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## HABITAT USE AND RELATIVE ABUNDANCE OF MIGRANT SHOREBIRDS IN A WESTERN AMAZONIAN SITE<sup>1</sup>

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*Key words:* Migrant shorebirds; Manu River; southeastern Peru; habitat use; dry season.

Little is known about the ways in which migrant shorebirds use the interior of South America as a stopover and wintering area (Dott 1985, Thomas 1987). The extensive river systems of the Amazonian headwaters offer a potentially rich, but highly seasonal, array of habitats for shorebirds. During the wet season, river channels are completely covered with water and there is little shorebird habitat. During the dry season, however, water levels drop well below their wet-season levels, exposing extensive mudflats, sandbars, and beaches on the rivers and lakes. The availability of habitats for shorebirds should therefore depend upon the timing of the wet and dry seasons relative to the timing of the shorebird migration. Our purpose in this paper is to describe the dynamics of and habitats available to the migrant shorebird community in the Manu River area of southeastern Peru.

### STUDY AREA

This research was conducted at the Cocha Cashu Biological Station in the Manu National Park in the Department of Madre de Dios, southeastern Peru, at 71°19'W, 11°51'S. The biological station is located on an oxbow lake (Cocha Cashu) 0.5 km from the bank of the Manu River (see Fig. 1). The Manu River meanders over a broad floodplain and forms extensive beaches on the inside of its many curves. The river channels along meander loops vary widely in structure during the dry season, but typically consist of five distinct zones. A zone of early successional vegetation

forms along the inside of the meander loop (Zone 1 in Fig. 1) consisting largely of a tree-like composite *Tessaria*. On some beaches, a steep bank occurs at the edge of the *Tessaria* at the bottom of which is a shallow depression containing standing water (Zone 2). This depression represents a secondary river channel during periods of high water. Zone 3 consists of a beach of fine, white sand on which young *Tessaria* grow throughout the dry season. These beaches form above the usual dry season (mid-June to mid-November) water level and therefore seldom receive fresh silt during the dry season. At the edge of these beaches, there is often a vertical bank, 0.5 to 2 m above water level. Below this bank is a gradual slope which is only exposed at very low water levels (Zone 4). Sandbars sometimes form in the middle of the river (see Fig. 1), usually downriver from large logjams. The amount of beach and mudflat exposed in Zone 4 changes dramatically with slight variations in water level. The outside banks of meander loops (Zone 5), where most erosion occurs, are steep and generally mudflats occur there only at very low water. During the wet season, which usually extends from mid-November to early June, Zones 2, 3, and 4 are underwater, leaving no exposed mudflats. Periodic floods early (June) and late (October–November) in the dry season cover the sandy beaches with a layer of fine silt.

Oxbow lakes, or cochas, form when a meander loop is cut off from direct flow from the river. Marshes form in areas which had formerly been beaches; these marshes are invaded by shrubs as succession continues. The area that was Zone 5 when the lake was part of the river (see Fig. 1) becomes overgrown with vines, but the bank remains steep, and no marshy vegetation forms. The water level in these lakes drops gradually during the dry season. In dry years, mudflats are exposed along the edge of marshes.

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## METHODS

Shorebird censuses were conducted daily in 1983 along a beach of the Manu River (12 October to 25 November) and on the southern half of Cocha Cashu (4 October to 25 November) (Fig. 1). During each river census, Bolster walked a 1.9-km census route along the river and recorded the locations of each shorebird and estimated the amount of habitat available on a scale of eight (0 = no beach exposed, 8 = extensive sand bars exposed). During each lake census, Robinson paddled a canoe around the edge of the southern third of the lake and noted the locations of any shorebirds. Additional censuses of the entire lake margin were conducted on the following dates: 2 and 15 August, and 4, 15, and 21 September. Once a week the lake level relative to a fixed point on a log embedded in the lake bottom was also noted. Robinson also conducted weekly late censuses from September through November, 1984–1988. Three shorebirds were netted in 1983 and another 12 were netted in 1987 on Cocha Cashu, individually marked with color bands, and observed for as long as they were present on the lake. Unless otherwise stated, all shorebirds from years other than 1983 were observed by Robinson.

