THE CONDOR

VOLUME 48 MAY-JUNE, 1946 NUMBER 3

THE PEREGRINE POPULATION OF WESTERN NORTH AMERICA

By RICHARD M. BOND

The breeding population of the Peregrine Falcon (Duck Hawk, *Falco peregrinus anatum*) in eastern North America has been the subject of a highly instructive paper by Hickey (1942). He was somewhat dissatisfied with his results because they were so incomplete. Nevertheless, his study is considerably more detailed than I have been able to make this one, partly because of a longer list of published notes and papers on eastern eyries and partly because he had invaluable assistance in the field from a number of active and enthusiastic students of the species.

Hickey was able to make a number of important generalizations from his data, and many of these hold for the western birds quite as well as for those of the east. It seems best, therefore, to present my material more or less in the form of a supplement to Hickey's paper rather than to repeat much that is already fully available.

This report is based partly on the literature (87 eyries) and partly on my own observations, but much more on the generous assistance of about fifty other observers. Of these, I am especially indebted to the following: Nelson Carpenter, H. W. Carriger, I. McT. Cowan, John E. Cushing, Jr., Herbert De Tracy, James B. Dixon, J. Elton Green, Ed N. Harrison, A. P. Marshall, Donald D. McLean, O. J. Murie, the late O. P. Silliman, Lewis W. Walker, and L. Zuk. I am also grateful to Philip F. Allan, J. J. Hickey, A. H. Miller, F. A. Pitelka, A. J. van Rossem, the late George Willett, and others for help with the literature, for proofreading all or part of this paper, and for valuable suggestions and advice, and to Homer F. Snow for permission to use one of his photographs (fig. 21).

In order not to overlap the territory covered by Hickey, I have limited this paper to Alaska, Yukon Territory, British Columbia and those parts of the United States and Mexico west of the continental divide.

BREEDING DISTRIBUTION

The present known breeding range of *Falco peregrinus* in western North America extends from the Rockies west through the Aleutians and from the coast of Alaska east of Point Barrow on the Arctic Ocean at 70° North Latitude (Bent, 1938; and skin in L. B. Bishop collection), south at least to Cape San Lucas in Baja California and Isabel Island off the coast of Nayarit (three pairs, April, 1940, reported orally by Ed N. Harrison). This range extends considerably north of that given in the 1931 A.O.U. Checklist ("Norton Sound") and also considerably farther south ("central Lower California"). The north-south range covers almost 50° of latitude and is at present all ascribed to the subspecies *anatum*.

Curiously, I have found no published reports of the Peregrine on Guadalupe Island, nor has L. W. Walker, in the course of half a dozen visits, ever seen one there (oral

communication). The island seems ideally suited to Peregrines, and although about 135 miles from the mainland of Baja California, it is well within flight range of this bird.

The Peale Falcon (*F. p. pealei*) presents a problem of breeding distribution that needs elucidation. The A.O.U. Check-list (1931:75) gives the breeding range as the "Queen Charlotte (?), Aleutian and Commander islands." Dawson (1908), using sight

Fig. 21. Peregrine protesting at nest in northern California. Photograph by Homer F. Snow.

records, extended the range of this race down the coast as far as the Carrol Islets off western Washington, although he (Dawson and Bowles, 1909) calls birds on the San Juan Islands *anatum*; and Stanley G. Jewett tells me he would not be surprised to find *pealei* breeding as far south as the coast of northern Oregon since his collection contains a number of immature Peale Falcons from there, all taken somewhat after the breeding season, however. The longest stretch of shoreline unsuitable for breeding Peregrines seems to be that from north of Grays Harbor, Washington, to Tillamook Head, Oregon, a distance of approximately 100 miles; I should first look there for a possible break between the subspecies.

How far inland the Peale Falcon breeds is also unknown, although according to J. Dan Webster (oral communication) in the Sitka region of Alaska the birds nest only on the outer capes and islands and apparently never on the cliffs near the heads of the

sounds or fjords. It is also unknown how far the range of the subspecies extends up the Bering Sea coast of Alaska.

As Hickey found, the same site was often referred to by my various informants by different names. In some instances this difficulty was solved by having the site marked on U.S.G.S. quadrangle maps or by other means. A few uncertain records were thus eliminated; I may have failed to list an eyrie rather than risk reporting it twice. A feature by which my records seem to differ from those of Hickey is that a large majority of mine are based on a single visit by an observer and their subsequent history and present status are entirely unknown. Some of these western records are very old, but I have included them with the more recent records.

Table 1

Number of Reported Sites	
Alaska	78
Canada	67
United States	136
Mexico	47
Total	328

Of the sites tabulated, a third, or 109, are in the range assigned to *pealei* in the 1931 A.O.U. Check-list. The fact that the total is smaller than that given by Hickey (408) for eastern North America is almost certainly due to the less intensive field work in the territory covered by my report, rather than to any actual differences in the populations.

