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NON-RANDOM ORIENTATION OF GILA WOODPECKER NEST ENTRANCES IN SAGUARO CACTI

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The use of holes for nesting protects birds from harsh weather conditions. Both nest placement and orientation of the entrance may influence the microclimate of the nest. Cactus Wrens (*Campylorhynchus brunneicapillus*), for example, change the orientation of nest entrances in order to gain heat in winter and admit cool air in summer (Ricklefs and Hainsworth 1968). Entrance holes to woodpecker nests in aspen trees in Colorado tend to face directions that receive maximum incident radiation (Inouye 1976). We report here a nonrandom orientation of Gila Woodpecker (*Melanerpes uropygialis*) nest entrances in saguaro cacti (*Cereus giganteus*), and cite some previously unpublished data which support the hypothesis that such orientation serves to reduce energetic costs of nesting birds.

Data on nest entrance orientation were collected (by RSI and NJH) in May 1979 in the Sonoran Desert within the Organ Pipe Cactus National Monument, Pima Co., Arizona. Woodpecker nests were examined in 14 cacti at one site and at 11 cacti at another site. At the second site the two observers, approximately 30 m apart, investigated all saguaros between them in order to reduce any directional bias in sampling. At each nest approximate height of cactus, height of hole, location of hole (in trunk or branch), approximate diameter of hole, and compass orientation were recorded.

Data for nest-hole orientation were corrected to true north, placed in four 90°-quadrats centered on the compass points, and tested for nonrandom dispersion with a χ^2 test. The center of gravity of the nest entrances was calculated by the method of Batschelet (1965).

Data for the two sites were not significantly different. Mean nest entrance orientation for 49 nest holes was 351°. A measure of dispersion, r, varying from 0 to 1.0 was 0.24 (the greater the dispersion the closer r is to 0). Results of χ^2 tests were not significant for the two sites separately, however, the combined data do show a significantly nonrandom orientation ($\chi^2 = 13.0$, $P < 0.01$, 3 df). The circular distribution of nest entrances and their center of gravity are shown in Figure 1.

Mean cactus height for the combined data was 9.6 m (s = 1.44, n = 25); mean nest entrance height was 7.2 m (s = 1.5, n = 49). Sample sizes are smaller for cactus height than for entrance holes because some cacti had multiple nest holes.

The orientation of nest entrances in saguaro cacti was nonrandom and centered close to due north, implying a potentially adaptive response to the environment. To support this hypothesis, two criteria must be met: 1) microclimate of the nest cavity must somehow be influenced by the placement and orientation of nests, and 2) this influence must be advantageous to the nesting birds.

Data from Soule (1964) indicate that the summer temperature within a nest is influenced by the orientation of the entrance hole. Temperatures inside north- and south-facing nests were considerably lower than those outside the nests, and north-facing nests were consistently cooler than south-facing nests. Krizman's (1964) data show similar trends for nest cavities in winter.

Nest temperature is undoubtedly important to birds in the nest. Gila Woodpeckers rear a first clutch in May–June and sometimes start a second clutch in July (S. Martindale, pers. comm.). These are the hottest months of the year in southern Arizona and air tem-

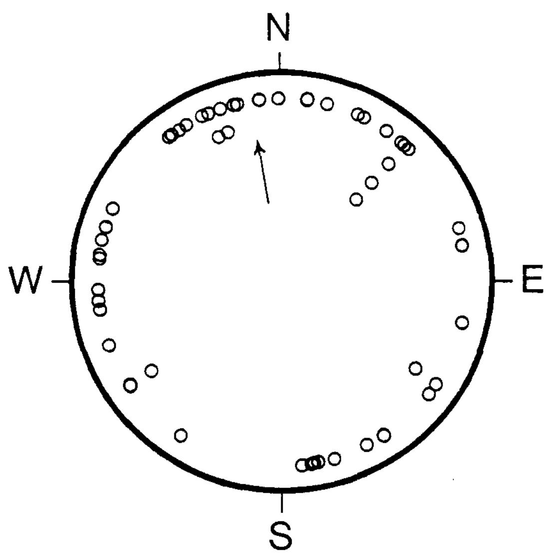

FIGURE 1. Compass orientation of nest entrance holes at two sites in Organ Pipe National Monument, Arizona. Mean direction is indicated by arrow.

