OCCURRENCE PATTERNS OF PEREGRINE FALCONS ON SOUTHEAST FARALLON ISLAND, CALIFORNIA, BY SUBSPECIES, AGE, AND SEX

SASHA EARNHEART-GOLD and PETER PYLE, Point Reyes Bird Observatory, 4990 Shoreline Hwy., Stinson Beach, California 94970

ABSTRACT: We summarize observations of 201 Peregrine Falcons (*Falco peregrinus*) at Southeast Farallon Island during the fall and winter from 1990 to 1999 by age, sex, and subspecies. The northwestern subspecies *F. p. pealei* and the continental subspecies *F. p. anatum* occurred with roughly equal frequency. We recorded 10 individuals of the arctic subspecies *F. p. tundrius*. During fall, adults occurred significantly earlier than immatures. Males tended to occur earlier than females; *anatum* tended to occur earlier than *pealei*. Four to six birds per year (of both *anatum* and *pealei*) remained through the winter. Under the assumption that wintering individuals returned each year to the maximum extent possible allowed by the observed variation by age, sex, and subspecies, their survival rate was 0.78.

Although the Peregrine Falcon (*Falco peregrinus*) was recently removed from the federal endangered-species list (*Federal Register* 64 FR 46541 46558), there is still much interest in this species (e.g., Ratcliffe 1980, Cade et al. 1988). On Southeast Farallon Island, 42 km off San Francisco, California, numbers of Peregrines increased significantly during fall migration from 1974 to 1993 (Pyle and DeSante 1994); the negative (but nonsignificant) curvilinear relationship found in that analysis suggested that the increase was leveling off by the early 1990s. This species has also become a regular winter resident at Southeast Farallon (Pyle and Henderson 1991).

Currently, there are about 19 recognized subspecies of the Peregrine Falcon in the world (White and Boyce 1988). The AOU (1957) listed two subspecies in California, *P. f. anatum*, which breeds and winters throughout the state, and *P. f. pealei*, which is reported to winter "rarely to California." Grinnell and Miller (1944) listed three specimens of *pealei* from California, as far south as San Diego County (Swarth 1933), but Beebe (1960) seemed to question most reports of this subspecies south of Washington, and Hunt et al. (1975) believed few if any Peregrines migrate down the Pacific coast. Anderson et al. (1988) listed two records of *pealei* banded as nestlings in British Columbia and recovered in San Diego and Santa Cruz; they suggested on the basis of sight reports that it is a regular visitor to Southeast Farallon and elsewhere in California.

A third subspecies, *P. f. tundrius*, breeding in arctic North America, was described by White (1968). He suggested that it is a rare or uncommon migrant along the west coast of North America and listed one specimen (of 213 *tundrius* examined) from California (March, Del Ray, Fresno County) and four specimens from Baja California (March and April). Anderson et al. (1988) listed a second California specimen of a banded *tundrius* recovered on San Miguel Island, and Hamilton and Willick (1996) listed two records of banded birds from Orange County. Otherwise, little has been published about the occurrence of *pealei* and *tundrius* in California.

During the past ten years Point Reyes Bird Observatory biologists have made an effort to identify Peregrines on Southeast Farallon Island by

subspecies, age, and sex. Here we summarize our findings from 1990 to 1999 for both fall and winter, when a majority of migrant and resident individuals were recorded. Arrivals from spring and summer are excluded because sample sizes are much smaller (Pyle and Henderson 1991) and critical subspecies, age, and sex determinations were not recorded.

METHODS

The standardized daily census for migrant and wintering birds on Southeast Farallon, uninterrupted since 1968, has been described by DeSante and Ainley (1980) and Pyle and Henderson (1991). Birds censused each day during the fall/winter period (15 July–1 March) were identified as arrivals if banding data and/or plumage observation, coupled with data from previous days, suggested that they had arrived at the island that day. Between 1990 and 1999 the size, shape, and plumage of most arriving and winter resident Peregrine Falcons were examined critically for subspecies, age, and sex. We defined as winter residents those remaining for at least 21 days between 15 December and 1 March.