## RESULTS

## SPECIES ACCOUNTS

The Lesser Golden-Plover (*Pluvialis dominica*) was not recorded during the 1983 census, and is known from only three records near Cocha Cashu (S. Robinson and J. Fitzpatrick, pers. observ.).

The Greater Yellowlegs (*Tringa melanoleuca*) is considerably less common than the Lesser Yellowlegs (*T. flavipes*). In 1983, most records were from later in the season when birds fed mostly along the lake. Records range from 2 August through 20 December.

The Lesser Yellowlegs is a common migrant occurring primarily along lakes, but also along the river.

The Solitary Sandpiper (*T. solitaria*) is a common migrant and short-term resident during the late dry season along the lake and river. Recorded from 28 July to 22 December.

The Spotted Sandpiper (*Actitis macularia*), the commonest shorebird along the river, is the only migrant found in the Manu area throughout the wet season. Unlike most shorebirds, Spotted Sandpipers occurred regularly along the bottom of steep river banks (Zone 5 in Fig. 1) and on logjams.

The Upland Sandpiper (*Bartramia longicauda*) was almost entirely restricted to sections of the beach that are overgrown with *Tessaria* and weeds (Zone 2 in Fig. 1). Records range from 21 August to 5 November.

A Sanderling (*Calidris alba*) was observed by E. Ortiz on 5 September 1988, the only Manu record for this species.

The White-rumped Sandpiper (*C. fuscicollis*) was not recorded in 1983 and is known from only six sightings, all in Zones 2 and 4 of the river (Fig. 1).

Baird's Sandpipers (*C. bairdii*) were recorded only once in 1983, and have been recorded six other times (three times in Zone 2 and three times in Zone 4).

Pectoral Sandpipers (*C. melanotos*) migrate commonly along the lake in Zones 2 and 4 of the river beaches. Records range from 1 to 28 August.

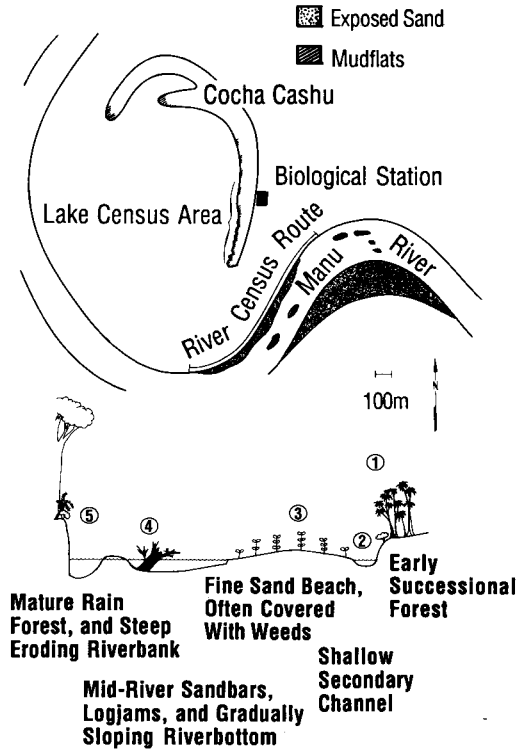


FIGURE 1. Map of the 1983 census areas around the Cocha Cashu Biological Station, and a schematic cross section of the Manu River, showing principal habitat zones (circled numbers).

The Stilt Sandpiper (*Calidris himantopus*) appears to be found primarily along oxbow lake margins during dry years and on larger mudflats in Zone 2 of river beaches. All records are between 25 September and 30 October.

The occurrence of Buff-breasted Sandpipers (*Tryngites subruficollis*) in the Manu area has already been documented (Terborgh et al. 1984). The individuals we observed in 1983 were on open, dry sandbars in the middle of the river, principally in September and October.

The Short-billed Dowitcher (*Limnodromus griseus*) photographed by Bolster on the lake on 12 November 1983 represented the first Manu area record for this species.

The Wilson's Phalarope (*Phalaropus tricolor*) is a rare migrant in the Manu area, occurring in small numbers on oxbow lakes and mudflats (Zone 2 in Fig. 1). On 21 September 1982, a flock of 20 was observed by Robinson on a large mudflat in a beach. Records range from 2 September through 6 November.

