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GENERAL NOTES

Pair formation behavior of the Galapagos Lava Heron.—The Lava Heron (*Butorides striatus sundevalli*) is a small ardeid endemic to the Galapagos Islands (Harris, Birds of Galapagos, Collins, London, England, 1974). This heron is characterized by its dark plumage and rather sedentary habits (Hancock and Elliott, The Herons of the World, London Editions, London, England, 1978). The birds occur along lava rock shorelines in the Galapagos, where they occupy permanent territories containing their nest-sites (Snow, Living Bird 13:15–72, 1975). This heron's breeding behavior is poorly known. In the only previous study of this species, Snow (1975) noted several differences between Lava and Green-backed herons (*B. s. virescens*), and she did not observe several pair bonding behaviors typical of herons. These findings suggested that the breeding behavior of the Lava Heron might be atypical compared to other populations of *B. striatus*.

During a study of Lava Heron territoriality, I was able to examine some aspects of pair formation. Although the study period was short, I observed a number of displays and followed one pair through courtship. In this paper I compare the pair formation behaviors of Lava Herons with those of Green-backed Herons and with the observations of Snow (1975). I especially consider how the sedentary habits and the permanent residency of this bird might have influenced the development of various courtship displays.

Study sites and methods.—My study was conducted on three sites in the Galapagos Islands in December 1978 and January 1979: Academy Bay on Isla Santa Cruz (14 days), James Bay on Isla Santiago (10 days), and Cartago Bay on Isla Isabella (2 days). The study site on Academy Bay encompassed the 1963 study area of Snow. I obtained information on 15 different birds nesting or engaged in pair formation. Most information on pair formation behavior came from the James Bay study site where I watched the courtship of four birds and followed one nesting attempt from the solo male stage into the incubation stage. Most of my detailed descriptions are from this pair but their behavior was typical of other observations I made. I usually watched from a distance of 5–10 m, but at times I approached as close as 2 m with no discernible effect on the birds. Individual birds were recognizable by unique plumage characteristics. I use the behavioral nomenclature developed for the Green-backed Heron by Meyerriecks (Publ. Nuttall Ornith. Club 9, 1960) as modified by Mock (Wilson Bull. 88:185–230, 1976).

Results.—Soft part coloration.—The legs of the Lava Heron turned from gray to a reddish-orange prior to pair formation, as noted by Snow (1975) who found that color changes in males occurred several weeks before egg-laying by the female. By the time of pair formation, the lores turned from green to bright cobalt blue, more so in the male than the female. The bill turned shiny black in males but remained silver-gray in females. In comparison, the tarsi of both the Green-backed Heron and the Striated Heron (*B. s. striatus*) turn from orange to orange-red, and the lores of the Green-backed Heron turn to blue-black (Meyerriecks 1960; Haverschmidt, Birds of Surinam, Oliver and Boyd, Edinburgh, Scotland, 1968). As with *B. s. striatus* and *B. s. virescens* (Meyerriecks 1960), it appears that the male *B. s. sundevalli* acquired more intense soft-part coloration than the female.

The overall plumage of Galapagos *Butorides* ranges from a condition similar to mainland *B. s. striatus* to a condition typical of dark *B. s. sundevalli* (Harris, Condor 75:265–278, 1973). Snow (1975) noted that a narrow streak on the lores periodically turned yellow and reported that one male lost his streak during incubation. My observations support Snow's (1975) contention that the yellow streak is a *B. s. striatus* characteristic. However, I detected no temporal change in the brightness of the streak in individual birds. Snow (pers. comm.)

has indicated that she now believes the yellow streak was lost because of the change in lore color.

Timing of nesting.—Lava Herons can nest three times yearly (Snow 1975). At Academy Bay, six of seven individuals under observation had been recently or were currently engaged in nesting activities. Fledged young were present in one territory, and eggs were being incubated at two other sites. At James Bay I saw no evidence of nesting activity from 23–28 December, but within the next week five birds on adjacent territories assumed breeding coloration and initiated pair formation, soon after heavy rains broke the seasonal drought. Thus, it appeared that the birds on James Bay were more synchronized than those at Academy Bay and that the beginning of the rains on this drier shore may have influenced the start of breeding activity. Similarly, Grant and Boag (Auk 97:227–244, 1980) found rainfall patterns affected the reproductive cycles of Darwin's finches (Geospizinae) on the Galapagos.

