data suggest that the decline was the result of a virus. Disease is not currently known to be a factor that could limit North American peregrine falcon populations.

Reduction of prey populations. Although peregrine falcons prey on a wide variety of prey species, reduction of prey populations could cause population problems. Shorebirds and waterfowl are important prey of the falcon, and loss of habitats important to those species during any stage of their life cycles could be harmful. Information from the Queen Charlotte Islands, British Columbia, indicates that the introduction of rats (*Rattus rattus* and *R. norvegicus*) and racoons on islands used by breeding seabirds has almost completely decimated one of the largest breeding populations of the ancient murrelet (Gaston 1994), a prey species of the peregrine falcon (Beebe 1960, Rodway et al. 1988). Similarly, the introduction of foxes to several hundred Alaskan islands for "fur farming" purposes resulted in substantial population declines of nesting seabirds (Bailey 1993). Such introductions have not been documented along the Washington coast, but it is clear that these species must not be given an opportunity to establish populations on seabird nesting islands.

CONCLUSIONS AND RECOMMENDATION

As is true in most parts of its range, the peregrine falcon population in Washington has increased substantially following the virtual ban on use of DDT in the United States and Canada, and an apparent reduction in DDT use in other parts of the western hemisphere. The population of breeding peregrines in Washington increased from 4 pairs to as many as 59 pairs over the last 20 years. Information on the size of the population prior to the DDT-induced population crash is incomplete and does not allow a reasonable comparison with historical numbers.

With the exception of peregrines that nest in urban areas and are habituated to certain types of disturbance, this falcon is somewhat sensitive to human disturbance, particularly rock climbing, at their nest sites. Most nest sites, however, are either on protected public lands where human access should be managed and disturbance would therefore be minimal, or are in remote locations or on very tall cliffs where disturbance would likely be negligible. Forest management disturbances are also possible, but it is likely that these can be managed on federal and non-federal lands via ongoing and future conservation and management strategies and agreements.

The state's population of peregrine falcons is and may always be small. In conceptual terms the likelihood of extinction is inversely related to population size. The Washington population, although numerically small, is not isolated however, as the species' high mobility and noted migratory behavior means that local birds are actually part of a larger regional population, within which peregrines interact, that includes at least Idaho, Oregon and British Columbia, Canada. Despite the regional context of the Washington population, its size makes it somewhat vulnerable should another factor emerge with the potential to reduce populations at large spatial scales (e.g. pollution, disease). That a disease- or chemically-induced decline will occur does not appear likely at present. Although contaminants are still present in the environment and eggshell thickness has not returned to levels considered normal in the pre-DDT era, the population is steadily increasing (34 sites occupied by pairs were discovered since 1996; Table 4, Appendix F), productivity is generally high, the majority of known sites are occupied annually (an average of 81.5% of territories were occupied by pairs between 1991 and 2000; Table 4, Appendix F), and peregrines have recolonized all regions of the state.

Because of the small population size, individual sites contribute substantially to the health and distribution of the overall population of the state. Consequently, site management plans should be developed to protect nest sites from human disturbance where such disturbance has the potential to adversely affect reproduction. Monitoring will be required to determine the locations and productivity of nest sites.

Future management activities for the peregrine in Washington should include development of a state management plan. Activities that should be conducted and outlined in the plan include:

1. Develop and implement a strategy to monitor the distribution, abundance, occupancy, and production (productivity) of nesting pairs in Washington that is capable of detecting a 20% decline in the number of occupied nest sites. The strategy should address the need for management information and be compatible with the national strategy being developed by the FWS.

2. Develop a management plan that addresses conservation actions needed to protect the state-wide population. These conservation actions would address the following issues:
    a. Harvest of birds for falconry if authorized
    b. Human disturbance at nest sites
    c. Encroachment of human development at nest sites
    d. Development of conservation agreements with landowners and interest groups where threats may occur at nest sites
    e. Management actions to improve nest site quality (e.g., improve drainage of ledges to reduce egg loss)
    f. Improve our understanding of peregrine population dynamics in Washington (population viability analysis)

3. Evaluate whether up-listing is warranted and develop de-listing (to status other than endangered, threatened, or sensitive) criteria based on modeling and the status of the population and habitat.

The management plan should outline strategies to provide for the long-term security ($\approx$100 years) of the species. In the interim, the species would be up-listed to threatened or endangered status if, over a five-year period, occupancy declined by $\geq$20% from the 2001 baseline. This will require a regular monitoring effort to determine territory occupancy.

Recommendation. The WDFW remains concerned about the health of the peregrine falcon population in Washington. The factors that caused the recent population decline have been reduced, however, and the population has increased steadily in recent years. The WDFW therefore recommends that the species be down-listed to sensitive in the state of Washington. A state sensitive species is considered a species "... that is likely to become endangered or threatened in a significant portion of its range within the state without cooperative management or removal of threats" (WAC 232-12-297).

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Appendix A. Museum specimens of peregrine falcons collected in Washington state.

