

BIOMETRICS OF SEMIPALMATED SANDPIPERS *CALIDRIS PUSILLA* IN SOUTHERN BRAZIL

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The Semipalmated Sandpiper *Calidris pusilla* is known to spend the boreal winter as far south as southern Brazil and Uruguay and occasionally to southern Argentina (AOU Press, Lawrence, Kansas, 1983). They have not been recorded however, from Rio Grande do Sul, the southernmost state of Brazil prior to 1984 (Belton 1984). This paper concerns Semipalmated Sandpipers captured in this area.

Morrison (1984) used wing and bill measurements to show from what part of the species breeding range individuals wintering in Suriname and elsewhere in northern South America are likely to have originated. Few measurements are available from southern South America for comparison. In this report we give measurements of *Calidris pusilla* captured at Lagoa do Peixe, Rio Grande do Sul, Brazil (c. 31°21'S, 50°00'W).

We captured 11 individual *C. pusilla* with mist-nets between 28 April and 3 May 1984. Another 49 individuals were trapped (N=39) or mist-netted (N=10) at the same location, mainly between February and 13 April 1987. The average exposed culmen length (20.3±1.5 mm, Table 1) of this sample agrees well with the 20.2±1.5 mm that Harrington and Morrison (1979) reported for *Calidris pusilla* from the northeastern United States (Plymouth, MA) during southward migration. The measurements of these birds corresponded to those of museum specimens from eastern Canadian arctic breeding zones.

The mean bill/mean wing ratio (0.205) for the 60 birds we captured in southern Brazil also suggests an eastern Canadian origin of the birds but could indicate predominance of females from Western Canada, since the birds were not sexed. Harrington & Morrison (1979) found that in the eastern breeding populations ratios for males were between 0.201 and 0.209 and ratios for females were between 0.209 and 0.221, while Western Canadian females had ratios of 0.204 to 0.207. Only birds with fully grown new primaries were considered for the bill/wing ratio, to avoid any bias due to incompletely grown or badly worn primaries.

The average weight for the 1984 sample (Table 1) was 32.2±6.6 g (N=9), with a range of 23 to 40 g. As it is likely that only the heaviest birds were ready to resume their northward flight, we used weights of the five heaviest birds (mean weight = 37.2±0.9 g) to estimate flight range capacities using McNeils' formulae (McNeil 1969). The estimate suggests that *C. pusilla* from Rio Grande do Sul were capable of

Table 1. Morphometrics of Semipalmated Sandpipers *Calidris pusilla* in Lagoa do Peixe, Brazil in 1984 and 1987.

	Bill length mm	Narina mm	weight g 1984	weight g 1987
Mean	20.3	18.3	32.2	23.8
S.D.	1.5	1.6	6.6	3.1
C.V.	7.5	8.5	20.5	12.9
N	57	59	9	48*

* excluding one recapture

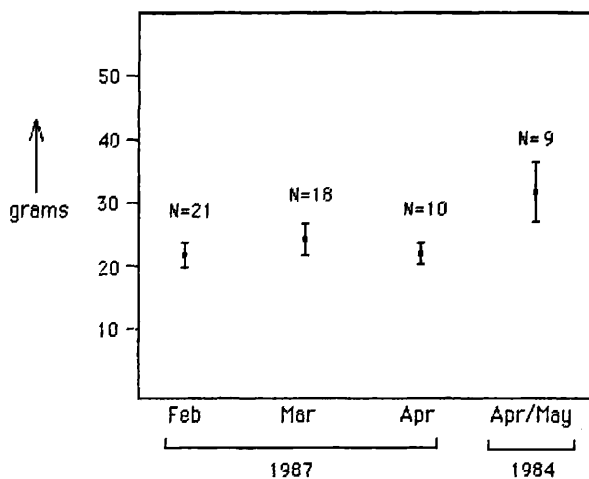


Figure 1. Mean weight (±SD) of Semipalmated Sandpipers in Lagoa do Peixe, Brazil.

flying non-stop for 4 000 km, a distance which would allow travel directly across eastern Brazil to major coastal wintering and migration areas used by the species in the Guianas (Spaans 1978). A route similar to this was hypothesized recently by Antas (1983).