Flight displays.—Snow (1975) suggested that Lava Herons did not use flight displays often. However, I saw many instances of the flight displays described by Meyerriecks (1960) and Mock (1976). I observed "flying around behavior," "pursuit flights" directed against both adults and older juveniles, and one "supplanting flight" of a male directed against its eventual mate. Birds also flew in "circle flights," but they did not land at the same place as they started. Similar flight behaviors seem to occur outside of the nesting period and so may be primarily functional in defending or advertising territories.

Pair formation.—Males vocalized from their nest-sites using *skow* calls. The Green-backed Heron gives this advertisement call in the same context. In contrast, however, the Lava Heron also gave *skows* from its feeding territory during the pair-formation period, occasionally interrupting feeding with such calling. Only *skuk-skuk* calls were given in agonistic encounters. Vocalizing appears to function in pair formation. In my most complete set of observations, a female approached two advertising males that called on adjacent territories before choosing one of them. These observations differ from those of Snow (1975) who found that the advertising call was rare.

I saw initial pairing of two birds on James Bay. The male advertised with *skow* calls while walking near a bush containing an old nest platform along the landward edge of the lava shore. The male flew out of its territory in a circle flight and then returned, and called from the bush that later held the nest. When its eventual future mate landed nearby, the male flew from the bush and landed near her on the shore. The male then flew back to the bush, and the female followed slowly after him and walked into the bush. Once in the bush, the two began mutual courtship displays. This early pairing sequence resembled that described by Meyerriecks (1960) for *B. s. virescens*, except for the extensive walking of Lava Herons. Green-backed Herons typically fly to and from their nest locations (Meyerriecks 1960), even though these may be located no higher than Lava Herons' nests.

In the bush, the male displayed from an old nest platform, performing typical "stretches" and "snaps," resembling those Meyerriecks (1960) described for *B. s. virescens*, except I noted no exaggerated swaying during the stretch. As in *B. s. virescens*, the male's stretch was often accompanied by a soft *coo*. The snap was often a gentle "bow" with no bill-snap component characteristic of *B. s. virescens*. The female initially remained about 1 m from the male, giving stretches and snaps, including the bow. During stretch performances, the female uttered a soft *cow*. The female display frequency exceeded that of the male, who manipulated old nest material with his bill. Both birds infrequently gave "forwards" and poked each other with their bills. The female stepped onto the nest, carefully positioning herself under the male's neck, and began to manipulate nest material. Both then manipulated the material before the male moved off to collect new sticks. When together at the nest, both gave snaps and engaged in considerable preening, primarily directed to wings, breast, and back. Allo-

preening involved the female nibbling at the male's crest. The frequency, extent, and appearance of preening suggested that preening was part of the display repertoire.

The behavior of the female Lava Heron differed in detail from that described by Meyerriecks (1960) for *B. s. virescens*. He noted that, except for nest exchange, stretches were given by the female only after she had gained access to the nest, at which time the male's stretch display ceased. I saw courting Lava Herons giving simultaneous stretches, before the female had first moved onto the nest-site. Meyerriecks (1960) did not see a female Green-backed Heron perform a snap display, whereas I saw both snaps and bowing in Lava Herons. One time a male mounted a female away from the nest-site. Copulation attempts were not necessarily preceded by stretches and appeared rather casual.

Discussion.—Pair formation of the Lava Heron generally resembled that of the Green-backed Heron described by Meyerriecks (1960). The substantial similarities are added evidence of a close relationship and lend no support for doubting Payne's (Bull. Br. Ornithol. Club 94:81–88, 1974) view of the conspecificity of the three forms of *Butorides*.

The ways in which courtship behaviors of Lava Herons do differ from those of Green-backed Herons are of particular interest in that such differences seem to be related to the Lava Heron's territorial system. Meyerriecks (1960) found that the area defended by the male Green-backed Heron decreased during the period of pair formation. In contrast, a Lava Heron continued to defend a length of shore including its nest-site during nesting, because the nest-site is only part of a larger pre-existing defended area. The protracted maintenance of a large territory may be related to other unusual aspects of pair formation, including the Lava Heron's reliance on terrestrial rather than aerial locomotion. Also, the courtship activity of Lava Herons is not confined to the nest-site. Males advertise, flights are initiated, and females may make contact with displaying males on the feeding territory away from the nest-site. Expansion of the courtship display arena appears to be a secondary response to the permanent, exclusive possession of a larger land area.