FACTORS AFFECTING BREEDING, DISTRIBUTION, AND DENSITY

1. *Cliffs.*—Hickey's conclusion that cliffs are the all-important factor in determining the distribution of breeding Peregrines, while largely true, seems to be an over-simplification when one tries to apply it in the west. There are literally hundreds of cliffs in the west that would be "second class" or better in the east, but that have no Peregrines on them and, so far as is known, never have had. There are other areas, more subject to human disturbance, where "second" and even "third" class cliffs are regularly occupied. A rough indication of the apparent areas of "high" (less than 2,000 square miles to the pair) population are shown on the map (fig. 22), although parts of the "low" (more than 20,000 square miles to the pair) area may really only be unexplored. Even in the area of "dense" population, there are cliffs that belie Hickey's generalization, as for example, the great cliff near Santa Barbara, California, where W. L. Dawson collected for a number of years, but which despite its "first class" appearance has been uninhabited since 1927, although second and third class cliffs within sight of it have been occupied off and on since that date. Some of the most magnificent cliffs in the west are in the Sierra Nevada and Cascade Range, mostly near or above timberline (6,000 to 11,000 feet), and so far as I know, very few are reported to be occupied by breeding Peregrines. Food in such areas is not over-abundant, but Leucostictes (*Leucosticte* sp.), Clark Nutcrackers (*Nucifraga columbiana*) and other high-country birds should be sufficient for at least an occasional pair. Also, so far as I can discover, the tremendous cliffs of the Grand Canyon have not been reported to harbor any eyries, although they have not been fully explored by any means and an adult carrying prey was seen on June 22, 1932, by Randolph Jenks in Havasu Canyon (letter from A. R. Phillips to Hickey).

Hickey (page 196) defines "*first-class Peregine cliffs*" as being "*extremely high,* often rather long, usually overlooking water, and generally dominating the surrounding

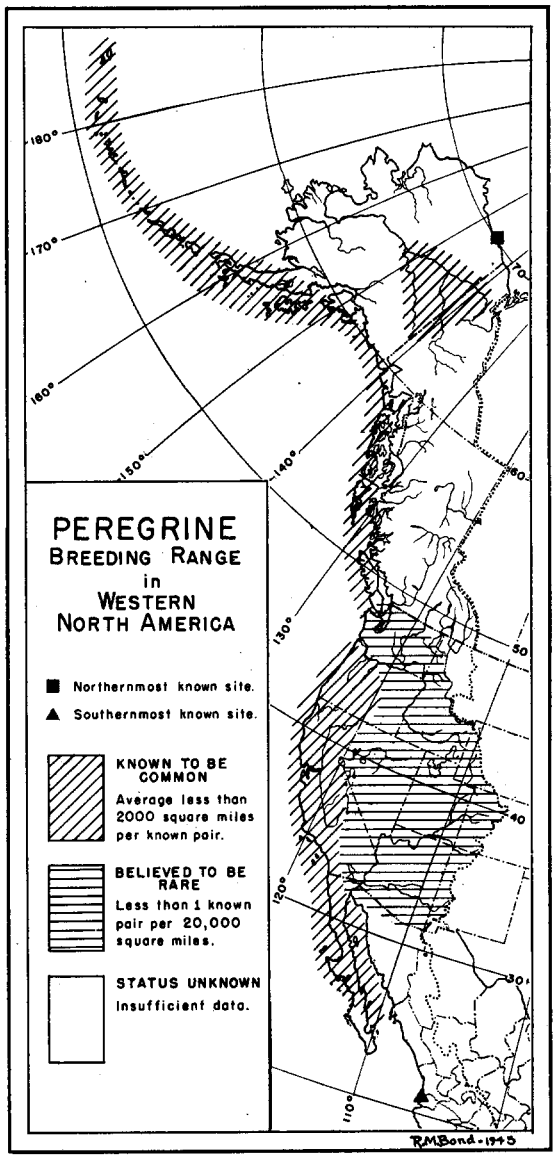

Fig. 22. Breeding distribution of Peregrines in western North America.

countryside. These so attract this species in the breeding season that Peregrines will apparently occupy them *no matter how many 'nests' are broken up or adult birds destroyed.*" "*Second-class Peregrine cliffs* differ from the above merely in their dimensions. Here, the birds can withstand considerable molestation. Death of one bird does not necessarily cause the abandonment of the eyries, but death of both adults may leave the cliff without birds for an indefinite time." "*Third-class Peregrine cliffs* are small, not very high, although they may be far up a long slope, and they may or may not

overlook water. They may be regarded as the marginal niches in Peregrine ecology."

In the west, a fourth type of natural site must be recognized, namely, *small islands*. These may not have any cliffs at all (fig. 23) or very low ones, and yet be as "magnetic" as first- or second-class cliffs. These are usually in the sea, although they are also found in large lakes. This type of site is especially important to *pealei* (McCabe and McCabe, 1937; Green, 1916), although by no means restricted to this subspecies. So far as I know, such islands are always fairly small, and they are without mammalian predators and without ground squirrels or rats.