Figure 1 shows the mean weight (±SD) for each month, and shows a slight trend towards higher weights from February to March and then a decrease before weights increase considerably in April-May. Although the sample is small, we suggest these results can be explained as follows: by mid-late March, a portion of the birds had gained enough weight for a flight to northern South America, and left Lagoa do Peixe. A few birds were caught with high weights during late March (32 g, 30 g, and some at 27 g), but the average weight for each month was lower than during April-May 1984. A departure at this time would parallel our findings for White-rumped Sandpiper *Calidris fuscicollis*, with which Semipalmated Sandpipers often associate at the lagoon. Presumably those which remain gain weight during the following weeks, which may explain the higher weights found in late April-early May.

Morrison (1984), summarizing information from northern South America, showed longer average bill lengths of Semipalmated Sandpipers from areas east of Suriname (20.1 mm in Belem) than from west of Suriname (18.9 mm in Venezuela). The mean values from areas east of Suriname agree well with ours. If Semipalmated Sandpipers from Rio Grande do Sul migrated west of Suriname, we would expect an average bill length in southern Brazil shorter than which we found.

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ALARM CALLS, HABITUATION AND FALCON PREDATION ON SHOREBIRDS

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INTRODUCTION

The ability to recognize predators and avoid predation are critical elements in the life history strategy of most birds. Habituation to improper stimuli and anti-habituation to predators are thought to be innate discriminatory mechanisms (Mueller & Parker 1980) which develop as an animal experiences a variety of contexts (Shalter 1984, Seyfarth & Cheney 1986). The ability to minimize habituation to predators, especially predators which are hunting, is perhaps more important than habituation to improper stimuli. Habituation to improper stimuli appears to develop in concert with anti-habituation to appropriate sources (e.g. Seyfarth & Cheney 1986). Anti-habituation must develop quickly because "...the inability to keep reacting (or at least keeping vigilant) to a predator, unless it is likely to attack, would make life very short" (Shalter 1984).

One way in which birds avoid predation is through the use of auditory signals. These signals advertise knowledge of a predator's presence and may be intended for the predator itself or as a warning to others. Habituation and alarm signals are intimately linked; the accurate assessment of predation risk is prerequisite to effective alarm signaling. In turn, selective advantage is accrued only by those who properly interpret signals (but see Charnov & Krebs 1975).

In this paper I discuss habituation and alarm signaling as these relate to real or potential predatory contexts experienced by shorebirds wintering in western Washington. In addition, I speculate about possible adaptive functions of these behaviour types, some of which may apply to shorebirds susceptible to similar predation

pressures in other wintering areas. Specifically, I speculate about 1) a possible relationship between sandpiper alarm calls and observed regional differences in predator efficiency, 2) the relationship between sandpipers and shorebirds which give mobbing alarm calls, and 3) the significance of habituation exhibited by larger shorebirds during hunting flights by falcons.

BACKGROUND ON ALARM CALLS

Birds, like mammals, compare incoming signals using binaural phase and intensity cues to locate sounds (Marler 1955, 1957). Binaural comparison of low frequency signals reveals differences in phase (time difference) while high frequency signals are interpreted through differences in intensity (see Gourevitch 1978, Knudsen 1980). Effective binaural comparison of phase and intensity differences are made within largely independent frequency ranges. Between these frequency ranges sounds are localized less effectively (see Calford et al. 1985 for discussion of frequency gaps in raptors). In humans this crossover range occurs at c. 1.5-3 kHz and in birds and mammals it is higher, depending on the overall auditory range (in kHz) and head size (distance between ears for binaural comparison).

Calls given by birds in response to predators are generally of two varieties: mobbing calls and "seeet" alarm calls (Marler 1955). Perception advertisement appears to be an important benefit of mobbing calls. The perception advertisement hypothesis states that an obvious display by the potential prey will advertise to a predator that it has been seen, thus reducing the probability of attack (for review see Klump & Shalter 1984). In contrast,