Date	Location Collected	Age	Sex	Museum Number[a]
Outer Coast				
F. p. anatum				
13 Sep 1916	west coast, Jefferson Co.	A	F	UCLA20987
7 Apr 1931	Westport, Grays Harbor Co.		M	PLU10145
7 Oct 1932	Westport, Grays Harbor Co.	U	F	PSM05951
2 May 1937	Westport, Grays Harbor Co.	A	F	PSM09737
14 Sep 1941	Kalaloch, Jefferson Co.	J	F	PSM06549
12 Nov 1941	James Rock, Grays Harbor Co.	J	M	PSM08445
8 Oct 1944	Baker Bay, Pacific Co.	J	F	PSM01538
F. p. pealei				
22 Jun 1907	Washington coast	U	F	Museum unknown; Dawson (1908b)
15 Jul 1913	LaPush, Clallam Co.	J	M	AMNH750457
23 Aug 1916	Jefferson Co.	A	F	AMNH750458
16 Sep 1916	Jefferson Co.	J	F	AMNH750459
23 Sep 1916	west coast, Jefferson Co.	A	F	UMMZ56051
25 Oct 1917	Grays Harb., Grays Harbor Co.	A	F	UCLA22080
16 May 1918	Ilwaco, Pacific Co.	J	M	USNM262288
20 Jun 1920	LaPush, Clallam Co.	U	F	SUI27521
16 Feb 1921	Westport, Grays Harbor Co.	J	F	USNM272604
19 Jan 1931	Westport, Grays Harbor Co.	J	M	PSM06546
9 May 1932	Westport, Grays Harbor Co.	J	F	PSM06548
17 Oct 1932	Westport, Grays Harbor Co.	J	M	PSM06547
31 Dec 1932	Westport, Grays Harbor Co.	J	F	PSM09728
25 Jan 1933	Westport, Grays Harbor Co.	J	F	PSM08292
25 Jan 1933	Westport, Grays Harbor Co.	U	F	UMMZ122132
17 Nov 1934	Westport, Grays Harbor Co.	U	F	UMMZ122133
9 Dec 1934	Westport, Grays Harbor Co.	U	M	UMMZ122134
1 Jan 1935	Westport, Grays Harbor Co.	J	F	PSM08302
8 Jan 1935	Westport, Grays Harbor Co.	J	M	PSM06545
13 Jan 1935	Westport, Grays Harbor Co.	J	M	PSM08303
28 Oct 1940	Laidlow Isl, Grays Harbor Co.	J	F	PSM08383
2 Dec 1940	Rennie Isl., Grays Harbor Co.	J	M	PSM08390
19 Nov 1946	Willapa Bay, Pacific Co.	J	M	PSM01772
19 Nov 1948	Clallam Co.	J	M	PSM05949
15 Sep 1963	Grays Marsh, Clallam Co.	J	F	PSM09020
summer 1989	northern coast, Clallam Co.	A	F	PSM12992
Unknown Subspecies				
23 Mar 1854	Willapa Bay, Pacific Co.	?	F?	USNMA08501
23 Mar 1854	Willapa Bay, Pacific Co	?	?	Museum unknown; Suckley and Cooper (1860)
Nov	Ocosta, Grays Harbor Co.	J	U	Museum unknown; Lawrence (1892)
5 Nov 1928	Westport, Grays Harbor Co.		M	UWBM7657
28 Dec 1931	Westport, Grays Harbor Co.		M	UWBM11444
5 May 1932	Westport, Grays Harbor Co.		M	UWBM15303
22 Oct 1935	Westport, Grays Harbor Co.		F	UWBM47857
31 Oct 1935	Westport, Grays Harbor Co.		F	UWBM47858
10 May 1936	Westport, Grays Harbor Co.		F	UWBM47861
4 Oct 1936	Westport, Grays Harbor Co.		F	UWBM47855
19 Feb 1937	Westport, Grays Harbor Co.		F	UWBM11445
27 Sep 1937	Westport, Grays Harbor Co.		M	UWBM47852
18 Oct 1937	Westport, Grays Harbor Co.		M	UWBM47859
30 Oct 1937	Westport, Grays Harbor Co.		F	UWBM47856

Date	Location Collected	Age	Sex	Museum Number[a]
8 Nov 1937	Westport, Grays Harbor Co.		M	UWBM47853
22 Jan 1938	Westport, Grays Harbor Co.		F	UWBM47860
6 Apr 1938	Westport, Grays Harbor Co.		F	UWBM47854
1981	west coast	A	F	CRCM84-486

San Juan Islands and Puget Sound

F. p. anatum

Date	Location Collected	Age	Sex	Museum Number
26 Sep 1854	Puget Sound		M	USNMA04367
17 Oct 1926	Nisqually, Pierce Co.	U	M	PSM05950
15 Aug 1930	Auburn, King Co.	J	F	PLU10142
12 Nov 1930	Nisqually Flats, Thurston Co.	J	F	PSM08257
10 Nov 1990	Tacoma, Pierce Co.	J	F	PSM21000
8 Jun 1994	Seattle, King Co.	A	F	PSM20758
15 Jun 1995	Seattle, King Co.	J	F	UWBM62062
1 Jan 1999	Tacoma, Pierce Co.	J	F	PSM22483
27 Jul 1999	Oak Harbor, Island Co.	A	F	PSM22661

F. p. pealei

Date	Location Collected	Age	Sex	Museum Number
1800's	Puget Sound	J	F	USNMA12022
28 Oct 1938	Bellingham, Whatcom Co.	U	F	Museum unknown; Edson (1939)
21 Nov 1941	Belfair Flats, Mason Co.	J	M	Private collection
15 Oct 1962	Port Townsend, Jefferson Co.	J	F	PSM08924

F. p. tundrius

Date	Location Collected	Age	Sex	Museum Number
8 Nov 1913	Nisqually Flats, Thurston Co.	J	F	UCLA7906
9 Oct 1995	Whidbey Island, Island Co.	J	F	UWBM62063

Unknown Subspecies

Date	Location Collected	Age	Sex	Museum Number
10 Nov 1932	Telegraph Slough, Skagit Co.		F	UWBM6317
16 Oct 1940	Mt. Vernon, Skagit Co.	U	F	UMNH9553
18 Nov 1948	Coupeville, Island Co.	J	F	CRCM48-466
9 Sep 1980	Kent, King Co.	J	F	UWBM36146
26 Apr 1985	Seattle, King Co.	A	M	UWBM40963
9 Mar 1993	Seattle, King Co.	A	F	UWBM45096
8 Jan 1996	Seattle, King Co.			UWBM62064
fall 1999	Seattle, King Co.			UWBM64950

Interior

F. p. anatum

Date	Location Collected	Age	Sex	Museum Number
date unknown				Museum unknown; Rhoads (1893)
date unknown				Museum unknown; Rhoads (1893)
26 Jul 1990	Lyle, Klickitat Co.	J	F	CRCM90-204
22 Aug 1990	Spokane, Spokane Co.	J	M	CRCM90-205
4 May 1992	near Mt. Rainier, Pierce Co.	J	F	PSM19885
12 Jan 1995	Chehalis, Lewis Co.	A	M	PSM21186