As to *man-made structures*, no western Peregrines are known to nest on buildings, but the use of a barrel-top in a marsh reported by de Groot (1927) seems to be authentic,

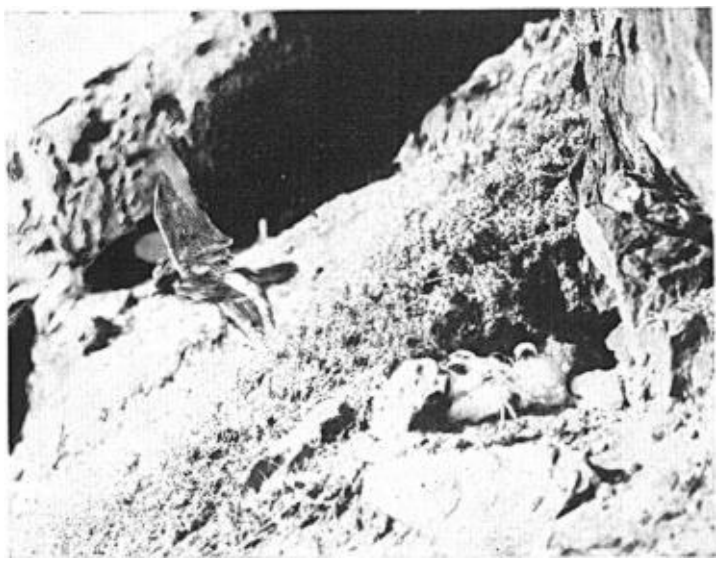

Fig. 23. Eyrie at top of talus slope on a small island in Mexico. The nest can be reached easily without climbing. Photograph by Lewis W. Walker.

and there are records of nests on an abandoned oil derrick (personal observation) and on a platform of a power pole (D. D. McLean, oral communication).

2. *Egg site.*—The requirements outlined by Hickey are perhaps more frequently met in the west by the appropriation of the nest of a Raven (*Corvus corax*) (fig. 24), Red-tail (*Buteo jamaicensis*) or other species that builds nests of sticks, than in the east where such birds are rarer. Several Peregrine sites in the west are known where the cliff would be entirely uninhabitable except for the architectural ability of some other species. At least in the southern part of its range, *pealei* seems to prefer to nest under the roots of a spruce tree at the top of a low cliff (McCabe and McCabe, 1937; Green, 1916).

3. *Territorial competition.*—The most closely placed mainland eyries of *anatum* I have seen are two found in 1936 in San Benito County, California, where a deep canyon cuts through a high ridge. One pair nested in a pothole near the top of a high, south-facing cliff and the other pair on an east-facing ledge on a cliff on the main ridge about a mile south of the first pair. I am not sure that the nest sites were in view of each other, but if not, members of the second pair could certainly be seen by the first when they

were in the air only 20 or 30 feet in front of the nesting ledge. Moreover, they spent much of their time on a cliff directly across the canyon from the first pair and only about 600 yards from the nest of the latter. I never saw members of either of these two pairs attack the other. However, the nest of the second pair was once approached by a strange young female that was about half molted into adult plumage, and the resident male drove her off, both birds going through exactly the actions described by Hickey (1942:181) even to the direction taken by the female in leaving!

Although, as Hickey (1942:180) states, "The entire foraging area is apparently not defended," I suspect that the birds do defend some sort of a territory, else it would

Fig. 24. Young Peregrines in a stick nest built by Ravens. Photograph by Lewis W. Walker.

be difficult to account for the fact that pairs are well spaced even on apparently ideal cliffs with innumerable suitable potholes and enormous supplies of food.

An interesting instance of territorial competition is reported by L. W. Walker (letter). In 1939 and 1940 two nests were found within 1000 feet of each other on a Mexican island, but only one male was in evidence. He screamed at a disturbance at either eyrie and was not threatened by either female as he passed from one to the other. The females fought each other vigorously whenever one came close to the nest of the other.

L. Zuk (letter, 1946) found that in southern California the adults of all the pairs he observed remained attached to the nest site through summer, fall and as late in the winter as his observations went. They were present on the cliff at dawn on practically every visit, and some pairs spent several hours there later in the day. The proprietary

attitude of the birds remained strong well after the nesting season. The female of one pair stooped at Zuk on July 30 when he visited the cliff, and the female of another pair struck at a trained Peregrine that was placed below the nesting cliff on December 31. Both sexes protested vocally at his visits, no matter what the date.

Peale Falcons appear to be less solitary. Brooks (1921:154) states that "sometimes the yelping of three different broods of young birds could be heard from one stand." S. J. Darcus, in a letter (1935) to W. E. Griffee, says of the birds on the island of which Brooks was writing: "There were two nests within 100 yards of my camp on either side."

4. *Competition with other species.*—I have seen nesting Peregrines strike Turkey Vultures (*Cathartes aura*), Horned Owls (*Bubo virginianus*) (Dixon and Bond, 1937) and strike at Golden Eagles (*Aquila chrysaëtos*), Red-tails, Ravens, Barn Owls (*Tyto alba*), Ferruginous Rough-legs (*Buteo regalis*), and Cooper Hawks (*Accipiter cooperii*). Osgood (1901:43) tells of a pair that "had daily altercations with a bald eagle [*Haliaeetus leucocephalus*]." But obviously the falcons were affecting the other birds—not vice versa except in the case reported by Dixon (1937) in which Golden Eagles drove off the Peregrines. It is my impression that most of this activity occurs when the Peregrines are disturbed by man or some other "foreign" agency, and that individual Peregrines vary greatly in their touchiness as regards other species. As pointed out above, some of the other predatory birds furnish nesting sites for the falcons.

