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“WALKING-IN-LINE” BEHAVIOR IN SAGE SPARROW TERRITORIAL ENCOUNTERS

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“Walking-in-line” behavior was apparently first described in agonistic encounters between Red Grouse (*Lagopus lagopus scoticus*) (Watson and Jenkins 1964). In this behavioral sequence, two territorial neighbors meet on a mutual territorial boundary and walk parallel to each other for a distance of several to 120 m, occasionally running briefly or stopping but remaining parallel. Such encounters often last 5 min or longer and are accompanied by head-bobbing and both “attack-intention” and “flight-intention” calls. The encounters usually end when the birds move apart, but sometimes end in fighting, and may be repeated several times over a period of days. Similar behavior has been observed in other tetraonids including male Greater Prairie-Chickens (*Tympanuchus cupido*), Sharp-tailed Grouse (*T. phasianellus*) (Hjorth 1970; Sparling, pers. comm.), and Black Grouse (*Tetrao tetrix*) (Nethersole-Thompson and Nethersole-Thompson 1939).

Both the Killdeer (*Charadrius vociferus*; Phillips 1972) and Piping Plover (*C. melodus*; Cairns 1982) exhibit “parallel runs.” In the latter species, displays of low intensity are walked, and shoving between displaying birds has been observed. In Savannah Sparrows (*Passerculus sandwichensis*), two territorial males either walk or run parallel to each other on the ground along their mutual territorial boundary (Potter 1972). Occasional singing, buzzing, and fighting accompany their movement.

I observed “walking-in-line” behavior in the Sage Sparrow (*Amphispiza belli*) in Bingham County, Idaho on five occasions in 1976. During the first sequence, two territorial males approached each other in a series of short flights between perches in the tops of sagebrush (*Artemisia tridentata*) plants. Both began head-bobbing. After 10 s one male dropped to the ground while the other remained in the sage, and both birds moved parallel to each other about 0.3 m apart. This continued for 2 min and was interrupted by three brief fights wherein the males flew 2-4 m vertically in continuous contact. The birds moved a total of about 10 m. I heard no vocalization, but head-bobbing preceded each fight.

In four other encounters involving a different pair of males, the two birds moved parallel to each other on the ground and 2-6 m apart. Both sang low-volume full-length songs and pecked at the ground in a foraging manner; Sage Sparrows usually do not sing while foraging—they fly to exposed perches to sing. Also, I have heard males sing low-volume songs only in response to playback, and then only rarely. Each sequence covered nearly 50 m and lasted

several minutes with occasional fights as described above. No other displays were observed, but head-bobbing and unilateral wing-raising occurred shortly after the last sequence.

In Red Grouse, walking-in-line behavior is used by territory owners to defend precise boundaries of large feeding territories from intruders. Males meet on the same lines on different days and are often quite evenly matched. One bird raises the wing on one side and makes other presumably submissive postures, and both individuals bob their heads. On the leks of Greater Prairie-Chickens, Sharp-tailed Grouse, and Black Grouse, walking-in-line is also used to defend the boundaries of display areas. But in the Black Grouse, at least, precise boundaries are not always defended. Rather, groups of displaying birds may drift and, thus, walk-in-line along different lines (Wynne-Edwards 1962).

Parallel-run displays are also used for territory defense by Piping Plovers (Cairns 1982) and Killdeer (Phillips 1972). This display becomes much more important for the former species after territories are established. Piping Plovers show other accompanying behaviors similar to those of Sage Sparrows including head-bobbing, shoving (rather than fighting), and pecking at the ground (Cairns 1982). In Savannah Sparrows, walking-in-line is used to defend precise territorial boundaries (Potter 1972).

For Sage Sparrows, the walking-in-line behavior in the first case occurred in an area between the two males' territories early in the breeding season but ultimately did not define a precise physical boundary. For the second pair of males, one male eventually incorporated the encounter area into his territory and the other withdrew some distance for the remainder of the breeding season. In another part of southern Idaho, Sage Sparrows commonly used walking-in-line displays and these always defined precise territorial boundaries (Best, pers. comm.). The difference in the frequency of walking-in-line in these two Idaho populations was probably a result of different population densities. In my study area territories averaged over 4 ha with large buffer zones among them, whereas in the other study area males were much more densely packed (Peterson, pers. comm.). Thus, in the latter case the exact size of a territory and its boundaries may have been crucial to the reproductive success of the pair, and walking-in-line was used regularly in boundary defense. Where I made my observations, in apparently unsaturated habitat, this behavior may have been triggered by chance encounters with neighboring males. With little or no competition for space, these males simply avoided further contact with each other.