Unknown Subspecies

Date	Location Collected	Age	Sex	Museum Number
1975-1978	Lewis Co.		F	PLU11385

Date	Location Collected	Age	Sex	Museum Number[a]
18 May 1995	Issaquah, King Co.	A	M	PSM21185
Incomplete Information				
Unknown Subspecies				
late 1800's ?		U	M	WCMHAZ18.7

[a] Museums listed in table are AMNH (American Museum of Natural History, New York), CRCM (Charles R. Conner Natural History Museum, Washington State University, Pullman), PLU (Pacific Lutheran University, Tacoma, Washington), PSM (James R. Slater Museum of Natural History, University of Puget Sound, Tacoma, Washington), SUI (University of Iowa, Iowa City), WCMHA (Whatcom County Museum of History and Art, Bellingham, Washington), UCLA (University of California at Los Angeles), UMMZ (Museum of Zoology, University of Michigan, Ann Arbor), UMNH (Utah Museum of Natural History, University of Utah,), USNM (United States National Museum of Natural History, Smithsonian Institution, Washington, D.C.), UWBM (Burke Museum of Natural History and Culture, University of Washington, Seattle).

Appendix B. Band-return data for peregrines banded and/or recovered in Washington.

Banded		Recovered		
Location	Date	Location	Date	How recovered
Banded as nestlings out-of-state, recovered during non-breeding period in-state				
Trail, OR	28 May 1991	Carson	31 August 1996	dead
Portland, OR	25 May 1995	Grays Harbor	24 September 1995	sighted
Portland, OR	19 May 1999	Olympia	27 January 2000	struck auto
Colville River, AK	1 August 1959	Humptulips	15 October 1959	killed by man
Colville River, AK	28 July 1982	Rochester	28 October 1982	caught by hand
Colville River, AK	21 July 1986	Bremerton	19 November 1999	dead
Colville River, AK	18 July 1995	Oak Harbor	8 October 1995	dead
Teller, AK	24 July 1989	Hood Canal	4 June 1990	dead
Lower Yukon River, AK	14 July 1986	W. Clallam Co.	2 October 1986	dead
Lower Yukon River, AK	11 July 1980	Burlington	23 September 1980	struck auto
Lower Yukon River, AK	14 July 1990	Willapa Bay	9 October 1990	dead
Lower Yukon River, AK	16 July 1990	Mt. Rainier NP	4 May 1992	dead
Dawson, Yukon	17 July 1980	Tukwila	8 September 1980	dead
Queen Charlotte Isl., BC	4 June 1992	Forks	25 March 1995	dead
Banded as nestlings in-state, recovered during the non-breeding period out-of-state				
Whatcom Co.	20 May 1988	Chemainus, BC	14 September 1991	dead
Whatcom Co.	29 April 1999	Duncan, BC	11 February 2000	dead
San Juan Co.	30 May 1999	Abbottsford, BC	19 August 1999	injured
San Juan Co.	30 May 1999	Vancouver, BC	3 October 1999	injured
Clallam Co.	23 May 1987	Cape Lookout, OR	15 January 2001	dead
Whatcom Co.	1 June 1997	Cannon Beach, OR	9 April 1998	dead
Skagit Co.	11 June 1995	San Francisco, CA	5 November 1995	trapped
Kliciktat Co.[a]	31 May 1984	Napa, CA	29 April 1985	dead
Seattle	28 May 1997	Glendale, CA	27 October 1997	killed by plane
Banded as nestlings in-state and recovered in-state				
Clallam Co.[b]	5 October 1984	Seattle	25 April 1985	caught by hand
Skamania Co.[c]	20 July 1985	Lake Stevens	9 September 1985	dead
San Juan Co.	24 June 1986	Willapa Bay	6 October 1986	trapped
Skamania Co.	14 July 1986	Plymouth	1 August 1986	dead
San Juan Co.	6 June 1988	Altoona	2 November 1988	injured
Skagit Co.	22 June 1995	Stanwood	22 February 1997	dead
San Juan Co.	4 June 1997	Ocean Shores	18 June 1998	sight record
San Juan Co.	4 June 1997	Oak Harbor	27 July 1999	injured
San Juan Co.	7 June 1998	Oak Harbor	23 September 1998	dead
San Juan Co.	30 May 1999	Auburn	29 December 1999	sight record
Skagit Co.	26 June 1999	Samish Flats	31 December 1999	sight record
San Juan Co.	30 May 1999	Oak Harbor	8 November 1999	injured
San Juan Co.	4 June 1997	Whatcom Co.	8 July 1999	sighted at eyrie
Hacked in-state, recovered during non-breeding period out-of-state				
Skamania Co.	13 June 1990	Portland, OR	15 December 1991	shot
Yakima Co.	29 May 1994	Shady Cove, OR	9 September 1994	caught by hand
Spokane	24 June 1988	Riverside Cty, CA	1 January 1990	trapped
Skamania Co.	20 June 1989	San Jose, CA	18 February 1990	dead
Lincoln Co.	5 June 1996	Earlimart, CA	29 November 1996	dead

Spokane	24 June 1988	Sonora, Mexico	10 November 1988	caught by hand
Skamania Co.	20 July 1985	Snohomish, WA	September 1985	hit by car
Banded during non-breeding period in-state, recovered out-of-state				
Cape Flattery	3 October 1984	Point Mugu, CA	11 October 1984	electrocuted
Long Beach	19 September 1985	LaJolla, CA	22 February 1986	injured
Ocean Shores	12 March 1998	Langara Island, BC	28 May 1998 7 June 1999	sighted
Banded during non-breeding period in-state and recovered in-state				
Bellingham	13 January 1979	Blanchard	24 January 1980	shot
Seattle	27 February 1997	Oso	30 October 1997	dead
Blanchard	21 February 1996	Ferndale	15,16 December 1999	sight record
Samish Flats	14 January 1996	Samish Flats	14 November 1999	sight record
Samish Flats	28 January 1996	Samish Flats	1 November 1999	sight record
Grayland Beach	29 October 1998	Grayland Beach	many dates 1998-2000	sight record
Grayland Beach	29 October 1998	Ocean Shores	19 April 2000	dead
Ocean Shores	1994 - 1999	Ocean Shores	1995 - 1999	sight records

[a] cross fostered

[b] banded as juvenile

[c] hacked bird

Appendix C. Orientation of peregrine falcon nest sites in four eco-regions of Washington; A) Outer Coast - islands; B) Outer Coast - headlands; C) Puget Sound, D) Forested Upland, and E) Arid.