The one species the relationship of which with the Peregrine I believe is not settled is the Prairie Falcon (*Falco mexicanus*). The two species may nest peaceably only a few hundred feet apart. The Prairie Falcon often nests in places that would never be used by a Peregrine, and competition for food can not be very serious (Bond, 1936*a*). But the Prairie Falcon is the one bird of the western United States that is an equal for the Peregrine when they do engage in battle. According to Ray Salt (letter) the Prairie Falcon may actually be dominant over the Peregrine in aerial conflict. A number of instances are known in which sites long occupied by *peregrinus* have been taken over by *mexicanus* (Allan Brooks, A. P. Marshall, letters). Although the reverse is sometimes observed (Marshall, Truesdale, oral communications), the possibility is not eliminated of serious competition between these two species, especially for high cliffs in which there is only a single good pothole or ledge. Similar competition may occur with the Gyrfalcon (*Falco rusticolus*) in the far north, but on this point I have no information.

5. *Biomes and life-zones.*—There appears to be no correlation whatever between the distribution of eyries and any of the life-zones. The known area of rarity (see map) includes much of the Palouse-prairie climax, but the correspondence is by no means exact.

6. *Altitude.*—Whether because of food supply, atmospheric conditions, or other factors, Peregrines are rarely found to nest above about 5,000 feet elevation. There are exceptions, however, and a few pairs are known to nest up to 10,000 feet (Donald D. McLean, letter). In the Sierra Nevada, Rocky Mountains, and elsewhere in the west, there are tremendous cliffs, especially above timberline, that are devoid of Peregrines, although Golden Eagles are not rare and Prairie Falcons may be quite common up to 6,000 or 7,000 feet in suitable localities and sometimes nest considerably higher. At about 7,000 feet, trained Prairie Falcons, with their much greater surface-to-weight ratio clearly outfly trained Peregrines that are their superiors at sea level (H. Webster, oral communication, and personal observations).

7. *Intermountain area.*—In the area between the Rockies and the Sierra-Cascade mountain chain, the known density of nesting Peregrines is extremely low, and this surely is not due simply to lack of knowledge. There appears to be only a single authentic

nesting record for the whole state of Nevada (Wolfe, 1937). I know of five records for eastern Oregon, but none for eastern Washington or for the Snake River valley of Idaho. Nor is this a matter of lack of nesting sites, for cliffs of every description abound. In this area, which is shown in figure 22 to include all of Washington except the northern coast, there is less than one known nest site per 20,000 square miles, whereas in the areas where Peregrines are mapped as being "common," there is slightly more than one known pair per 2,000 square miles. Possible factors influencing population density are:

a. Competition with the Prairie Falcon in the center of abundance of the latter. (See item 4.)

b. Altitude. A good deal of this interior country is at elevations above 5,000 feet. (See item 6.)

c. Water. Water is scarce in the Great Basin, and almost all of the Peregrine nests known to me anywhere are within one-half mile of at least enough water for bathing. The Prairie Falcon is less dependent on water, being habitually a dust bather. One eastern Oregon nest, mentioned by Gabrielson and Jewett (1940), is eleven miles from the nearest water, at least in dry years, but the next greatest known distance is about three miles, and the site was within one mile of water before Lower Klamath Lake was drained.

d. Climate. It is possible that dryness and heat are harmful or disagreeable to the Peregrine, but at least two pairs nest along the lower Colorado River in California and two or three nest in the extreme northeastern part of the state; some in eastern Oregon are in areas equally hot and dry in the breeding season.

8. *Food supply.*—As in the east, an especially good food supply may be an attraction, but Peregrines nest in places that seem to be about as low in prey as are most areas without any falcons.

POPULATION FLUCTUATIONS

A. *Age of present nesting sites.*—In California, collectors have taken eggs over a longer period and more regularly than in other parts of the west. Herbert De Tracy (letter, 1941) writes of a site in Monterey County occupied "for 50 years to my knowledge," although he did not collect there until 1902 and took his last set there on April 6, 1937, after which the birds moved about half a mile and nested under a ten-foot overhang. Nelson Carpenter told me of a site in San Diego County collected for 29 consecutive years (up to about 1930). A. P. Marshall (letter, 1937) writes: "On April 8th, 1932, a friend of mine offered to show me a nesting site from which he had collected a set of four eggs on March 26th., 1896 (set now in my collection) and imagine my surprize when a shot from my pistol brought forth Mr. Duck Hawk . . . . A nice set of four eggs was secured . . . . Thirty-six years had passed since this site had been visited and it was still in use . . . . Some .22 artist killed [the birds] last year. I visited the site a few days ago but found no birds, however, a pair of birds were located about two miles south of this site and I'm sure are ready to nest." Sharp (1907) says that one "pair" in southern California occupied the same cliff 20 years to his knowledge and "were old residents before that." This is the site taken over by Golden Eagles (Dixon, 1937) in 1916; thus, the cliff was occupied at least 30 years. J. B. Dixon told me the nest mentioned by his brother (J. S. Dixon, 1906) was in use as late as 1940, although it had been occupied by Prairie Falcons in some years.

There is no reason to suppose that many of the western eyries have not been occupied continuously for far longer than the records show.

