creased protection of existing sites will become even more important.

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BREEDING DISTRIBUTION AND HABITAT OF PRAIRIE FALCONS IN NORTHERN MEXICO[1]

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Key words: *Prairie Falcon;* Falco mexicanus; *Mexico; distribution; breeding; habitat.*

The Prairie Falcon (*Falco mexicanus*) breeds in Canada and the United States (US) south to Baja California, southern Arizona, southern New Mexico, western Texas, and southeastern Coahuila (AOU 1983). C. A. Ely (1962) collected one of two immature Prairie Falcons on 30 June 1958 at a nest cliff in the mountains of southeastern Coahuila; this is the only published nesting record we are aware of for Mexico outside of Baja California. We observed Prairie Falcons, located Prairie Falcon nest sites, and collected limited data on their occupancy, productivity, and habitat during a study of Peregrine Falcons (*Falco peregrinus*) in northern Mexico between 1975 and 1986.

STUDY AREA AND METHODS

The study area (Fig. 1) included the mountains of northern Mexico, known as the Sierra Madre Occidental in northwestern Mexico and the Sierra Madre Oriental in northeastern Mexico. Sheer cliffs are common in the mountains and canyons. Cliffs in the northwest are of mostly igneous origin, those in the northeast are usually limestone. The climate varies with altitude and with proximity to the moist coastal regions or interior arid desert. Spring and summer temperatures generally range from 10–30°C in the mountains. Mean

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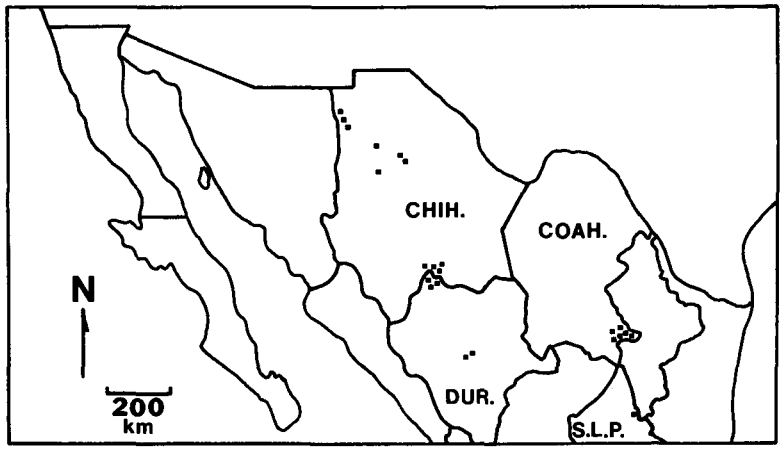

FIGURE 1. Map of northern Mexico, showing the locations of 23 Prairie Falcon sites in the states of Chihuahua, Coahuila, Durango, and San Luis Potosí.

annual precipitation varies from 30–60 cm and from 55–82% falls from June through September (Instituto de Geografía 1970).

Five major biotic communities occur in the mountains (Brown 1982). Madrean Montane Conifer Forest, dominated by pines (*Pinus* spp.) and other conifers, and Madrean Evergreen Woodland, dominated by a variety of larger oaks (*Quercus* spp.), are prominent above 2,000 m elevation. Interior Chaparral occurs below 3,000 m and consists of low-growing oaks and a variety of other shrubs and compact trees. Semidesert Grassland, with numerous grasses, shrubs, and succulents, is common in the intermontane valleys betwen 2,000 and 2,500 m. Chihuahuan Desert scrub, common below 2,000 m on the lower slopes of the mountains and in the valleys and canyons, is dominated by creosote bush (*Larrea tridentata*), tarbush (*Fluorensia cernua*), and whitethorn acacia (*Acacia neovaernicosa*).

W. G. Hunt and M. A. Hitchcock began the search for Peregrine Falcons in northeastern Mexico during the breeding season of 1975 (Hunt 1976). The Peregrine Falcon study continued throughout northern Mexico during 1976, 1977, 1978, 1979, and 1982 (Hitchcock 1978, Lanning et al. 1985, Hunt et al. 1988) and during 1986 (Lanning and Jenkins, unpubl.). We recorded incidental observations of Prairie Falcons during the Peregrine Falcon research.

We surveyed potential Prairie Falcon nesting sites by observing cliffs in the early morning and in the late afternoon and early evening, when falcons were likely to be active and vocal. The term "nest site" includes the nest and its nearby surroundings, such as the cliff or set of cliffs occupied by the falcons. We searched cliffs at least 25 m tall and at elevations above 1,500 m. At each nest site, we measured the cliff used during the latest year that young were produced. If no young were known from a site, we used the cliff most recently occupied by a pair. We estimated cliff rim elevation, cliff height, cliff length, cliff orientation, and percent coverage for the biotic communities with the aid of maps and photographs. We used ropes of known length to measure the height of several nests and cliffs. We used topographic, aeronautic, climate, and vegetation maps produced by the Mexican government.