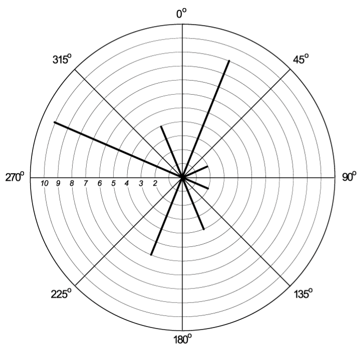

Figure A

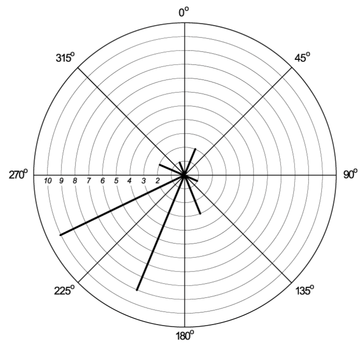

Figure B

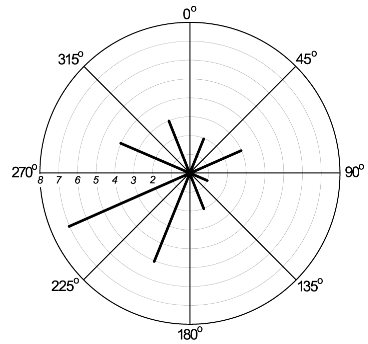

Figure C

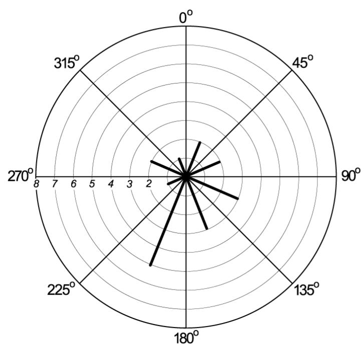

Figure D

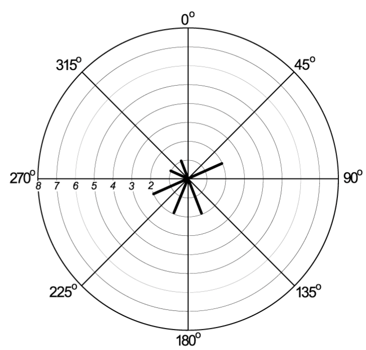

Figure E

Appendix D. Procedures used to analyze Christmas Bird Count data.

Christmas Bird Count (CBC) data can be used to evaluate trends in the winter abundance of birds. The CBC is an annual mid-winter bird count that uses volunteers to locate and count all birds of all species within the area of a 7.5-mile (12 km) radius circle. There are numerous CBC circles in western Washington. To determine whether the abundance of peregrine falcons had changed in recent years CBC data were recorded from the six CBC circles in western Washington that a) contained large estuaries and adjacent open lowland habitats, and b) where counts were made between about 1975-1980 (shortly after the approximate date of the restriction on use of DDT in the United States) and the present. The sites that met these criteria included Bellingham, the Columbia River estuary, Grays Harbor, Olympia, Padilla Bay, and Sequim-Dungeness Bay.

Correction factors are often used to standardize CBC data to control for differences in observer effort. It is generally recognized that additional observer effort, above a certain level, does not result in detections of additional individuals of some species. The reasons for this are that a) the focal species, although found in low numbers, is conspicuous, and/or b) the habitats used by the focal species are emphasized by the count effort. The peregrine falcon is an example of such a species (Bill Tweit, pers. comm.). For this reason, CBC data presented in this analysis were not converted to an index value, but rather were presented in raw form.

The analysis of the data involved use of linear regression (Neter et al. 1990). Count data were missing for some of the counts (i.e., a count was not conducted in that year), so a single regression was run for each site, evaluating the relationship between total number of falcons and the year of the count. Missing data values were then estimated by calculating the missing value according to the site-specific model. After that, the raw data for all sites were combined and the analysis evaluated the relationship between year of CBC effort and the total number of falcons detected at the 6 CBC locations.

Two points should be considered when interpreting the results of the regression analysis. First, the peregrine falcon's flight capability and tendency to use rather large winter ranges (Dobler 1993, Dobler and Spencer 1989) indicates that individual falcons can move quickly from one location to another within a count circle. CBC compilers (i.e., the people responsible for coordinating the count effort) attempt to account for these movements by asking that observers report the times, locations, and behavior of the falcons seen to minimize the amount of double-counting (Bill Tweit, pers. comm.). Nonetheless, a small amount of double-counting likely occurs in CBC circles, particularly those which support larger numbers of these birds (Bill Tweit, pers. comm.). The effect of double-counting on the trend analysis reported above is not currently quantifiable, but could result in a slight reduction in the slope of the line which indicates a relationship between number of falcons and year of count. Second, the CBC analysis is a species-level assessment of winter abundance in the region, and is not sensitive to subspecies status (because CBC participants do not identify falcons to subspecies). Given that both *F. p. pealei* and *F. p. anatum* occur in western Washington during winter, the trend indicated in Fig. 9 may vary somewhat from the actual trend for either subspecies.

Appendix E. Eggshell measurement, correction factors and pre-DDT baseline for eggshell thinning calculations.

Addled eggs and eggshell fragments were collected from eyries by WDFW biologists and personnel from the Falcon Research Group between 1980 and 2000. All samples were measured by Clark (Sam) Sumida during and after his association with the Western Foundation of Vertebrate Zoology in California. The eggshells were measured using a variety of procedures depending on whether the egg was whole or in small or large fragments (see Cade et al. 1996 for summary of procedures). All samples measured were included in the data presentation in this document. A correction factor of 0.063 mm was applied to the eggshell thickness value for any sample which lacked a shell membrane (Clark Sumida, pers. comm.; Lloyd Kiff, pers. comm.). Calculations of eggshell thinning were based on pre-DDT baselines of 0.363 mm for Peale's falcons (Anderson and Hickey 1972) and 0.365 mm for *anatum* falcons; the latter value, derived from California *anatum* populations, was used because there were no samples from Washington from which to establish a more local baseline (L. Kiff, pers. comm.).