Differences between Lava and Green-backed herons in pair formation displays included the female performing the stretch at the nest-site, her performing snaps, and her lack of swaying. It is possible, however, that such variations also occur in other *Butorides* populations which are poorly known. My observations may not even reflect the situation in all Lava Herons. My study concentrated on birds that foraged along the lava shore. Other birds nest in mangrove patches and may not have nest-sites within feeding territories. Considering the limits of current knowledge, it would seem premature to give much weight to the display differences I observed.

One characteristic of the courtship of Lava Herons that stood out was its apparent perfunctory quality, lacking the intense aggressive behavior described for the Green-backed Heron by Meyerriecks (1960). Such a difference may reflect mutual recognition between potential Lava Heron mates. Failure of the female to respond to a potential supplanting attack, boldness of the female in entering the nest bush and periodically poking at the male, limited aggressive forward behavior by the male, early copulation attempts off the nest-site, and ease of final access of the female to the nest all may be explained by familiarity of the two birds with each other. The very limited development of color parts in the female compared to the male may also reflect a lessened need for a recognized female to be identified by the male as in breeding readiness in order to effect her entrance into his territory. Snow's (1975) observations support my suggestion insofar as she found that the same birds may breed together in successive nesting episodes. Displays might be expected to be less complex when birds familiar with each other form pairs.

Thus, it appears then that most differences observed between Lava Herons and the Green-backed Herons studied by Meyerriecks (1960) reflect the former's possession of a territory that is held throughout the year. Long-term occupancy leads to continued association and

recognition of neighboring birds. As noted by Snow (1975), repeated breeding through the year would be facilitated by repetition in mate choice, which could result in abbreviated courtship, comparatively rapid lowering of aggressive tendencies, and simplification and truncation of courtship displays.

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Pre-migratory behavior of Common Loons on the autumn staging grounds.—Animals are frequently depicted as social or non-social organisms. Evidence indicates that such rigid categorizing should be reevaluated (Stacey and Bock, Science 202:1298–1300, 1978). Common Loons (*Gavia immer*) claim large territories as mated pairs during the summer breeding season and have developed a reputation as non-social birds. They are highly visible at this time, and because lakes smaller than 100 ha are rarely occupied by more than a single pair, loons are termed "solitary."

However, they do form intraspecific associations throughout the year. Loons raft at night on the wintering grounds (McIntyre, Auk 95:396–403, 1978), begin migratory flights in groups (Williams, Wilson Bull. 95:238, 1973), have been recorded in large numbers during migration (Trautman, Univ. Mich. Mus. Zool. Misc. Publ. 44:99–100, 1940; Hochbaum, Travels and Traditions of Waterfowl, Univ. Minn. Press, Minneapolis, Minnesota, 1955) and have been noted in summer flocks (Rand, Can. Field Nat. 62:42–48, 1948; Predy, Blue Jay 30: 221, 1972; Nero, Blue Jay 30:85–86, 1972, and Blue Jay 32:113–114, 1974). Herein we report on aggregations and activities of Common Loons during autumn.

Study site and methods.—Mille Lacs Lake is a large (54,000 ha) shallow lake in Aitkin, Crow Wing, and Mille Lacs counties in central Minnesota, and is known for its walleye (*Stizostedion vitreum*) sport fishing. The major fish species in terms of biomass is yellow perch (*Perca flavescens*), and cisco (*Coregonis artedi*) is sufficiently abundant to provide an annual commercial harvest.

Observations were made 2–3 days each week from 24 September–11 November 1975; we were at the site daily from 20–25 October. Aerial surveys were made on 6, 20, and 25 October, and 3 and 11 November. The entire lake was covered during the first four surveys. Only the west side was covered during the last flight and the survey discontinued because we found no loons.

Shore surveys were made periodically from all vantage points around the lake, principally on the west side after it was found to be the site of most loon concentrations. On 21 October we followed loon flocks by boat from 09:15–11:45 and from 17:00–20:00. On October 22 and 23 we made continual observations from 07:30–10:30 CDST with one observer at each of two locations. All shore and boat surveys were made with 40× spotting scopes and/or 10 × 50 binoculars.

Results.—(1) Lake use. Loons congregate primarily on the west and northwest sides of the lake. Mille Lacs has a gradual slope over much of the lake (3000–6000 m to the 7.5 m contour line) but in some places the slope is steeper (<1800 m to the 7.5 m line) and feeding groups