peratures regularly exceed 38°C. Braun (1969) reported the upper limit of thermoneutrality in Gila Woodpeckers to be approximately 35°C. Thermoregulation at higher temperatures may require expenditure of water, which is scarce in the desert in mid-summer. Heat stress on the young and eggs may be even more severe than that on the adults. Thus, the tendency for northern orientation of nest entrances is probably an adaptive response to environmental conditions as is the southern orientation documented for nests in cooler environments (Crockett and Hadow 1975, Inouye 1976).

We found considerable scatter in the orientation of the nest entrances (Fig. 1). If Gila Woodpeckers excavate new cavities for roosting, this variation may reflect selection for different microhabitats at different times of the year. Cooler, north-facing nests may reduce water loss in hot summer months, while warmer south-facing nests may reduce energy expenditures in the winter. A study of nests used by birds at different seasons might provide evidence to test this hypothesis.

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OBSERVATIONS OF FEEDING AT SEA BY A PEREGRINE FALCON AND AN OSPREY

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While birds of a number of non-oceanic species have been reported to land on ocean-going vessels, they rarely do more than rest briefly aboard the ship (e.g., Bailey 1913, Cowan and Cowan 1961, Willis 1961, Buchanan and Fierstein 1964, Harris 1966, pers. observ.). From 23 October through 28 October 1976, while working aboard the *R/V David Starr Jordan*, operated by the National Oceanic and Atmospheric Administration (NOAA), and the *Elizabeth C.J.*, a privately owned tuna seiner under contract to NOAA, we repeatedly observed an immature Peregrine Falcon (*Falco peregrinus*) and an Osprey (*Pandion haliaetus*) as they fed in the waters adjacent to the two vessels. The ships were operating in the eastern tropical Pacific tuna grounds where we were investigating deaths of porpoises in the purse seines of the U.S. tuna industry. Observations of the birds were incidental to the porpoise work and were not recorded systematically. However, our records probably reflect accurately the full extent of the birds' presence.

The Osprey was seen from 23 October through 27 October while the falcon was seen from 23 October through 28 October. Both birds were first observed about 2,600 km west of Costa Rica and approximately 65 km northeast of Clipperton Atoll (10°51′N, 107°45′W). We know of one record of an Osprey from Clipperton Atoll but none of Peregrine Falcons (Stager 1964). The Osprey was last seen at 9°49′N, 105°46′W and the falcon at 9°33′N, 106°02′W; during the birds' stay, the vessels ran an irregularly-shaped track approximately 580 km in length.

For two and one-half days prior to the arrival of the birds we had encountered a storm with choppy high seas, rain squalls, and easterly winds up to about 30 knots. The storm lessened in severity by the time of the first sighting and the weather was stable and clear for most of the five days that the birds were seen. The day after we last saw the falcon and two days after we last saw the Osprey a new storm arrived, also from the east. Other observations of raptors at sea have occurred in conjunction with storms in the same fashion as ours (e.g., Bailey 1913, Voous 1961, Craddock and Carlson 1970). However, both Peregrine Falcons and Ospreys are known to migrate offshore in many parts of their ranges (Bent 1938b, Henny and van Velzen 1972). Thus, they regularly occur over water, although storms may push them out to sea farther than they might normally occur.

Both birds appeared to move back and forth between the two vessels. The locations of the birds when they were not reported near either ship are not known although it is likely they were in the vicinity of other boats known to have been operating in the area.

During the day the birds most commonly occupied the yardarms above the flying bridge on the *Jordan* (ca. 19 m above the water) and the crow's nest on the seiner (ca. 25 m above the water). During the night, when aboard the *Jordan*, the Osprey usually perched on the lower, broader, more stable radar antenna frame (ca. 15 m above the water) while the falcon remained higher, either on the yardarms or, in one instance, on the weather vane (ca. 21 m above the water). The nocturnal roosts of the birds on the *Elizabeth C.J.* are not known.

Whenever possession of a perch was in question, the