Appendix F. Occupancy and productivity of breeding *Falco peregrinus* in Washington, 1978-2000.

		Occupancy		Reproductive Success			
Year	No. Sites Checked	Single Adults	No. Occupied Territories[a] (%)	Nest Success (N)	No. Young[b]	No. Terr. with Known Outcome	Young Per Territorial Pair[b]
Coast							
1980	3	0	3 (100)	67 (2)	4	3	1.33
1981	4	0	4 (100)	67 (2)	4	3	1.33
1982	3	0	2 (67)	100 (2)	5	2	2.50
1983	6	2	4 (67)	100 (3)	5	3	1.67
1984	7	1	6 (86)	67 (4)	6	6	1.00
1985	7	1	5 (71)	40 (2)	4	5	0.80
1986	7	1	5 (71)	80 (4)	9	5	1.80
1987	7	0	6 (86)	67 (4)	11	6	1.83
1988	8	2	4 (50)	75 (3)	7	4	1.75
1989	10	3	6 (60)	60 (3)	7	5	1.40
1990	10	0	8 (80)	75 (6)	17	8	2.13
1991	14	1	11 (79)	45 (5)	10	11	0.91
1992	14	1	9 (64)	55 (5)	13	9	1.44
1993	14	2	12 (86)	54 (6)	14	11	1.27
1994	14	0	14 (100)	54 (7)	20	13	1.54
1995	18	4	12 (67)	83 (10)	30	12	2.50
1996	22	3	18 (82)	50 (9)	22	18	1.22
1997	24	1	22 (92)	41 (9)	21	22	0.95
1998	25	1	19 (76)	70 (12)	29	17	1.71
1999	28	1	25 (89)	52 (13)	24	25	0.96
2000	28	1	22 (78)	65 (13)	25	20	1.25
Puget Sound[a]							
1978	2	0	0 (0)	-	-	0	-
1979	3	0	0 (0)	-	-	0	-
1980	4	1	1 (25)	0 (0)	0	1	0.00
1981	4	0	1 (25)	100 (1)	3	1	3.00
1982	1	0	1 (100)	100 (1)	1	1	1.00
1983	1	0	1 (100)	100 (1)	3	1	3.00
1984	1	0	1 (100)	100 (1)	2	1	2.00
1985	1	0	1 (100)	100 (1)	3	1	3.00
1986	1	0	1 (100)	0 (0)	0	1	0.00
1987	2	0	2 (100)	100 (2)	5	2	2.50
1988	3	0	3 (100)	67 (2)	5	3	1.67
1989	4	0	4 (100)	50 (2)	4	4	1.00
1990	4	0	4 (100)	50 (2)	4	4	1.00
1991	6	1	5 (83)	40 (2)	7	5	1.40
1992	8	1	7 (88)	43 (3)	9	7	1.29
1993	8	0	8 (100)	75 (6)	14	8	1.75
1994	12	0	12 (100)	67 (8)	19	12	1.58
1995	12	0	12 (100)	75 (9)	24	12	2.00
1996	11	0	11 (100)	64 (7)	13	11	1.18
1997	14	0	14 (100)	86 (12)	29	14	2.07
1998	14	0	14 (100)	71 (10)	28	14	2.00

Appendix F (continued).

Year	No. Sites Checked	Occupancy: Single Adults	Occupancy: No. Occupied Territories[a] (%)	Reproductive Success: Nest Success (%)	No. Young[b]	No. Terr. with Known Outcome	Young Per Territorial Pair[b]
1999	18	0	17 (94)	53 (9)	24	17	1.41
2000	21	0	18 (86)	50 (9)	25	18	1.39
Forested							
1978	1	0	1 (100)	100 (1)	2	1	2.00
1980	1	0	0 (0)	-	-	0	-
1981	1	0	0 (0)	-	-	0	-
1982	1	0	1 (100)	100 (1)	2	1	2.00
1984	1	0	0 (0)	-	-	0	-
1988	1	0	1 (100)	0 (0)	0	1	0.00
1989	2	1	0 (0)	-	-	0	-
1990	3	3	0 (0)	-	-	0	-
1991	3	1	2 (67)	0 (0)	0	2	0.00
1992	3	1	2 (67)	100 (2)	5	2	2.50
1993	4	0	1 (25)	0 (0)	0	1	0.00
1994	6	0	4 (67)	75 (3)	7	4	1.75
1995	6	0	4 (67)	75 (3)	7	4	1.75
1996	9	2	5 (56)	60 (3)	8	5	1.60
1997	10	0	7 (70)	57 (4)	10	7	1.43
1998	11	1	7 (64)	86 (6)	14	7	2.00
1999	13	0	11 (85)	91 (10)	20	11	1.82
2000	16	0	12 (75)	75 (9)	23	12	1.92
Arid Region							
1985	1	0	1 (100)	0 (0)	0	1	0.00
1986	1	0	1 (100)	100 (1)	3	1	3.00
1987	1	0	1 (100)	100 (1)	2	1	2.00
1988	1	0	1 (100)	100 (1)	2	1	2.00
1989	1	0	1 (100)	100 (1)	4	1	4.00
1990	1	0	1 (100)	100 (1)	3	1	3.00
1991	1	0	1 (100)	100 (1)	1	1	1.00
1992	3	0	3 (100)	33 (1)	2	3	0.67
1993	3	0	3 (100)	50 (1)	2	2	1.00
1994	3	0	2 (67)	50 (1)	2	2	1.00
1995	3	0	2 (67)	100 (2)	3	2	1.50
1996	4	0	3 (75)	100 (3)	8	3	2.67
1997	5	0	3 (60)	67 (2)	4	3	1.33
1998	6	0	5 (83)	100 (4)	10	4	2.50
1999	7	0	6 (86)	80 (4)	11	5	2.20
2000	7	0	4 (57)	50 (1)	2	2	1.00

[b] Reproductive success data from Anderson 1993, 1995, 1996, 1997, 1998, 2000, 2001.