Walking-in-line is a highly ritualized behavior in the species discussed above and is a central feature of complex display sequences involving a variety of other behaviors. In several species it usually establishes which individual will have access to a portion of the area. The behavior of Black Grouse, however, suggests that this display may also

become divorced from a physical, i.e., territorial, setting and may serve to determine dominance for access to another resource, e.g., females. As both territoriality and dominance are apparently served by this behavior, it may be widespread among birds.

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A FIRST RECORD OF THE NEST AND CHICKS OF THE SMALL KAUAI THRUSH

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The Small Kauai Thrush, or Puaiohi (*Phaeornis palmeri*), is one of two endemic thrushes in the Hawaiian archipelago. Restricted to the island of Kauai, it inhabits wet montane forest dominated by ohia (*Metrosideros collina*, Myrtaceae), Hawaii's most abundant forest tree. The Puaiohi has always been considered rare (Rothschild 1893-1900, Perkins 1903), and now occurs only in a few local areas above 1,160 m in or adjacent to the Alakai "Swamp," a very wet montane forest on Kauai's deeply-dissected central plateau. It is listed as an endangered species by the U.S. Fish and Wildlife Service (U.S.F.W.S. 1980) and the International Council for Bird Protection (King 1981). The population was estimated at about 230 birds in the early 1970s (J. Sincock, pers. comm.).

The nests of only one-half of Hawaii's endemic passerine species have been described (Scott et al. 1980). For the thrushes, a completed, active nest of the relatively common Hawaiian Thrush, or Omao (*Phaeornis obscurus*), was not discovered until 1968 on the island of Hawaii (Berger 1969). Nests of now-extinct subspecies of the Omao on Lanai and Oahu were never found, and only two poorly described cup nests of the endangered Molokai race were ever located (Perkins 1903). Nothing seems to have been written on the nesting of wild Puaiohi, although three eggs laid by a captive female in the Honolulu Zoo were described by Berger (1972).

From 24 April to 25 May 1981 the U.S.F.W.S. conducted a survey of the forest birds of the Alakai, Kauai, as the final part of a six-year state-wide program to determine the distribution, abundance, and habitat correlates of all Hawaii's forest birds (see Scott et al. 1981). We were part of a team that included six ornithologists and

four botanists. We camped throughout the Alakai during the survey period, censusing birds in the mornings and exploring additional areas each afternoon. At 17:00 on 12 May 1981 we discovered the first known Puaiohi nest at 1,335 m elevation on a streamside cliff in the eastern Alakai. It was situated in a cavity in the bank 1.3 m above ground. The earth bank was about 6 m high, well vegetated, and about 12 m from the stream (Fig. 1). The muddy ground at the base of the bank was about 2 m above normal stream level, and there was no evidence from the intervening vegetation that the stream had recently extended to the bank. The cavity in which the nest was placed was 23 cm deep, 35 cm wide by 23 cm high at the entrance, and sloped slightly downwards. The back of the cavity was covered by a growth of large thalloid liverworts resembling *Marchantia* sp. Cliff protrusions overhung the cavity, which was surrounded to a distance of nearly 1 m by a dense mat of *Sadleria squarrosa unisora*, an endemic Kauai fern characteristic of wet banks. Tree ferns (*Cibotium glaucum*) and other nearby native shrubs (*Cyanea hirtella*, *Coprosma* sp.) afforded protection and shade for the nest site: they were also used as perches by adult Puaiohi when the birds approached the nest.

The nest, a woven cup placed at the cavity mouth, was constructed primarily of bryophytes and miniscule ferns, interwoven with small lengths of fine grass. The outer diameter was 11.6 × 10.8 cm, the inner diameter 9.0 × 7.2 cm, and the inner depth 6.0 cm. An untidy mass of nest material trailed about 6 to 8 cm out of the cavity mouth from the base of the nest. A portion of this apron of mosses, leafy liverworts, and ferns was collected, and included *Dicranum spirophyllum*, *Campylopus* sp., *Bazzania* sp., *Lepidozia* sp., *Adenophorus tripinnatifidus*, *A. hymenophylloides*, and three or four other unidentified species.

Two almost fully feathered nestlings with downy heads snugly occupied the nest (Fig. 2). Sooty gray pin feathers covered their heads, necks, throats, and tails. Most conspicuous were their emergent sooty-gray contour feathers, tipped with light brown spots (about 1 mm in diameter), which covered their backs, breasts, and flanks. Soft part colors were: iris, dark brown; eye-ring, tan; bill, yellow; inside of mouth, bright orange; and legs, pink. Both chicks appeared healthy and well-fed, with full (bulging) crops