R. McClelland, pers. comm.). These, however, were not obvious factors influencing Rough-legged Hawk movements.

Range fidelity was determined from seven hawks that were trapped in winter 1981–1982, and 15 others in winter, 1982–1983. Eleven females and eleven males were captured, and two birds were in juvenile plumage. Eleven sightings of at least six marked hawks were made in winters up to three years subsequent to their being marked. All observations were along highways. Hawks were seen 225 km southeast (Labarge, WY), 440 km south (Scipio, UT), 295 km north (Wilsall, MT) and 260 km west (Nampa, ID) of the study area. Three marked hawks were seen on the INEL. Lack of individual identification precluded determining if hawks returned to ranges occupied in previous winters. However, all birds seen on the INEL were located on seasonal ranges previously occupied by marked hawks. The wide distribution of hawks sighted in surrounding areas was not unexpected since the major prey species (voles and rabbits) are subject to population fluctuations and low availability in certain years and were at lower densities in winters following the marking of hawks (J. Anderson, pers. comm.; B. Keller, pers. comm.). Thus hawks moved through ranges they previously occupied and remained where sufficient prey was available.

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MOVEMENTS AND DAILY ACTIVITY PATTERNS OF A BROWN PELICAN IN CENTRAL CALIFORNIA[1]

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INTRODUCTION

The Brown Pelican (*Pelecanus occidentalis*) has been the subject of numerous studies (Schreiber and Schreiber 1980), yet little is known of its daily movements and activity patterns. Briggs et al. (1983) presented data showing that attendance of Brown Pelicans on central California roosts during the fall was lowest around midday, suggesting an activity peak at that time. Herbert and Schreiber (1975) found that Brown Pelican attendance at a Florida marina was highest during midday and suggested that the birds foraged mostly during the morning hours.

In this paper we present results of a radiotagging study designed to follow the daily activity patterns of a Brown Pelican near Monterey Bay, California, during the fall of 1983. Our study demonstrates a successful method of transmitter attachment that allows collection of detailed data in a continuous manner.

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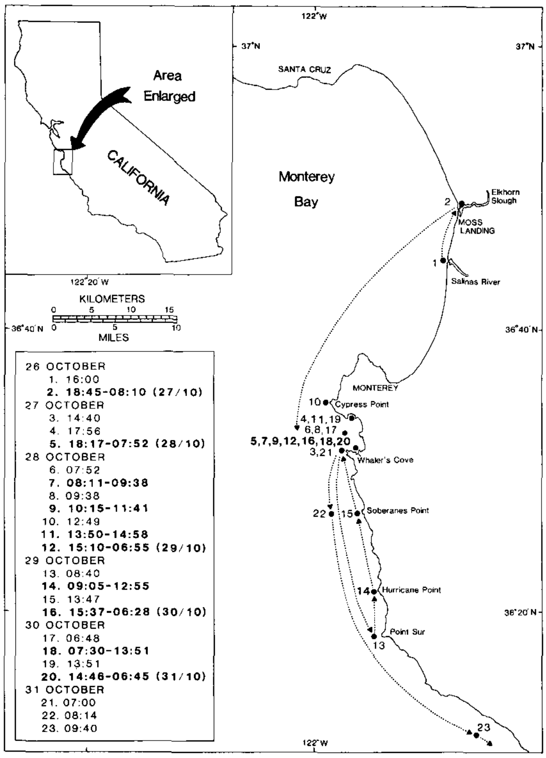

FIGURE 1. Daily movements of a radio-tagged Brown Pelican. Bold type represents roosts.

METHODS

The study area included the southern part of Monterey Bay, California, from Elkhorn Slough to Cypress Point and south to Point Sur (Fig. 1). This is an important feeding area for Brown Pelicans during the summer and fall (Briggs et al. 1983).

A Brown Pelican was captured on 26 October at 1600 just offshore of the Salinas River mouth (Fig. 1), by attracting it to the side of a boat with chum and netting it with a large dip net. Based on its plumage, we estimated the bird to be a 3-year-old subadult (Palmer 1962).

The radiotransmitter was secured with Superglue® to the contour feathers of the midsection of the pelican's spinal tract, and was then permanently set with 10-minute epoxy. The antenna ran down the back toward the pelican's tail. When the bird's wings were folded, the transmitter was not visible. The transmitter (Telonics, Model RB5) measured 1.7 cm in diameter and 5.6 cm in length, weighed 27 grams, and had a 45-cm-long one-quarter wavelength antenna. To monitor signals we used a Telonics receiver (Model TR-2) and a 2-element Yagi-Uda directional antenna on a 5-m pole.

We followed the pelican from a 6-m-long Boston Whaler during the first day and a car during the rest of the study. The directional antenna and a compass were used to obtain bearings of the pelican's position. We monitored the pelican's movements for four consecutive days, from 0430 to 1930 each day. On 31 October at approximately 1200 we lost the signal while the pelican was traveling south.

We characterized the pelican's behavior into two categories based on variations in the signal. When the signal was constant in strength and direction, we assumed the animal was inactive. When the signal fluctuated in strength or changed direction, we assumed the bird to be active. Other researchers have used similar signal variations to characterize activities of pinnipeds (Siniff et al. 1971) and cetaceans (Read and Gaskin 1983).