Appendix G. Washington Administrative Code 232-12-297, 232-12-011 and 232-12-014.

WAC 232-12-011 Wildlife classified as protected shall not be hunted or fished.

Protected wildlife are designated into three subcategories: Threatened, sensitive, and other.
(1) Threatened species are any wildlife species native to the state of Washington that are likely to become endangered within the foreseeable future throughout a significant portion of their range within the state without cooperative management or removal of threats. Protected wildlife designated as threatened include:

Common Name	Scientific Name
western gray squirrel	*Sciurus griseus*
Steller (northern) sea lion	*Eumetopias jubatus*
North American lynx	*Lynx canadensis*
Aleutian Canada goose	*Branta canadensis leucopareia*
bald eagle	*Haliaeetus leucocephalus*
ferruginous hawk	*Buteo regalis*
marbled murrelet	*Brachyramphus marmoratus*
green sea turtle	*Chelonia mydas*
loggerhead sea turtle	*Caretta caretta*
sage grouse	*Centrocercus urophasianus*
sharp-tailed grouse	*Phasianus columbianus*

(2) Sensitive species are any wildlife species native to the state of Washington that are vulnerable or declining and are likely to become endangered or threatened in a significant portion of their range within the state without cooperative management or removal of threats. Protected wildlife designated as sensitive include:

Common Name	Scientific Name
Gray whale	*Eschrichtius robustus*
Common Loon	*Gavia immer*
Larch Mountain salamander	*Plethodon larselli*
Pygmy whitefish	*Prosopium coulteri*
Margined sculpin	*Cottus marginatus*

(3) Other protected wildlife include:

Common Name	Scientific Name
cony or pika	*Ochotona princeps*
least chipmunk	*Tamius minimus*
yellow-pine chipmunk	*Tamius amoenus*
Townsend’s chipmunk	*Tamius townsendii*
red-tailed chipmunk	*Tamius ruficaudus*
hoary marmot	*Marmota caligata*
Olympic marmot	*Marmota olympus*

Cascade golden-mantled ground squirrel	*Spermophilus saturatus*
golden-mantled ground squirrel	*Spermophilus lateralis*
Washington ground squirrel	*Spermophilus washingtoni*
red squirrel	*Tamiasciurus hudsonicus*
Douglas squirrel	*Tamiasciurus douglasii*
northern flying squirrel	*Glaucomys sabrinus*
wolverine	*Gulo gulo*
painted turtle	*Chrysemys picta*
California mountain kingsnake	*Lampropeltis zonata;*

All birds not classified as game birds, predatory birds or endangered species, or designated as threatened species or sensitive species; all bats, except when found in or immediately adjacent to a dwelling or other occupied building; all wildlife within Titlow Beach Marine Preserve Area and the conservation areas defined in chapter 220-16 WAC; mammals of the order *Cetacea*, including whales, porpoises, and mammals of the order *Pinnipedia* not otherwise classified as endangered species, or designated as threatened species or sensitive species. This section shall not apply to hair seals and sea lions which are threatening to damage or are damaging commercial fishing gear being utilized in a lawful manner or when said mammals are damaging or threatening to damage commercial fish being lawfully taken with commercial gear.

[Statutory Authority: RCW 77.12.047, 00-17-106 (Order 00-149), § 232-12-011, filed 8/16/00, effective 9/16/00. Statutory Authority: RCW 77.12.040, 77.12.010, 77.12.020. 00-10-001 (Order 00-47), § 232-12-011, filed 4/19/00, effective 5/20/00. Statutory Authority: RCW 77.12.040, 77.12.010, 77.12.020, 77.12.770, 77.12.780. 00-04-017 (Order 00-05), § 232-12-011, filed 1/24/00, effective 2/24/00. Statutory Authority: RCW 77.12.020. 98-23-013 (Order 98-232), § 232-12-011, filed 11/6/98, effective 12/7/98. Statutory Authority: RCW 77.12.040. 98-10-021 (Order 98-71), § 232-12-011, filed 4/22/98, effective 5/23/98. Statutory Authority: RCW 77.12.040 and 75.08.080. 98-06-031, § 232-12-011, filed 2/26/98, effective 5/1/98. Statutory Authority: RCW 77.12.020. 97-18-019 (Order 97-167), § 232-12-011, filed 8/25/97, effective 9/25/97. Statutory Authority: RCW 77.12.040, 77.12.020, 77.12.030 and 77.32.220. 97-12-048, § 232-12-011, filed 6/2/97, effective 7/3/97. Statutory Authority: RCW 77.12.020. 93-21-027 (Order 615), § 232-12-011, filed 10/14/93, effective 11/14/93; 90-11-065 (Order 441), § 232-12-011, filed 5/15/90, effective 6/15/90. Statutory Authority: RCW 77.12.040. 89-11-061 (Order 392), § 232-12-011, filed 5/18/89; 82-19-026 (Order 192), § 232-12-011, filed 9/9/82; 81-22-002 (Order 174), § 232-12-011, filed 10/22/81; 81-12-029 (Order 165), § 232-12-011, filed 6/1/81.]

