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FACULTATIVE MIGRATION IN YELLOW-EYED JUNCOS[1]

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Key words: Facultative migration; winter flock stability; Yellow-eyed Juncos; Junco phaeonotus.

Altitudinal migrants, wintering relatively close to the breeding grounds can assess more precisely when the breeding grounds become favorable for habitation than can long-distance migrants. Altitudinal migrants also have the opportunity to inhabit the breeding grounds early if local weather conditions permit, and then can quickly return to the wintering area if weather conditions deteriorate. The close proximity of refuges from severe climatic conditions at the breeding grounds may permit the timing of spring migration to be highly facultative in these birds.

Yellow-eyed Juncos (*Junco phaeonotus*) are altitudinal migrants in mountain ranges in southern Arizona and throughout Central America (Moore 1972). As part of an ongoing study of the behavioral ecology and demography of Yellow-eyed Juncos, we documented winter site fidelity and spring movements between the breeding and wintering grounds in a population of juncos in the Chiricahua Mountains, Cochise County, Arizona.

METHODS

The senior author conducted censuses of individually marked juncos at one high elevation site (Rustler Park, elevation 2,560 m) and at two lower elevation sites (Southwestern Research Station, SWRS, elevation 1,646 m, 8 km from Rustler Park; and Sunnyflat Campground, elevation 1,554 m, an additional 2 km from Rustler Park) between 3 January and 31 March 1986.

A census of banded individuals was carried out at SWRS (36 banded Yellow-eyed Juncos) on 71 days between 16 January and 31 March 1986. The area was not visited on 25 January, 30 January, and 13 February and therefore these dates are not included in Figure 1. At least once every 3 days an extensive search of the research station grounds was made to find banded juncos. We classified individuals as present if they were sighted at least once during the 3-day interval. The senior author also conducted a census of an additional 10 banded Yellow-eyed Juncos at Sunnyflat on 14 February, 20 February, 13 March, and 20 March and searched for banded juncos at Rustler Park (where we had banded 552 Yellow-eyed Juncos during the previous two summers) on 18 January, 19 February, 10 March, 22 March, 28 March, and 31 March.

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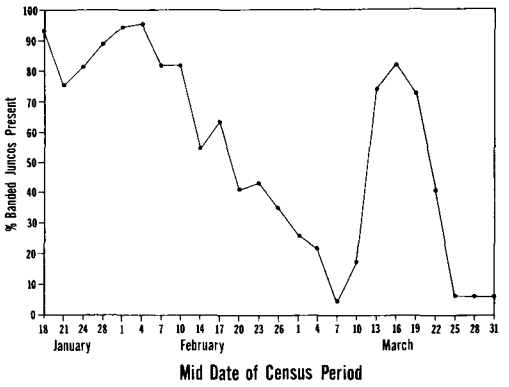

FIGURE 1. The percentage of banded Yellow-eyed Juncos present at the Southwestern Research Station during each 3-day census period (number of banded individuals seen at least once during the 3-day period/ total number of banded individuals at SWRS).

RESULTS

Yellow-eyed Juncos show site fidelity both between and within winters. Three of the birds banded at Rustler Park during the 1984 breeding season spent both the 1984–1985 and 1985–1986 winters at SWRS. A Yellow-eyed Junco banded in Portal (elevation 1,454 m, 3.9 km from SWRS) by S. Spofford during the 1984–1985 winter held a breeding territory at Rustler Park in both 1985 and 1986 and returned to Portal for the 1985–1986 winter. From 17 January to 11 February at least 75% of the banded winter residents were seen at SWRS during each 3-day census period (Fig. 1). During this period there was no measurable movement between census sites. None of the juncos banded at SWRS were seen at lower elevations, either at the Portal site (monitored by S. Spofford) or at Sunnyflat. Juncos banded at Portal (by S. Spofford) and Sunnyflat did not appear at SWRS until very late in the winter (17 March).

During the latter half of February the juncos at SWRS gradually dispersed (Fig. 1). By 26 February six banded juncos were seen singing and defending territories near SWRS. A late winter storm brought snow and low temperatures to the area on 11, 12, and 13 March. Rustler Park and other high elevation sites received at least 0.3 m of snow. Local males, holding breeding territories near SWRS, ceased singing and joined other Yellow-eyed Juncos in flocks. While only one banded junco was present at SWRS during the census period before the storm, 26 (72.2%) of the winter residents were present during the census period following the storm ($\chi^2 = 23.1$, df = 1, $P < 0.01$). During the 2 weeks following this storm most of the snow at the higher elevations melted and the Yellow-eyed Juncos at SWRS dispersed once again (Fig. 1). By 25 March only the local territory holders remained at the research station.

We found breeding territories for 11 of the 46 individually marked winter residents from SWRS and Sunnyflat. Six individuals from SWRS occupied territories near the research station and five individuals (two from SWRS and three from Sunnyflat) occupied territories at Rustler Park.