All subspecific, age, and sex determinations of Peregrines were made either by Pyle (78.6% of 126 identifications) or long-term interns (including Earnheart-Gold) that had been trained for this by Pyle. Plumage criteria used in these determinations included those presented by Brooks (1926), Beebe (1960), Brown and Amadon (1968), White (1968), and White and Boyce (1988), supplemented by examination of specimens at the California Academy of Sciences (CAS), San Francisco, and Museum of Vertebrate Zoology (MVZ), Berkeley. Determinations were usually made in the order age, subspecies, sex. During most (91.2%) determinations there were one to five other Peregrines at Southeast Farallon on the same day, often interacting with each other, allowing direct comparisons of size and plumage. Peregrines for which determinations were not made were not observed adequately or were difficult to categorize by known criteria. There is much variation within each subspecies, leading to overlap in size and/or plumage, especially between *anatum* and each of the other two subspecies. Because of this intrasubspecific variation we identified only typical examples and left many birds unidentified to subspecies. The following criteria were used to identify subspecies:

F. p. anatum: Medium sized; stocky build. Adults with medium-dark gray upperparts, contrastingly black hood extending to the bill, and buffy- or rosy-tinged underparts with medium-heavy spotting. Immatures medium brownish, sometimes tinged rufous, with little or no buffy in the crown, a medium-thick malar stripe, and a thin buffy terminal band on the tail.

F. p. pealei: Large; medium-stocky build. Adults with medium-dark grayish upperparts blending to a slightly darker crown and hood, often interrupted by a white band at the base of the bill, and whitish underparts with heavy barring throughout the breast and belly. Immatures dark gray to blackish without buffy in the crown, a thick malar stripe, and a thin or no buffy terminal band on the tail.

F. p. tundrius: Medium-small; slender and long-winged in build. Adults with medium-pale grayish to bluish upperparts contrasting somewhat with a blackish crown and hood, interrupted by a white band at the base of the bill, and white

underparts with light barring on the belly but little or no barring on the upper breast. Immatures brownish with extensive buffy in the crown and nape, a reduced malar stripe, and an extensive buffy terminal band on the tail.

We used simple and multiple linear regression and analysis of variance (ANOVA) to help describe the occurrence patterns and look for significant variation in these patterns among subspecies, ages, and sexes.

RESULTS

We counted 201 Peregrine Falcons during fall and winter, 1990–1999 (Table 1); 126 birds identified to subspecies included 56 of *anatum*, 57 of *pealei*, and 10 of *tundrius*. Of 87 birds that were sexed, 47 were females and 40 were males, and of 121 birds that were aged, 50 were adults and 71 were immatures. There was no significant linear trend in number of arrivals during the 10-year period taken as a whole (Figure 1; linear regression; $t = 0.363$, $P = 0.719$). Evidently, however, fewer Peregrines arrived immediately after El Niño years (1992 and 1997–1998), followed by gradual increases in arrivals until the next El Niño (Figure 1). For example, the positive linear trend in arrivals between 1993 and 1998 was significant ($t = 7.86$, $P = 0.001$). The 10-year trend for identified *anatum* was slightly and nonsignificantly positive ($t = 0.147$, $P = 0.887$), and that for identified *pealei* was positive and nearly significant ($t = 2.193$, $P = 0.060$). It should be noted that biases related to the 75 Peregrines (37.3%) not identified to subspecies could affect these analyses.

All ten individuals of *tundrius* noted during the study period were observed and identified by Pyle. They were recorded in only five of the ten

Table 1 Arrival Dates of Peregrine Falcons on Southeast Farallon Island during Fall and Winter (15 July–1 March), 1990–1999

Subspecies/Age/Sex	*n*	Mean	Minimum	Maximum
Total	201	14 Oct	22 Jul	31 Dec
F. p. anatum	56	14 Oct	6 Aug	1 Dec
Male	18	30 Sep	6 Aug	23 Nov
Female	18	22 Oct	13 Aug	27 Nov
Adult	26	3 Oct	6 Aug	1 Dec
Immature	28	24 Oct	13 Aug	27 Nov
F. p. pealei	57	20 Oct	26 Aug	3 Dec
Male	18	24 Oct	7 Sep	24 Nov
Female	26	20 Oct	26 Aug	3 Dec
Adult	22	13 Oct	13 Sep	13 Nov
Immature	34	26 Oct	7 Sep	3 Dec
F. p. tundrius	10	19 Oct	2 Oct	17 Nov
Male	3	11 Oct	7 Oct	14 Oct
Female	3	14 Oct	7 Oct	22 Oct
Adult	2	11 Oct	7 Oct	14 Oct
Immature	8	21 Oct	2 Oct	17 Nov