## BEACH CENSUS

In 1983, shorebirds were most common along the river in early October (Fig. 2) when the river was very low and had been low for the previous 3 months (Bolster

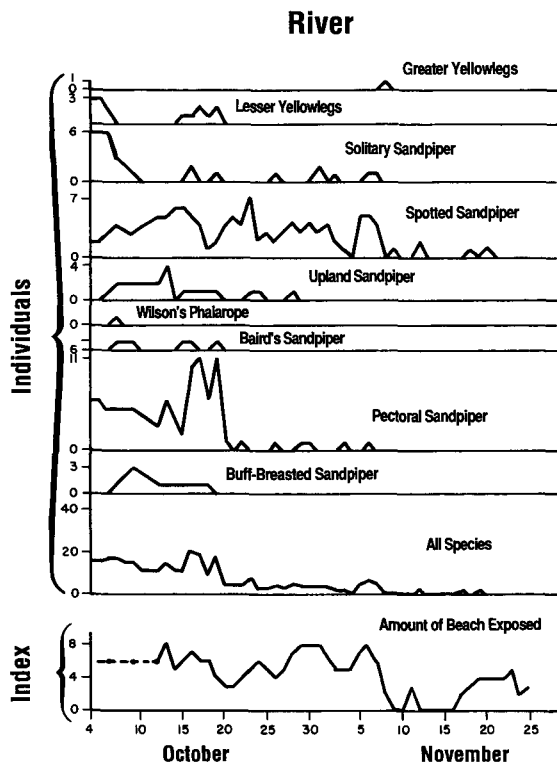


FIGURE 2. Shorebird populations along the portion of the Manu River censused in 1983.

and Robinson, pers. observ.). Beginning on 19 October 1983 the river rose for 5 days and flooded most of the sandbars in the river. The loss of this habitat coincided with a marked decrease in overall shorebird numbers (Fig. 2). Shorebird numbers recovered somewhat after the water level dropped again towards the end of October. The flood, however, left behind a 2- to 4-cm layer of silt, which covered the sandbars of Zone 3 (Fig. 1) and apparently made them unsuitable for shorebird use. A second major flood on 9 November covered the entire beach and all but a few Spotted Sandpipers left the area.

LAKE CENSUS

In 1983, the lake fell to its lowest level in 6 years (Robinson, unpubl. data), perhaps as a result of the El Niño drought (D. Duffy, pers. comm.). The exposed habitat was used extensively by five species of shorebirds, and infrequently by two others (Fig. 3). As the lake level dropped in August and September, more and more shorebirds appeared on the small mudflats bordering the marshes. In mid-November, however, most shorebirds disappeared after the lake level rose 7.5 cm.

Lesser Yellowlegs, and Solitary and Pectoral sandpipers defended territories against each other, and fed singly or in small flocks. One Solitary Sandpiper banded on 18 September 1983 remained in the same cove until 27 October when it disappeared. This marked

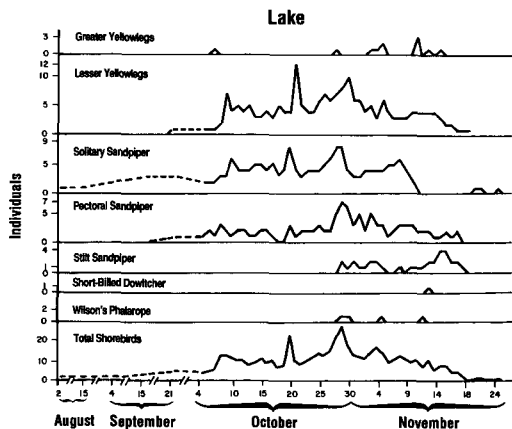


FIGURE 3. Shorebird populations along Cocha Cashu mudflats in area censused in 1983.

individual defended a mudflat roughly 20 m long and 1 m wide against other Solitary Sandpipers which it regularly chased away. A marked Lesser Yellowlegs defended nearly the same territory and often fed together with the marked Solitary Sandpiper. A second marked Solitary Sandpiper was chased away by the first from two adjacent mudflats, and disappeared on the same day that it was caught. Most shorebird flocks consisted of single individuals of each species. The average flock size on Cocha Cashu ( $\bar{x} = 2.94 \pm 0.92$  SD individuals) consisted of a nearly equal number of species ( $\bar{x} = 2.88 \pm 0.89$  SD,  $n = 97$ ).