WAC 232-12-014 Wildlife classified as endangered species. Endangered species include:

Common Name	Scientific Name
pygmy rabbit	*Brachylagus idahoensis*
fisher	*Martes pennanti*
gray wolf	*Canis lupus*
grizzly bear	*Ursus arctos*
sea otter	*Enhydra lutris*
sei whale	*Balaenoptera borealis*
fin whale	*Balaenoptera physalus*
blue whale	*Balaenoptera musculus*
humpback whale	*Megaptera novaeangliae*
black right whale	*Balaena glacialis*
sperm whale	*Physeter macrocephalus*
Columbian white-tailed deer	*Odocoileus virginianus leucurus*

woodland caribou	*Rangifer tarandus caribou*
American white pelican	*Pelecanus erythrorhynchos*
brown pelican	*Pelecanus occidentalis*
peregrine falcon	*Falco peregrinus*
sandhill crane	*Grus canadensis*
snowy plover	*Charadrius alexandrinus*
upland sandpiper	*Bartramia longicauda*
spotted owl	*Strix occidentalis*
western pond turtle	*Clemmys marmorata*
leatherback sea turtle	*Dermochelys coriacea*
Oregon spotted frog	*Rana pretiosa*
Northern leopard frog	*Rana pipiens*
Oregon silverspot butterfly	*Speyeria zerene hippolyta*
Mardon skipper	*Polites mardon*

[Statutory Authority: RCW 77.12.040, 77.12.010, 77.12.020, 77.12.770, 77.12.780. 00-04-017 (Order 00-05), § 232-12-014, filed 1/24/00, effective 2/24/00. Statutory Authority: RCW 77.12.020. 98-23-013 (Order 98-232), § 232-12-014, filed 11/6/98, effective 12/7/98; 97-18-019 (Order 97-167), § 232-12-014, filed 8/25/97, effective 9/25/97; 93-21-026 (Order 616), § 232-12-014, filed 10/14/93, effective 11/14/93. Statutory Authority: RCW 77.12.020(6). 88-05-032 (Order 305), § 232-12-014, filed 2/12/88. Statutory Authority: RCW 77.12.040. 82-19-026 (Order 192), § 232-12-014, filed 9/9/82; 81-22-002 (Order 174), § 232-12-014, filed 10/22/81; 81-12-029 (Order 165), § 232-12-014, filed 6/1/81.]

Washington Administrative Code 232-12-297.

WAC 232-12-297 Endangered, threatened, and sensitive wildlife species classification.

PURPOSE

1.1 The purpose of this rule is to identify and classify native wildlife species that have need of protection and/or management to ensure their survival as free-ranging populations in Washington and to define the process by which listing, management, recovery, and delisting of a species can be achieved. These rules are established to ensure that consistent procedures and criteria are followed when classifying wildlife as endangered, or the protected wildlife subcategories threatened or sensitive.

DEFINITIONS

For purposes of this rule, the following definitions apply:

2.1 "Classify" and all derivatives means to list or delist wildlife species to or from endangered, or to or from the protected wildlife subcategories threatened or sensitive.

2.2 "List" and all derivatives means to change the classification status of a wildlife species to endangered, threatened, or sensitive.

2.3 "Delist" and its derivatives means to change the classification of endangered, threatened, or sensitive species to a classification other than endangered, threatened, or sensitive.

2.4 "Endangered" means any wildlife species native to the state of Washington that is seriously threatened with extinction throughout all or a significant portion of its range within the state.

2.5 "Threatened" means any wildlife species native to the state of Washington that is likely to become an endangered species within the forseeable future throughout a significant portion of its range within the state without cooperative management or removal of threats.

2.6 "Sensitive" means any wildlife species native to the state of Washington that is vulnerable or declining and is likely to become endangered or threatened in a significant portion of its range within the state without cooperative management or removal of threats.

2.7 "Species" means any group of animals classified as a species or subspecies as commonly accepted by the scientific community.

2.8 "Native" means any wildlife species naturally occurring in Washington for purposes of breeding, resting, or foraging, excluding introduced species not found historically in this state.

2.9 "Significant portion of its range" means that portion of a species' range likely to be essential to the long term survival of the population in Washington.

LISTING CRITERIA

3.1 The commission shall list a wildlife species as endangered, threatened, or sensitive solely on the basis of the biological status of the species being considered, based on the preponderance of scientific data available, except as noted in section 3.4.

3.2 If a species is listed as endangered or threatened under the federal Endangered Species Act, the agency will recommend to the commission that it be listed as endangered or threatened as specified in section 9.1. If listed, the agency will proceed with development of a recovery plan pursuant to section 11.1.

3.3 Species may be listed as endangered, threatened, or sensitive only when populations are in danger of failing, declining, or are vulnerable, due to factors including but not restricted to limited numbers, disease, predation, exploitation, or habitat loss or change, pursuant to section 7.1.

3.4 Where a species of the class Insecta, based on substantial evidence, is determined to present an unreasonable risk to public health, the commission may make the determination that the species need not be listed as endangered, threatened, or sensitive.

DELISTING CRITERIA

4.1 The commission shall delist a wildlife species from endangered, threatened, or sensitive solely on the basis of the biological status of the species being considered, based on the preponderance of scientific data available.

4.2 A species may be delisted from endangered, threatened, or sensitive only when populations are no longer in danger of failing, declining, are no longer vulnerable, pursuant to section 3.3, or meet recovery plan goals, and when it no longer meets the definitions in sections 2.4, 2.5, or 2.6.

INITIATION OF LISTING PROCESS

5.1 Any one of the following events may initiate the listing process.

5.1.1 The agency determines that a species population may be in danger of failing, declining, or vulnerable, pursuant to section 3.3.

5.1.2 A petition is received at the agency from an interested person. The petition should be addressed to the director. It should set forth specific evidence and scientific data which shows that the species may be failing, declining, or vulnerable, pursuant to section 3.3. Within 60 days, the agency shall either deny the petition, stating the reasons, or initiate the classification process.

5.1.3 An emergency, as defined by the Administrative Procedure Act, chapter 34.05 RCW. The listing of any species previously classified under emergency rule shall be governed by the provisions of this section.

5.1.4 The commission requests the agency review a species of concern.

5.2 Upon initiation of the listing process the agency shall publish a public notice in the Washington Register, and notify those parties who have expressed their interest to the department, announcing the initiation of the classification process and calling for scientific information relevant to the species status report under consideration pursuant to section 7.1.

INITIATION OF DELISTING PROCESS

6.1 Any one of the following events may initiate the delisting process:

6.1.1 The agency determines that a species population may no longer be in danger of failing, declining, or vulnerable, pursuant to section 3.3.

6.1.2 The agency receives a petition from an interested person. The petition should be addressed to the director. It should set forth specific evidence and scientific data which shows that the species may no longer be failing, declining, or vulnerable, pursuant to section 3.3. Within 60 days, the agency shall either deny the petition, stating the reasons, or initiate the delisting process.