B. *Deserted eyries.*—There are too many cases of eyries being "deserted" and then reoccupied after a year or two, to warrant acceptance of reports of desertion based on only a single visit. For example, according to Marshall (letter, 1937), "The pair on

. . . have nested eight consecutive years to my knowledge." In 1939, some quarrying was done on the cliff, and during that year the birds were absent; but they returned to nest in 1940 when the disturbance abated. Moreover, there is quite a number of instances in which it appears that a pair moves about erratically among several "third class" cliffs, to use Hickey's term, any one of which may be used and then "deserted" for many years although a "new" site a mile or two or three away is occupied the next year, apparently by the same birds. Eleven sites definitely deserted together with what is known of them are listed in table 2. Causes of desertion are as follows: Numbers 1

Table 2

Deserted Eyries

Number	Site	Class	Last year of known use
1	Sea cliff (earth)	2nd	1932 (about)
2	Sea cliff (earth)	2nd	1930 (about)
3	Sandstone cliff (inland)	2nd	1934
4	Rock sea cliff	2nd	1929
5	Lava cliff	1st	1936
6	Rock cliff	2nd	1935
7	Sandstone cliff	1st	1932 (about)
8	Sandstone cliff	1st	1929
9	Rock cliff	1st	1916
10	Rock cliff	1st	1926
11	Rock cliff	?	1887
12	Rock cliff	2nd	1930 (about)
13	Granite cliff	1st	?
14	Basalt cliff	2nd	1915-20

and 2, highway built close to cliff edge, beach much used. Number 3, unknown; occupied by Prairie Falcon most years since 1935. Number 4, "location where formerly nested now a sort of Sunday holiday location and usual bunch of guns" (Carriger, letter, 1941). Number 5, see Dixon and Bond (1936), Bond (1937); "There is a trap shooting club against part of the [cliff] and fewer hawks and owls than I have ever seen there. . . . I found no falcon nests there" (L. L. Schramm, letter, 1940). Number 6, cause unknown. Number 7, "Sunday picnicking and shooting" (Truesdale, oral communication). Number 8, cause unknown. Number 9, driven off by Golden Eagles (J. B. Dixon, 1937). Number 10, Dawson's site near Santa Barbara; cause of desertion unknown. Number 11, Mearns (1890); not present in 1939 according to a letter from Mrs. Earl Jackson to Hickey; cause and date of desertion unknown; I have not seen this cliff and do not know how Hickey would classify it. Number 12, "Shot out?" (J. B. Dixon, oral communication). Number 13, cause and date of desertion unknown. Number 14, deserted shortly after a road, much used by hunters, was built under the cliff.

Cowan (letter, 1939) and Brooks (oral communication) state that several sites in the Okanagan Valley in British Columbia, formerly occupied by Peregrines, are now used by Prairie Falcons, but I have no further data on these.

In addition, there have been three desertions which, it is hoped, are temporary and which were caused by operations of the armed forces. Two of these are on sea cliffs almost directly under coast artillery or AA batteries, and the third cliff is used as the back-stop for a small-arms range. It is not known if any of the birds was killed. Two of these pairs reoccupied the nesting cliffs in the summer of 1945, although they are not known to have nested (Zuk, oral communication).

C. *Newly used eyries.*—I know of only one newly occupied eyrie. This is a second-class conglomerate cliff where Prairie Falcons had long nested (Marshall, oral com-

munication; Bond, 1936*b*). When Dr. Marshall went to collect these in 1939, he found the cliff in possession of a pair of Peregrines which have occupied it each year that it has been visited since.

There are a good many records of third-class cliffs being newly occupied, but these cases seem to be the consequence of the "desertions" of the third-class cliffs as already described.

D. *Future of the Peregrine in the west.*—The constantly increasing human population west of the Rockies cannot do other than cause a decrease in the Peregrine population to some extent. The increasing numbers of hunters and of others with guns will certainly be too much for the more vulnerable pairs, especially when it is remembered that they are not protected by state or national law anywhere in this great area. In many places, the very cliffs that attract the birds also attract picnickers with their noise and disturbance, and frequently with their .22's. At the same time, the Peregrine is tenacious, is not easy to shoot and, after reaching adulthood, is usually very wary. The ability of Peregrines to maintain themselves in Massachusetts and around New York City speaks well for their future in the younger west. Moreover quite a number nest in state and national parks and monuments where they are subject to little or no molestation, and many others nest and feed in areas where they are very nearly impregnable.

FACTORS AFFECTING SURVIVAL

A. *Eggs and young.* 1. *Clutch size.*—I have not made any exhaustive search for clutch records. A few examples which have been recorded are summarized in table 3.

Table 3

Clutch Size

Number of eggs	*pealei*	Alaska and Canada	U.S. except southern California	Southern California	Mexico	Total
1					1	1
2				2	3	5
3			3	7	8	18
4	6	4	11	14	10	45
5	2	1	3	1	1	8
Total	8	5	17	24	23	77
Average	4.50	4.20	4.00	3.58	3.30	3.70

Marshall (letter, 1937) says: "From personal observations of local birds [southern central California] I would say four eggs constitutes the usual compliment of 80 per cent of my records, the rest but three eggs. . . . Certain females will invariably lay four eggs, others but three, and I suppose some five or more."