We determined occupancy and productivity during at least one breeding season at each nest site. We were able to return to only a few of the easily accessible sites for observations in two or more breeding seasons. We usually made one visit to each site, lasting only one or two days, and may have inaccurately listed a known site as unoccupied when the site may have been occupied at another period during the same breeding season; Allen (1987b) discusses this bias in Prairie Falcon surveys. In most cases we recorded only the minimum number of young visible and audible; more young might have been present, but were not visible. At sites where all fledged young were visible and the entire nest floor was visible, we recorded the exact size of the brood. Results for each site and each pair during a breeding season are listed as site-year and pair-year, respectively.

RESULTS

Between 1975 and 1986 we visited 23 Prairie Falcon sites in northern Mexico: 11 in Chihuahua, 6 in Coahuila, 5 in Durango, and 1 in San Luis Potosí (Fig. 1). We observed incubation behavior as early as 13 March and as late as 30 April, pairs with nestlings between 21 April and 7 June, and fledglings between 20 May and 23 June.

We collected occupancy and productivity data during one breeding season at 12 sites and during two or more breeding seasons at 11 sites. Occupancy by Prairie Falcons was determined for 49 site-years. The site occupancy rate was 84%. Pairs were observed during 38 (78%) of the site-years. Single falcons were observed during three site-years (6%) and cliffs were unoccupied for eight site-years (16%). We determined minimum productivity for 28 pair-years. At least one nestling or

fledgling was produced during 27 pair-years. We obtained exact acounts of only six fledged broods, which contained 2, 3, 3, 3, 3, and 4 young ($\bar{x}$ = 3.0 ± 0.63 [SD]).

Cliff rim elevations of the 23 sites were from 1,600 to 3,200 m ($\bar{x}$ = 2,450 ± 370). The 23 cliffs were 25 to 130 m tall ($\bar{x}$ = 65 ± 35) and 40 to 1,000 m long ($\bar{x}$ = 350 ± 270). Cliffs faced north (2), northeast (2), east (3), south (4), southwest (4), and west (8). Nests at seven measured cliffs were from 6 to 30 m ($\bar{x}$ = 15 ± 7) below the top of the cliff and between 10 and 90 m ($\bar{x}$ = 35 ± 30) above the base of the cliff; mean nest height was 65% (±14) of cliff height. The forest, woodland, and chaparral biotic communities of the mountains covered 10 to 80% ($\bar{x}$ = 60 ± 25) of the terrain within a 15-km radius of each of the 23 cliffs. The grassland and desert scrub biotic communities of the open slopes and valleys covered the remaining 20 to 90% ($\bar{x}$ = 40 ± 15).

DISCUSSION

Our observations of the breeding Prairie Falcons in Chihuahua, Coahuila, Durango, and San Luis Potosí have expanded upon the single record of Ely (1962) and the 1983 AOU summary for northern Mexico. Two nest sites in Coahuila were within 2 km of the nest described by Ely (1962). We found nest sites as far south as 23°30'N latitude. However, there is no reason to assume this was the southern limit of breeding in Mexico.

Prairie Falcon sites in northern Mexico had an 84% occupancy rate, similar to Prairie Falcons in the US Rocky Mountain Region, where an average of 27 ($\bar{x}$ = 87%) out of 31 sites were occupied over a three-year period (Enderson 1964). In northern Mexico there was an average of 3.0 fledged young from six successful nests. Ogden and Hornocker (1977) found a mean of 3.7 fledged young per successful nest (91 nests) and 3.1 fledged young per nesting attempt (110 nests) in southwestern Idaho. Olendorff and Stoddart (1974) reported a mean of 3.4 fledged young per nesting attempt (27 nests) in northeastern Colorado. Enderson (1964) found a mean of 1.4 fledged young per nesting attempt (67 pairs that laid eggs) and 1.2 fledged young per pair studied (77 pairs).

Prairie Falcon nest cliffs in northern Mexico were similar to nest cliffs in the US. Runde and Anderson (1986) summarized the characteristics of Prairie Falcon nest cliffs in the western US and found the cliffs vary from 2–154 m tall ($\bar{x}$ = 29 m, n = 418), the mean nest height is 60%–70% ($\bar{x}$ = 63%, n = 417) of cliff height, and the exposure of nest cliffs (n = 188) tends to be southerly. Boyce (1987) measured 52 nest sites in the Mojave Desert, California, and found a mean cliff height of 29.3 m, a mean nest height of 18.3 m (62% of cliff height), and a mean southern exposure, similar to the summary by Runde and Anderson (1986). Allen (1987a) found that Prairie Falcon nests in North Dakota are on small cliffs with a mean cliff height at 34 nests of 11 m, a mean nest height at 33 nests of 7 m (64% of cliff height), and that cliffs facing southwest seem to be preferred.