We documented the movements of one SWRS winter resident (O/M W/A) between its wintering and breeding sites. O/M W/A was banded as a juvenile at Rustler Park in 1984, spent the 1984–1985 and 1985–1986 winters in a flock at SWRS and held a breeding territory at Rustler Park in 1985 and 1986. This bird was seen at SWRS on 38 of 46 possible days between 3 January and 20 February 1986. O/M W/A left SWRS after 20 February, was observed singing at Rustler Park on 10 March and was then seen in a flock at SWRS on the morning of 12 March during the late winter storm. O/M W/A was last seen at SWRS on 20 March and was sighted at Rustler Park on 16 April, defending the same territory as before (March 10).

DISCUSSION

Yellow-eyed Juncos exhibit little movement between wintering sites prior to the onset of spring migration. Our results agree with Moore's (1972) observations that the size and composition of the winter flocks remains constant from mid-December to mid-February. At the beginning and end of the winter season, flock size is related to climatic conditions. Stable winter flocks might improve survival of members as an individual learns both the location of food sources and refuges and may spend less time on aggression associated with establishing dominance hierarchies (Balph 1979).

Yellow-eyed Juncos return to the breeding grounds several weeks before the earliest nests are constructed in late April. There could be advantages, both in terms of obtaining a territory and a mate, in occupying the breeding grounds as soon as the area is habitable (Ketterson and Nolan 1976, Gauthreaux 1978, Myers 1981). Any benefits of early arrival on the breeding ground would be offset to some extent by the costs of experiencing detrimental climatic conditions. Those costs may be minimal for Yellow-eyed Juncos in comparison to the costs experienced by long distance migrants. In the Chiricahua Mountains, Yellow-eyed Juncos probably spend the winter within 15 km of their breeding site. The relative proximity of the wintering and breeding sites may reduce the energetic expenditure required for migration, allowing individuals to assess climatic conditions at the breeding site, and to return to the familiar wintering site if conditions deteriorate. Within 72 hr of the onset of a spring storm at the high-elevation breeding sites, most of the SWRS winter residents returned to their wintering site. In particular, O/M W/A was foraging at SWRS the morning following the onset of inhospitable weather at its breeding site. The relative proximity of wintering and breeding sites for altitudinal migrants such as the Yellow-eyed Junco and the Carolina Junco (*J. h.* carolinensis, Rabenold and Rabenold 1985) appear to contribute to the facultative timing of spring migration by reducing the potential costs of early arrival on the breeding grounds.

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NAVIGATION TO NEST SITE IN THE SNOW PETREL (*PAGODROMA NIVEA*)[1,2]

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Key words: *Snow Petrel;* Pagodroma nivea; *olfactory navigation; visual navigation; breeding colony; Antarctica.*

Procellariiform birds have a well-developed olfactory apparatus (Bang 1966, 1971), suggesting that olfaction is of vital importance to these birds. Experiments made at sea (Hutchison and Wenzel 1980, Hutchison et al. 1984, Jouventin and Robin 1984) and in captivity (Jouventin 1977) strongly support the view that procellariiforms use olfaction in locating food. Evidence also supports the view that an olfactory guidance system is utilized to locate nesting burrows at night in the Leach's Petrel, *Oceanodroma leucorhoa* (Grubb 1974). Birds of this species approached their island upwind at twilight or after dark, plummeted through the heavy wooded cover and landed a few meters downwind of their burrows, finally walking upwind the last short distance.

When the ratio of olfactory bulb diameter to the largest diameter of the cerebral hemisphere was measured, the Snow Petrel, *Pagodroma nivea,* ranked highest among the 151 species from 23 orders studied, even higher than the Brown Kiwi, *Apteryx australis* (rank 2), and the Turkey Vulture, *Cathartes aura* (rank 10), both of which have been shown to be capable of discriminating between relevant food odors (Stager 1964, Bang and Wenzel 1985, Houston 1986).

During the Norwegian Antarctic Research Expedition in January to February 1985 to the Mühlig-Hofmann Mountains, in Queen Maud Land on the Antarctic continent, we had the opportunity to study a population of Snow Petrels, roughly estimated as 500 pairs (Mehlum et al. 1985). The colony was situated at Svarthamaren (71°53′S, 5°10′E), where the Snow Petrels were nesting close to and partly within a huge colony of the Antarctic Petrel, *Thalassoica antarctica.* The distance to the open sea was about 200 km.

To test whether the Snow Petrels depend on olfaction for navigation to their hidden nests, we carried out a small-scale experiment. Because of the 24-hr continuous daylight during the breeding season (the sun being continually above the horizon from 15 November to 27 January), we hypothesized that the birds should be able to locate the nests by vision alone, using learned landmarks. The results of our experiments in fact support this view.

METHODS AND MATERIALS

The majority of the Snow Petrels were nesting under large boulders on the ice-free, north-exposed hillside

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