Carriger (letter, 1941) states: "From what information I have [from central California], four eggs is the usual number, occasionally three or five; apparently a bird that lays five eggs will continue to do so year after year; apparently this does not follow with one laying three." In this connection, several egg collectors have told me they thought first-year adults often laid one egg less in their first nesting season than in subsequent years. This might explain Carriger's findings in the case of three-egg sets.

Nelson Carpenter told me (oral communication, 1939) that sets of two eggs are much commoner in Baja California than they are in California. L. W. Walker and J. E. Green (oral communication, 1939) offered no exact figures, but said they shared Carpenter's impression. Willett (1917) and Green (1916) both give four eggs as the normal complement of *pealei*, although they do not list any specific sets.

This is substantially the reverse of the trend shown by Hickey's (1942:187) table 3 for eastern North America, which shows increasingly large clutches from the Arctic to the United States. However, my records of Arctic birds and those of *pealei* are too few to be dependable.

One doubt about my figures, and about those of Hickey, is that most of them are taken from sets in various collections. Egg collectors, like other humans, are attracted by the unusual, and their take probably represents a certain amount of deviation from the true average, a deviation which may well be significant.

2. *Second clutches and egg collectors.*—I have many records of cliffs visited after the first set of eggs was taken, and it appears certain that a considerable majority of the pairs lay a second set if the first is taken. However, the observer has seldom bothered to climb to the nest when he did not mean to collect, and records of the number of eggs in the second set are available only in nine instances. The size of the first and second clutches, respectively, in the same nest in the same season in these instances are as follows: 5-3, 5-3, 4-4, 4-4, 3-3, 3-3, 3-3, 3-3 and 3-3. Incubation of the second set ordinarily began within 30 days of the time the first set was collected. Green (1916) says of *pealei* that if the eggs are taken fresh, a second set is laid in about ten days, but if incubation is advanced, the second set is not produced for about three weeks.

J. B. Dixon told me (1946) of a nest found by him and J. S. Dixon in 1902 which was visited periodically (though not every year) through 1931. On every visit there were three light-colored eggs. These were never collected, but Mr. Dixon believed them to have been the product of a single female because of their being laid each year on approximately the same date, because of there always being three eggs, and because of their similarity in pattern and color. In 1932 this eyrie was visited at the usual time and found to contain four young. In 1933 the site was visited about a month earlier than usual, and four dark, well marked eggs were collected. A second set of four was soon laid, and out of curiosity also collected. Still later in the season a third set of four was taken. The female then laid a fourth set, but by that time the weather was so hot that the cliff was not climbed again, so the number of eggs was not determined. All twelve eggs taken were fertile.

In the time since Peregrines were first discovered nesting in the west, several hundred sets of eggs must have been collected. Some of these birds failed to lay a second clutch, and probably in some instances second clutches were also taken. This sort of molestation has probably caused desertion of some of the less favorable cliffs. All in all, however, I must agree with Hickey that egg collectors have not been seriously detrimental to the Peregrine. Although there are certainly more active collectors in the west than in the east, their numbers as in the east have declined markedly in recent years.

3. *Nesting success and nest losses.*—Hickey (1942:188) concludes that "about one egg in every set fails to hatch." There are certainly cases of infertile or addled eggs in the west (see Willett, 1921, for example), but such data as I have fail to show a loss approaching 25 per cent from this cause. It certainly is not true of the nest reported by Dixon in the preceding section. On the other hand, I have several records of the loss of the last hatched fledgling, especially in the first few days of life. My unsupported guess is that this loss is commoner when the last-hatched birds is a male, and therefore small, and commoner when the number of eggs is five than when it is four or three (for a case, see McCabe and McCabe, 1937). There are also cases of pairs that apparently failed to lay at all (personal observations). Eggs are also destroyed by enemies other than man. J. B. Dixon (oral communication) reports a nest in San Diego County, California, that can be looked into but not reached by man; the eggs were destroyed in 1940 by

some unknown agent. He also tells me of an eagle alighting on a Peregrine nest and breaking the eggs either by accident or on purpose.

Another cause of nest failure is exemplified by a Mexican eyrie visited by Walker (oral communication) in which for at least three years all or most of the young were never able to fly because of abnormal feather growth. One nestling female had normal wings, but her tail was in continuous molt (in captivity) for over a year. Two young males had at all times so many missing primaries and secondaries that they never flew, and the one on exhibition in the San Diego Zoo had great difficulty in reaching a low perch. It was permanently in a state similar to that of a mallard in the eclipse plumage.

Green (1916:475-476) says the Haida Indians believe that "the best way to bring a west wind is to visit an eyrie and hurl the eggs or young to the west into the sea, and for an east wind to go to the other side of the island." These Indians have dwindled to a remnant of their former numbers, and the motor boat has displaced the dugout sailing canoe, so perhaps this cause of nest destruction no longer operates.

4. *Falconry and pet-keeping.*—I believe I know of most of the Peregrines that have been taken from the nest by falconers, or would-be falconers, at least since 1935. During that period I learned of eight nests that had been robbed, some in more than one year, for a total of less than 25 fledglings. Of these, one at least escaped in full health and under the most ideal conditions for survival. One was shot within a few yards of its protesting owner; one escaped and was shot a few days later; two died in the hands of "trainers"; four died in zoos; and of the rest I have no knowledge. So far, it does not appear that this has been a very serious drain on the population. The reader is referred to Spofford's (1945) excellent paper on this subject.