The Prairie Falcon often is common (where it occurs) in the arid and semi-arid deserts and steppes of western North America; it also breeds less commonly in timbered mountains up to 3,700 m (Cade 1982). The habitat for the Prairie Falcon in northern Mexico is a combination of forest, woodland, and chaparral in the mountainous terrain surrounding the nest site and grassland and desert scrub on the open slopes and valleys, often in front of and below the nest site.

Our search for Prairie Falcon sites was not exhaustive and was conducted in the mountains. Prairie Falcons probably nest at lower elevations in northern Mexico on cliffs that are completely surrounded by grassland and desert scrub. Further research in Mexico is needed to locate breeding Pairie Falcons south of our study area.

We thank the many observers in the Peregrine Falcon study for their Prairie Falcon observations. We sincerely appreciate Grainger Hunt's enthusiasm, encouragement, and advice; the Peregrine Falcon study in Mexico might never have been initiated without his leadership. Logistical and financial support for the Peregrine Falcon study was provided by the Chihuahuan Desert Research Institute, G. M. Sutton Avian Research Center, National Audubon Society, National Ecology Research Center of the U.S. Fish and Wildlife Service (USFWS), National Geographic Society, and the United States-Mexico Joint Committee on Wildlife Conservation of the USFWS and the Dirección General de Flora y Fauna Silvestres. Mike Bogan, David Ellis, Alan Jenkins, Peter Lawson, John Oldemeyer, Richard Porter, and Jim Sedgwick critiqued the Prairie Falcon information as part of a larger unpublished manuscript. This short communication has been reviewed by George Allen, Noel Snyder, Susan Tornquist, and an anonymous reviewer. To all of the people and organizations who directly and indirectly helped, we give our deepest appreciation.

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DEMOGRAPHY OF THE PIGEON GUILLEMOT ON SOUTHEAST FARALLON ISLAND, CALIFORNIA[1]

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Key words: Demography; Pigeon Guillemot; Cephus columba; *seabirds; survivorship.*

Auks (Alcidae) form an important component of marine avifaunas in the Northern Hemisphere, in terms of numbers of both individuals and species. In order to effectively manage and protect alcid populations, basic demographic data are vital (Nisbet 1979). Demographic parameters have been estimated for five of the six species in the North Atlantic (Hudson 1985). In contrast, survivorship of banded birds is known for only one Pacific Ocean alcid species (Ancient Murrelet, *Synthliboramphus antiquus,* Gaston 1990). In this note, I report survivorship and recruitment of a color-marked sample of Pigeon Guillemots (*Cepphus columba*) over a five-year period.

METHODS

I observed Pigeon Guillemots in 1977 and from 1979–1982 on Southeast Farallon Island, California (37°42'N, 123°00'W), a 44 ha island about 43 km west of San Francisco. Biological and physical features of the island were described by Ainley and Lewis (1974) and Ainley and Boekelheide (1990). Among the 12 species of marine birds breeding on SE Farallon is a population of approximately 1,000 Pigeon Guillemot pairs (Ainley et al. 1990). I began observations in March 1977, 1979 and 1980 before guillemots had returned to the island from their wintering areas, and continued observations until late July or August when chicks began to fledge. I also visited the island for one month in April 1981 and May 1982.

In 1977, I studied about 10 pairs of guillemots that nested atop a 40 m high ridge on Shubrick Point. After 1977, I also made observations on the southeast side of the island where approximately 20 pairs nested in or near a rubble pile at the head of a surge channel (East Landing).

Guillemots nested in natural and artificial crevices at East Landing (Nelson 1987). Eight-nine guillemots were captured with leg nooses and banded with unique combinations of two color bands and a numbered monel U.S. Fish and Wildlife Service band (Nelson 1987). To minimize nest desertion, I allowed birds to occupy a site for at least one week before capture. Additional birds were identified by unique tears or holes in their webbed feet or by plumage marks in the white wing patches. Birds were sexed by copulation position (Nelson 1987). The Point Reyes Bird Observatory (PRBO) also banded between 19 and 284 chicks annually since 1970 with unique year-class color rings (Ainley et al. 1990). Most of these birds were banded on Lighthouse Hill, about 200 m from my study sites. Several of these birds were in my study plot each year as territory owners and non-territorial "loafers."

Survivorship of territory owners was estimated by resighting banded birds and five birds with easily visible, unique natural marks at Shubrick Point and East Landing. This includes several pairs each year that held territories but did not produce eggs (Nelson 1987). Sur-

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