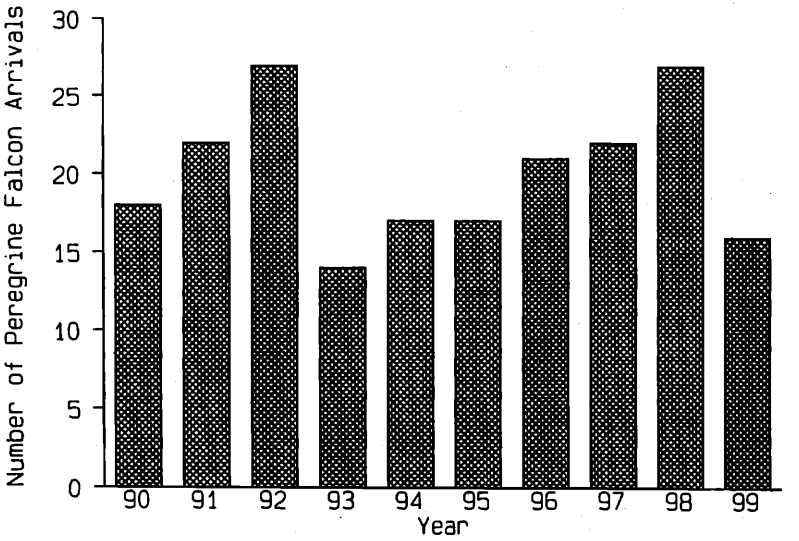

Figure 1. Numbers of Peregrine Falcon arriving (see text) on Southeast Farallon Island, by year, 1990–1999.

years, 1992 (two birds), 1993 (one), 1994 (one), 1995 (two), and 1997 (four), despite a similar amount of observation effort each year. Both adults (see Table 1) were males, recorded on single days in 1997. Seven of the ten birds were recorded between 7 and 22 October. There are also at least six records of this subspecies (all immatures) observed and described or photographed (e.g., Figure 2) by Pyle or other biologists between 26 September and 6 November, 1981–1988. All birds identified as *tundrius* fit the description above, and most were seen in direct comparison with other Peregrines.

Examination of mean arrival dates (Table 1) reveals several patterns according to subspecies, age, and sex. In all three subspecies identified males apparently tended to arrive before females, but this pattern was not signifcant for the species as a whole ($F_{(1,99)} = 1.50$, $P = 0.299$; $F_{(3,83)} = 1.62$, $P = 0.207$, adjusting for subspecies) or for *pealei* ($F_{(1,42)} = 0.38$, $P = 0.543$). It was almost significant for *anatum* ($F_{(1,34)} = 3.98$, $P = 0.054$). In all three subspecies identified adults arrived before immatures, and this pattern was significant for the species as a whole ($F_{(1,154)} = 11.32$, $P = 0.001$; $F_{(3,118)} = 15.14$, $P < 0.001$, adjusting for subspecies), for *anatum* ($F_{(1,52)} = 6.87$, $P = 0.012$), and for *pealei* ($F_{(1,54)} = 7.32$, $P = 0.009$). The mean arrival date of *anatum* was not significantly earlier than that of *pealei* ($F_{(1,111)} = 1.29$, $P = 0.259$) when all age/sex groups were combined. When the ages and sexes were separated, this comparison was significant for males ($F_{(1,34)} = 6.53$, $P = 0.015$) but not for females, immatures, or adults ($F < 1.72$, $P > 0.197$). As in analyses of subspecies, it should be noted that biases among birds not identified to age ($n = 80$; 39.8% of the sample) or sex ($n = 114$; 56.7% of

Figure 2. Immature Peregrine Falcon of the tundra subspecies *F. p. tundrius*, Southeast Farallon Island, 6 November 1987.

Photo by Scot Anderson

the sample) might affect these results. The sample of *tundrius* was too small for these analyses to be meaningful.