I know of three Peregrines acquired by falconers after they left the nest. One individual was found shot during the duck season; it escaped after it was nursed back to health, but before it was fully trained. The other two birds were trapped as adults, but no regular trapping of migrating Peregrines is practiced in the west.

B. *Mortality after leaving the nest.* 1. *Causes of death.*—As is true of most birds, the majority of Peregrines that are fledged die in their first year. Hickey (1942:192) states that "Man is the adult Peregrine's worst enemy." This is doubtless true if first-year birds are excluded. I suspect, however, that this latter group suffers more seriously from other causes, although from what, I do not know—perhaps starvation or disease. Certainly man plays a prominent part in reducing their numbers, but I cannot believe that gunners every year kill a number that must nearly equal the whole breeding population, or even a major part of it. Surely the forces that kept the species in equilibrium in the days before the white man must still operate, particularly in those parts of the west in which gunners are rare as in the Aleutians, Baja California, and much of the Great Basin region where the birds are not rare in fall and early winter.

One cause of death not mentioned by Hickey is botulism. This disease struck Tule Lake, California, in the fall of 1937 (Bond, 1939) and two first-year Peregrines that became diseased from eating sick ducks were run down on foot by CCC boys. They would doubtless have died or have been killed by some carnivore, even if humans had not found them. Adults present in the same area and skillful enough to take healthy prey apparently did not suffer. This disease may be of considerable importance at least in some years.

L. W. Walker states (letter, 1946) that "in late May or early June [on a Mexican island where two or three pairs nest] an adult [Peregrine] was seen to knock a young bird into the surf and probable death." The young bird was not seen again after striking

the water. Walker interprets the incident as defense of territory by the adult against a bird from another nest.

Spring records of Peregrines in the juvenal plumage or undergoing the first molt are extremely rare. I have seen only one such bird in life (mentioned above), and Hickey (1942) refers to five.

2. *Life expectancy.*—If all Peregrines shot by all collectors were skinned, and if old adults were no more wary than juveniles, it should be possible to calculate the life expectancy from museum collections. I have done this for the Sparrow Hawk in the west (Bond, 1942) but have not considered it worth trying for the Peregrine. However, for what it is worth, the Museum of Vertebrate Zoology contains 25 skins of *anatum* and *pealei*; of these only five are adults, and one is molting into adult plumage. There is one other such specimen in the Dickey Collection.

Carpenter (oral communication, 1939) tells me that evidence from the eggs taken from the same eyrie for 29 consecutive years show only three females to have been present. De Tracy (letter, 1941) records the same female for five years, but he did not collect at the site again until after a lapse of 29 years when there was another female present. If the nest reported by J. B. Dixon (discussed above) actually had only one female from 1902 to 1931, inclusive, this must be something of a record. Since the eggs were never collected, however, the point cannot be determined by direct comparison of the sets.

ACTUAL SIZE OF THE TOTAL POPULATION

The total size of the breeding population of western North America may be estimated at 750 pairs (including *pealei*) of which somewhat less than half are in the United States. As anyone who has studied the bird with any care will realize, this is a gloriously wild guess, but I am sure the actual population is more than twice the known population (328), and I would be surprised if it should be much over five times that, or 1500. If these beliefs are correct, my estimate would be well within the range of error common to estimates for big game populations.

EFFECT OF THE PEREGRINE ON OTHER WILDLIFE

1. *Food.*—Peregrines undoubtedly can and probably sometimes do kill and eat practically any bird that is reasonably near their own size. Major Brooks told me of seeing a Peregrine swoop at a Black Brant (*Branta bernicla nigricans*) and break its wing, although the falcon was driven off before completing the kill. L. W. Walker reports (oral communication) a Peregrine's killing a wobbly pelican (*Pelecanus occidentalis*) which was evidently on a premature flight induced by the presence of humans. Especially when the young are small, the parents commonly bring them Horned Larks (*Otocoris alpestris*), House Finches (*Carpodacus mexicanus*), blackbirds (*Euphagus* sp.), bluebirds (*Sialia* sp.) and similarly small passerines. Stager (1941) reports Peregrines taking bats (*Tadarida mexicana*) in Texas; and Bond (1936*c*) has reported the eating of a brush rabbit (*Sylvilagus bachmani*). Major Brooks has told me of a recently fledged Peale Falcon on an island off the British Columbian coast eating the huge slugs (*Ariolimax*) that are native there.

Western Peregrines also kill ducks on occasion, and I have seen them take individuals of several species, including Green-winged Teal (*Anas carolinensis*), Gadwall (*Chaulelasmus streperus*) and Shoveller (*Spatula clypeata*), and I have found remains of Mallard (*Anas platyrhynchos*), and Ruddy Duck (*Erismatura jamaicensis*) at nest sites. I do not know, however, of a single Peregrine that has used ducks as its main food, even for short periods, with the exception of two or three in immature plumage that

were living on cripples during the hunting season and those observed by the critical eye of Major Brooks and reported by him to me orally. Crippled birds, for some reason, seem to hold a fascination for Peregrines, and devices used by falconers for capturing falcons are usually baited with a tethered (hence apparently disabled) pigeon, to which the Peregrines are frequently attracted even though their crops are already as full as possible.