6.1.3 The commission requests the agency review a species of concern.

6.2 Upon initiation of the delisting process the agency shall publish a public notice in the Washington Register, and notify those parties who have expressed their interest to the department, announcing the initiation of the delisting process and calling for scientific information relevant to the species status report under consideration pursuant to section 7.1.

SPECIES STATUS REVIEW AND AGENCY RECOMMENDATIONS

7.1 Except in an emergency under 5.1.3 above, prior to making a classification recommendation to the commission, the agency shall prepare a preliminary species status report. The report will include a review of information relevant to the species' status in Washington and address factors affecting its status, including those given under section 3.3. The status report shall be reviewed by the public and scientific community. The status report will include, but not be limited to an analysis of:

7.1.1 Historic, current, and future species population trends.

7.1.2 Natural history, including ecological relationships (e.g., food habits, home range, habitat selection patterns).

7.1.3 Historic and current habitat trends.

7.1.4 Population demographics (e.g., survival and mortality rates, reproductive success) and their relationship to long term sustainability.

7.1.5 Historic and current species management activities.

7.2 Except in an emergency under 5.1.3 above, the agency shall prepare recommendations for species classification, based upon scientific data contained in the status report. Documents shall be prepared to determine the environmental consequences of adopting the recommendations pursuant to requirements of the State Environmental Policy Act (SEPA).

7.3 For the purpose of delisting, the status report will include a review of recovery plan goals.

PUBLIC REVIEW

8.1 Except in an emergency under 5.1.3 above, prior to making a recommendation to the commission, the agency shall provide an opportunity for interested parties to submit new scientific data relevant to the status report, classification recommendation, and any SEPA findings.

8.1.1 The agency shall allow at least 90 days for public comment.

8.1.2 The agency will hold at least one public meeting in each of its administrative regions during the public review period.

FINAL RECOMMENDATIONS AND COMMISSION ACTION

9.1 After the close of the public comment period, the agency shall complete a final status report and classification recommendation. SEPA documents will be prepared, as necessary, for the final agency recommendation for classification. The classification recommendation will be presented to the commission for action. The final species status report, agency classification recommendation, and SEPA documents will be made available to the public at least 30 days prior to the commission meeting.

9.2 Notice of the proposed commission action will be published at least 30 days prior to the commission meeting.

PERIODIC SPECIES STATUS REVIEW

10.1 The agency shall conduct a review of each endangered, threatened, or sensitive wildlife species at least every five years after the date of its listing. This review shall include an update of the species status report to determine whether the status of the species warrants its current listing status or deserves reclassification.

10.1.1 The agency shall notify any parties who have expressed their interest to the department of the periodic status review. This notice shall occur at least one year prior to end of the five year period required by section 10.1.

10.2 The status of all delisted species shall be reviewed at least once, five years following the date of delisting.

10.3 The department shall evaluate the necessity of changing the classification of the species being reviewed. The agency shall report its findings to the commission at a commission meeting. The agency shall notify the public of its findings at least 30 days prior to presenting the findings to the commission.

10.3.1 If the agency determines that new information suggests that classification of a species should be changed from its present state, the agency shall initiate classification procedures provided for in these rules starting with section 5.1.

10.3.2 If the agency determines that conditions have not changed significantly and that the classification of the species should remain unchanged, the agency shall recommend to the commission that the species being reviewed shall retain its present classification status.

10.4 Nothing in these rules shall be construed to automatically delist a species without formal commission action.

RECOVERY AND MANAGEMENT OF LISTED SPECIES

11.1 The agency shall write a recovery plan for species listed as endangered or threatened. The agency will write a management plan for species listed as sensitive. Recovery and management plans shall address the listing criteria described in sections 3.1 and 3.3, and shall include, but are not limited to:

11.1.1 Target population objectives.

11.1.2 Criteria for reclassification.

11.1.3 An implementation plan for reaching population objectives which will promote cooperative management and be sensitive to landowner needs and property rights. The plan will specify resources needed from and impacts to the department, other agencies (including federal, state, and local), tribes, landowners, and other interest groups. The plan shall consider various approaches to meeting recovery objectives including, but not limited to regulation, mitigation, acquisition, incentive, and compensation mechanisms.

11.1.4 Public education needs.

11.1.5 A species monitoring plan, which requires periodic review to allow the incorporation of new information into the status report.

11.2 Preparation of recovery and management plans will be initiated by the agency within one year after the date of listing.

11.2.1 Recovery and management plans for species listed prior to 1990 or during the five years following the adoption of these rules shall be completed within five years after the date of listing or adoption of these rules, whichever comes later. Development of recovery plans for endangered species will receive higher priority than threatened or sensitive species.

11.2.2 Recovery and management plans for species listed after five years following the adoption of these rules shall be completed within three years after the date of listing.

11.2.3 The agency will publish a notice in the Washington Register and notify any parties who have expressed interest to the department interested parties of the initiation of recovery plan development.

11.2.4 If the deadlines defined in sections 11.2.1 and 11.2.2 are not met the department shall notify the public and report the reasons for missing the deadline and the strategy for completing the plan at a commission meeting. The intent of this section is to recognize current department personnel resources are limiting and that development of recovery plans for some of the species may require significant involvement by interests outside of the department, and therefore take longer to complete.

11.3 The agency shall provide an opportunity for interested public to comment on the recovery plan and any SEPA documents.

CLASSIFICATION PROCEDURES REVIEW

12.1 The agency and an ad hoc public group with members representing a broad spectrum of interests, shall meet as needed to accomplish the following:

12.1.1 Monitor the progress of the development of recovery and management plans and status reviews, highlight problems, and make recommendations to the department and other interested parties to improve the effectiveness of these processes.

12.1.2 Review these classification procedures six years after the adoption of these rules and report its findings to the commission.

AUTHORITY

13.1 The commission has the authority to classify wildlife as endangered under RCW 77.12.020. Species classified as endangered are listed under WAC 232-12-014, as amended.

13.2 Threatened and sensitive species shall be classified as subcategories of protected wildlife. The commission has the authority to classify wildlife as protected under RCW 77.12.020. Species classified as protected are listed under WAC 232-12-011, as amended.