YEAR-TO-YEAR VARIATION

From 1980 to 1982, the level of Cocha Cashu never dropped low enough to expose mudflats, and only Solitary and Spotted sandpipers were observed feeding (Robinson, unpubl. data). In 1982, there was a large mudflat cut off from the flow of the river in Zone 2 of the beach closest to Cocha Cashu. During the first week of October 1982, there were many shorebirds on this flat including three to 20 Wilson's Phalaropes, three to eight Solitary Sandpipers, four to seven Lesser Yellowlegs, zero to two Greater Yellowlegs, one White-rumped Sandpiper, and two to 10 Pectoral Sandpipers, which represented the largest concentration of shorebirds ever recorded in the Manu area. On 10 October, however, the river rose approximately 8 m after a 22-cm rain, completely eliminating the mudflat and changing the river channel. After this flood, which also caused the waters of Cocha Cashu to rise over 4 m, Spotted Sandpipers were the only shorebirds seen in the area (Robinson, unpubl. data). During 1984-1988 the lake level never dropped low enough to expose mudflats, and again only Spotted Sandpipers were recorded on lake censuses (S. Robinson, unpubl. data).

DISCUSSION

Shorebirds did not occur in dense aggregations in the Manu during migration as they do in the coastal areas of South America (Duffy et al. 1981). Most shorebirds occurred in small numbers on any one beach or lake

and many were territorial, which would further limit local population densities. Western Amazonia, therefore, may have few areas where shorebirds are concentrated and in need of special protection (Myers 1983).

Perhaps the major reason why migrant shorebirds do not occur in large numbers is the unpredictability of the onset of the rainy season. The peak numbers of most shorebirds occurred in October, which also coincides with the beginning of the wet season (Terborgh 1983). Early rainy season floods cover mudflats and leave behind a layer of silt which may impede foraging. Only the Spotted Sandpiper, which uses steep river banks and logjams, remains after the first wet season floods. We know nothing, however, of prey concentrations, which may also influence shorebird abundance.

Nevertheless, the large extent of habitat available on the many tributaries of the Amazon may provide important shorebird habitats. Areas south of the equator such as the Manu River may be used primarily as stopovers during the southward migration. Areas north of the equator, where the seasons are reversed, may be used primarily during the northward migration. Indeed, some shorebirds could winter entirely within the Amazon basin by staying south of the equator from August to November, and then migrating north of the equator from December to April, where they occur in Venezuela (Thomas 1987). There are, however, no

comparable data on the occurrence of shorebirds from a site in northwestern Amazonia.

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## EXTRA-PAIR COPULATIONS IN BLACK BRANT<sup>1</sup>

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Monogamy is the primary mating system among waterfowl, but extra-pair copulations (EPCs) have been documented in at least 39 species (McKinney et al. 1983). Extra-pair copulations occur in most Holarctic species of dabbling ducks (*Anas* spp.), but have been recorded in only three species of geese: Lesser Snow Geese, *Chen caerulescens caerulescens* (Mineau and

Cooke 1979a), Ross' Geese, *C. rossii* (J. Ryder in McKinney et al. 1984), and Greater White-fronted Geese, *Anser albifrons frontalis* (C. R. Ely, pers. comm.).

In colonial Lesser Snow Geese, the close proximity of nesting conspecifics may enable males to pursue EPCs as a secondary reproductive strategy (Mineau and Cooke 1979a, 1979b). Copulatory behavior of other geese has not been studied in sufficient detail to permit comparison with Lesser Snow Geese. Here we report on timing and rates of pair copulations (PCs) and EPCs, and describe behaviors associated with EPCs in colonially nesting Black Brant (*Branta bernicla nigricans*).

#### METHODS

This study was conducted on the Tutakoke River Black Brant colony (61°15'N, 165°40'W), on the coast of the Yukon Delta National Wildlife Refuge, Alaska, during 1984-1986. Habitat consisted of coastal tundra dom-

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