Although the extraordinary powers of flight of the Peregrine perhaps allow it to indulge in gustatory fancies that less skillful hunters cannot afford, its usual food consists of birds of moderate size and speed and of little or no game value. In Alaska, on the Yukon, Osgood and Bishop (1900:74) report their feeding on "marsh hawks [*Circus cyaneus*], Alaska jays [*Perisoreus canadensis*], white-winged crossbills [*Loxia leucoptera*], intermediate sparrows [*Zonotrichia leucophrys*], and varied thrushes [*Ixoreus naevius*]." Peale Falcons are said to feed on Ancient Murrelets (*Synthliboramphus antiquus*) (Green, 1916; Heath, 1915), on puffins, auklets and murrelets (Willett, 1915), on Rhinoceros Auklets (*Cerorhinca monocerata*) and Cassin Auklets (*Ptychoramphus aleuticus*) (McCabe and McCabe, 1937), or on Ancient Murrelets, Marbled Murrelets (*Brachyramphus marmoratus*) and Cassin Auklets (Darcus, letter to Griffee, 1935).

Farther south along the coast in Oregon, shorebirds, and sometimes nestling murres (*Uria aalge*), are standard prey of the Peregrine (Stanley G. Jewett, oral communication and personal observations) as well as Cassin Auklets (personal observations). In California, on the coast of Monterey County, a farmer told me the Peregrines were known as "Pigeon Hawks" because of their taking Band-tailed Pigeons (*Columba fasciata*) when the latter fed in the open grain fields. He also stated that the falcons could not catch the pigeons in the timber, and most of the time lived on "sea birds." From a locality a few miles farther south, Marshall (letter) reports that "young cormorants furnish the bulk of the food for the young," and that non-breeding phalaropes also receive "quite a little attention" in summer. Marshall states further that in the fall and winter Peregrines take crippled and winged ducks, and that Coots (*Fulica americana*), where present, are taken the year around. On the southern California coast, I have reported Coots and Horned Grebes (*Colymbus auritus*) as prey (Bond, 1936*c*), and I have seen the falcons capture Cassin Auklets, nestling cormorants (*Phalacrocorax auritus*), a Black Oyster-catcher (*Haematopus bachmanii*), and a Pigeon Guillemot (*Cepphus columba*).

Still farther south in California, L. Zuk (letter) reports shorebirds to be almost the sole food of three of the four pairs on which he made observations in the summer and fall of 1945. A fourth pair, in addition to eating shorebirds, raided a neighboring city for pigeons (*Columba livia*). This is the only far western pair that I know of that makes regular use of this food, although there are many records of Peregrines in the east and in Europe that make city pigeons their staple diet.

Off the coast of Mexico, Howell (1910, 1912) tells of Peregrines killing murrelets, auklets and petrels. Kaeding (1905) says they breed commonly on all islands where Cassin Auklets breed. Lamb (1927) speaks of their living largely on Black-vented Shearwaters (*Puffinus opisthomelas*), on a group of Mexican islands.

In interior British Columbia, J. A. Munro told me the Coot is the commonest prey. The same species furnished most of the food for one family of Peregrines in eastern Oregon, according to Stanley G. Jewett (oral communication).

In the Sacramento-San Joaquin Valley in California, I have seen Peregrines capture (in winter) nearly equal numbers of crippled ducks and healthy Coots. I never happen

to have seen any other kind of prey taken in that region and at that season.

Practically the entire population of Peale Falcons is outside the range of game ducks and the same is true of probably 75 per cent of the Mexican pairs of *anatum*. Furthermore, probably not over half of the pairs of *anatum* of the western United States and Canada live where they can do much damage to ducks, and even these seem to prefer coots and shorebirds. When these facts are considered and when it is noted that the figure for ducks given me by the Flyway Biologist of the Fish and Wildlife Service in 1945 is "close to 5,000,000" in the Pacific flyway, it appears that the "Duck Hawk" cannot be a very serious drain on the duck population.

2. *Fear.*—I have heard it said that a breeding or winter-resident Peregrine will frighten away the ducks (or other game birds) from its locality. As is well known, birds pursued by a hawk give every evidence of extreme fear, but they seem to recover their normal behavior within five or ten minutes, and I have seen a flock of Sanderlings in Ventura County, California, resume feeding within thirty seconds after one of their number was taken by a Peregrine. The ducks at the Santa Barbara Refuge showed only momentary disturbance when the wintering Peregrine stooped over them for his daily Coot, and they certainly were as abundant as usual (Bond, 1936*c*).

RECOMMENDATIONS

Hickey offers a number of recommendations at the close of his article, and they are good ones, but few of them are applicable to the west, where many of the Peregrine cliffs are on public land and where no state or province protects the bird. My only suggestions are as follows:

1. To second his plea that the name "Duck Hawk" be abandoned as inaccurate and prejudicial to the species, and that "American Peregrine Falcon" or Peregrine Falcon" be used as in Canada.

2. To urge continued efforts to educate the public as to the rarity, reputation, and harmlessness (at least as a species), looking to the day when enforceable laws can be passed for its protection.

3. That authors and editors take care not to publish the location of an occupied eyrie.

4. That further studies by means of banding as well as observation be undertaken.

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