The winter resident population consisted of four to six individuals, up to three of *anatum* and three of *pealei* of various ages and sexes (Table 2). Under the (perhaps tenuous) assumption that winter residents return in consecutive years, the table implies a minimum of 13 wintering individuals

Table 2 Winter Resident Peregrine Falcons on Southeast Farallon Island, 1990–1999

Year	Summary by subspecies/age/sex
1990–91	Four adults; subspecies unknown
1991–92	*anatum*: 2 adults, 1 immature; *pealei*: 2 adults
1992–93	*anatum*: 2 adults; *pealei*: 1 adult ♂, 1 adult ♀
1993–94	*anatum*: 1 adult ♂, 1 adult ♀; *pealei*: 1 adult ♂, 1 adult ♀
1994–95	*anatum*: 1 adult ♂, 1 immature ♂; *pealei*: 1 adult ♂, 2 immature ♀
1995–96	*anatum*: 1 adult ♂, 1 adult ♀, 1 immature ♀; *pealei*: 1 adult ♂, 1 adult ♀, 1 immature ♀
1996–97	*anatum*: 1 adult ♂, 1 adult ♀; *pealei*: 1 adult ♀, 1 immature
1997–98	*anatum*: 1 adult ♂, 1 adult ♀; *pealei*: 1 adult ♂, 1 adult ♀
1998–99	*anatum*: 1 adult ♂, 1 immature ♂, 1 immature ♀; *pealei*: 1 adult ♂, 1 immature
1999–00	*anatum*: 1 adult ♂, 1 adult ♀; *pealei*: 1 adult ♀, 1 immature ♂, 1 immature ♀

over the 10-year period, five of *anatum* (two males and three females) and eight of *pealei* (three males and five females). If returning winter resident adults of the same sex represented the same individuals, six adults (two of *anatum* and four of *pealei*) disappeared and 21 adults returned for an annual adult survival rate of 0.78 (0.86 for *anatum* and 0.69 for *pealei*) over the 10-year period.

DISCUSSION

Our finding no linear trend in Peregrine numbers between 1990 and 1999 suggests that populations have stabilized since recovery from their pesticide-related reductions from the 1950s to the 1970s and that our proportions may represent historical distributions in population size and range. It is also possible, however, that distributions have shifted since the population bottlenecks of the 1950s–1970s, especially if seabird populations or other prey resources have changed. Our data further suggest that mortality of Peregrines is higher and/or fall and winter populations shift during El Niño periods (e.g., 1992 and 1997–1998), perhaps in response to reduced abundance of seabird prey off central California during these events (Ainley and Boekelheide 1990).

The regularity of *pealei* in California (similar in abundance to *anatum* at Southeast Farallon) has not been previously appreciated in the literature (e.g., AOU 1957, Beebe 1960, Hunt et al. 1975), although suspected by Anderson et al. (1988) and confirmed by museum specimen examination (C. White pers. comm.) and unpublished data collected by the Santa Cruz Predatory Bird Research Group (B. Walton pers. comm.). It is possible that the abundant alcid populations at Southeast Farallon (Ainley and Boekelheide 1990) provide a food resource for *pealei*, an alcid specialist where it breeds (Beebe 1960). Because the colony at Southeast Farallon represents the southernmost point of such alcid abundance (Carter et al. 1992), the island may represent the southern limit of the regular winter range of *pealei*. Individuals of *pealei*, though, winter or wander as far south as San Diego and even Baja California but are greatly outnumbered by *anatum* south of Southeast Farallon (B. Walton pers. comm.).

Our data suggest that *tundrius* is an uncommon but regular transient down the California coast from late September through mid November, as proposed by White (1968) and Anderson et al. (1988) and confirmed with unpublished data from the Santa Cruz Predatory Bird Research Group (B. Walton pers. comm.). It is possible that these birds winter in Baja California (White 1968), although residents of *anatum* of that region, particularly immatures, may resemble *tundrius* in size and plumage more closely than those of California-breeding populations (C. White, M. A. Patten, pers. comm.; Pyle, specimen examination at CAS and MVZ). We suggest that the identification of the four specimens of *tundrius* from Baja California listed by White (1968) be reconfirmed.

Our data on arrival patterns of *anatum* and *pealei* by age and sex are consistent with patterns widely known in birds: smaller males depart nesting grounds for winter areas slightly before larger females, and adults migrate and arrive on winter grounds well before immatures. The more local and

southern *anatum* arriving before the more northern *pealei*, especially among males, is also to be expected (Anderson et al. 1988).

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