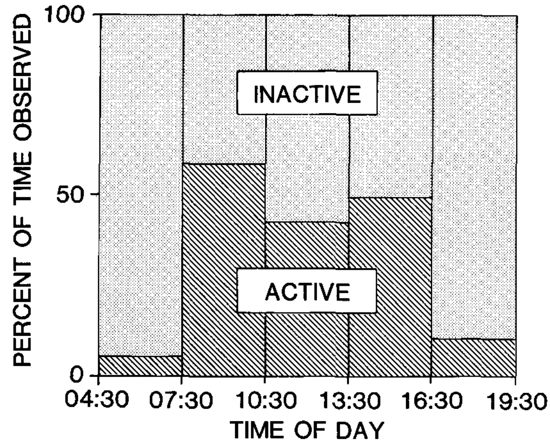

FIGURE 2. Daily activity pattern of a radio-tagged Brown Pelican. Activity is shown as a percentage of total time observed (68.8 hours).

We did not monitor the pelican between 1930 and 0430. We always left the bird in an inactive state and returned in the morning to find it inactive and in the same location. Therefore, we assumed it had been roosting the entire night.

RESULTS AND DISCUSSION

Numerous methods for the attachment of radio tags to birds have been tried, including harnesses (Sibley and McCleery 1980) and the sewing of transmitters to tail feathers (Dunstan 1973, Kenward 1978). We believe the method used in this study was highly successful for several reasons. The tag was easily and quickly applied. We observed the bird diving into the water without any obvious hindrance several minutes after being tagged. We believe that the loss of the signal was not due to tag detachment or transmitter failure, but was due to the bird's traveling out of receiving range too quickly to be followed. The signal had been strong and consistent; the bird was traveling at the time the signal was lost, and the signal grew weaker and weaker as if the transmitter were progressively farther away. Because a plunge diver such as the pelican makes rigorous demands on a transmitter, we feel this method of attachment would be applicable to many other seabirds. We followed only one pelican, however; generalizations from this bird to an entire population must be made with caution. Nevertheless, our experiment demonstrates a successful method of radiotagging that could prove to be an effective way to study free ranging seabird behavior.

The pelican was monitored for a total of 68.8 hours. Of this, the bird spent 22.7 hours (32%) active and 46.1 (68%) inactive. If the presumably inactive night roosting time is included with the hours of monitored time, the pelican was active 22.7 hours (19%) and inactive 91.2 hours (81%). This low value of percent time active may indicate that the Brown Pelican is a very efficient predator, or that each individual prey item has a high degree of food value.

The pelican exhibited a clear diurnal pattern. Almost all activity occurred during daylight hours, probably none during dark hours, and very little during twilight hours (Fig. 2). A similar diurnal pattern was found by Briggs et al. (1983) for pelicans near Elkhorn Slough, California, that left by the hundreds in the morning and returned to roost again at dusk. This correlation of activity with daylight hours may represent a strong dependence on vision for flight and predation. During a plunge dive a pelican orients itself visually towards its prey (Schreiber et al.

TABLE 1. Distance traveled per day by a Brown Pelican.

Date	Distance traveled (km)
27 October 1983	49.4
28 October 1983	17.5
29 October 1983	38.1
30 October 1983	10.2
31 October 1983	43.8*

* Distance traveled before 1200, when pelican was lost.

1975), and therefore light seems to be a requirement for foraging success.

We found no significant difference in the activity level of the pelican at different wind speeds (single factor ANOVA; $F = 0.977$; $P = 0.39$), and there was no significant correlation between time of day and wind speeds during the study period (single factor ANOVA; $F = 0.399$; $P = 0.81$). Therefore, our results for effects of wind speed on activity level were probably not confounded by the diurnal activity pattern of the pelican.

We treated distance traveled as a different category of behavior from activity level. Several times, the pelican was active yet remained near the roost, thus traveling a small distance. Alternatively, the pelican sometimes flew straight to a distant point in a short period of time; thus the active period was relatively short. Throughout the study period, the pelican traveled a large distance one day, followed by a small distance the next (Table 1). Average distance traveled per hr increased with increasing wind speeds (0.68 nautical miles/hr at a wind speed of 0 to 5 knots, 1.30 nautical miles/hr at a wind speed of 5 to 10 knots, and 2.19 nautical miles/hr at wind speeds greater than 10 knots). Although this trend was not significant (Kruskal-Wallis; $H(6) = 5.731$; $P = 0.06$), the increasing values suggest that this pelican was taking advantage of wind energy to decrease its own energetic requirements.

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ERRATA

In our February issue, four lines of text were omitted from the paper entitled "The systematic status of *Cranioleuca furcata* Taczanowski (Furnariidae)" by Gary R. Graves. The following bracketed text should be inserted into the second paragraph: "Following his examination of the Warsaw specimen, Vaurie (1971) identified three 'ochraceous' immature specimens of *Cranioleuca* in the [American Museum of Natural History (AMNH) as immature *C. furcata.* Two of these specimens (AMNH 180315, 180318) were taken on the same day and at the same locality as adult *curtata* (AMNH 180317, 180319),] 'abajo chaco,' Rio Oyacachi (ca. 1,500–2,000 m) on the eastern slope of the Ecuadorian Andes."

In the February article entitled "VIREO: procedures and services for the ornithology community" by J. P. Myers, R. F. Cardillo, and F. B Gill, the following sentence appeared in paragraph (2) of the section "VIREO methods":. "Of the 90,000 photographs in VIREO, we have duplicated approximately 3,600 and placed them in VIREO's working collection." The 3,600 should have read 36,000.