

OCCURRENCE OF MIGRANT SHOREBIRDS IN THE MARIANA ISLANDS

DEREK W. STINSON¹

*Division of Fish and Wildlife
Department of Land and Natural Resources
Saipan, MP 96950*

GARY J. WILES

*Division of Aquatic and Wildlife Resources
Guam Department of Agriculture
P.O. Box 2950
Agana, Guam 96910*

JAMES D. REICHEL²

*Division of Fish and Wildlife
Department of Land and Natural Resources
Saipan, MP 96950*

Abstract—We summarize data on seasonality and relative abundance of shorebirds in the Mariana Islands based on bi-weekly surveys on Saipan (1987–1993) and Guam (1980–1981), and miscellaneous counts and records from all 15 islands. Of 46 species documented (36 Scolopacidae, 7 plovers, 1 stilt, 1 oystercatcher, 1 pratincole), only the Pacific Golden-Plover (*Pluvialis fulva*) is abundant. The Whimbrel (*Numenius phaeopus*), Gray-tailed Tattler (*Heteroscelus brevipes*), and Ruddy Turnstone (*Arenaria interpres*) were common, and the Wood Sandpiper (*Tringa glareola*), Common Sandpiper (*Actitis hypoleucos*), Wandering Tattler (*Heteroscelus interpres*), Rufous-necked Stint (*Calidris ruficollis*), and Mongolian Plover (*Charadrius mongolus*) were uncommon migrants and winter visitors. A greater number and variety of shorebirds were seen during autumnal migration, which coincides with flooding of seasonal wetlands and higher shorebird populations, than during spring migration. The rarity of certain species, radar studies, and comparison with studies elsewhere in the region, support the hypothesis that some species normally migrate non-stop between Asia and Australia. The archipelago is not a major wintering or stopover area, but shorebirds make up a large portion of the avifauna of the islands. Inter-tidal foraging areas are very limited in the Marianas and the most important sites are threatened by development and human activity.

INCIDENCIA DE AVES COSTERAS MIGRATORIAS EN LAS ISLAS MARIANAS

Sinopsis.—Resumimos datos sobre la estacionalidad y abundancia relativa de aves costeras en las Islas Marianas basados en muestreos bisemanales llevados a cabo en Saipán (1987–1993) y en Guám (1980–1981), y en conteos y registros misceláneos de todas las 15 islas. De 46 especies documentadas, solo *Pluvialis fulva* es abundante. Migrantes comunes incluyen a *Numenius phaeopus*, *Heteroscelus brevipes* y *Arenaria interpres*, mientras que *Tringa glareola*, *Actitis hypoleucos*, *Heteroscelus interpres*, *Calidris ruficollis* y *Charadrius mongolus* resultaron visitantes invernales y migratorios raros. Durante la migración otoñal se pueden observar un mayor número y variedad de aves que durante la migración primaveral. Esto coincide con la inundación de anegados estacionales. La rareza de ciertas especies, estudios de radar, y

¹ Current address: 12106 SE 314th Pl, Auburn, Washington 98092 USA.

² Current address: Montana Natural Heritage Program, 1515 E. 6th Ave., Helena, Montana 59620-1800 USA.

comparaciones con estudios en otras partes de esta región, apoyan la hipótesis de que algunas especies normalmente migran sin detenerse entre Asia y Australia. El archipiélago no es un área principal de escala migratoria o invernada, pero aves de costas forman la porción principal de la avifauna de las Islas Marianas. Las áreas de forraje entre mareas son muy limitadas en las Marianas, y los lugares más importantes están amenazados por el desarrollo y la actividad humana.

Large numbers of shorebirds migrate annually between their breeding grounds in northeastern Asia and Alaska and wintering areas in southern Asia, Australia, New Zealand, and the islands of the tropical Pacific. Most migrants pass along routes through eastern Asia (Lane 1987, Parish et al. 1987, Williams and Williams 1990). However, some birds travel farther to the east across the open expanses of the western Pacific Ocean, thereby taking a more direct flight path between Japan and New Guinea.

Baker (1951:35) originally proposed the existence of a Japanese-Marianan Flyway in which shorebirds flew southward from Japan along a corridor following the Izu, Ogasawara, Iwo, and Mariana archipelagos to reach wintering areas in Micronesia and farther south. However, recent radar studies have shown that significant numbers of shorebirds instead fly southward in a broad front through Micronesia (Williams and Williams 1988, 1990). An estimated half million birds pass within 1000 km of Guam in the Mariana Islands during autumn migration (Williams and Williams 1988). The Mariana and Caroline Islands are potential stopover sites along this route. Yet, general observations show that relatively small numbers of most species of shorebirds are recorded on these islands during passage migration or in the winter (Baker 1951, Jenkins 1981, Williams and Grout 1985). This suggests that most species make non-stop flights across Micronesia (Williams and Williams 1988).

In this paper, we describe the species composition, habitat use, and relative abundance of shorebirds visiting the Mariana Islands. Results were determined by regular surveys on the island of Saipan from 1987–1993 and from general observations on the other islands in the chain, especially Guam, from 1980–1993. This period of data collection is considerably longer than that of previous workers who were able to view shorebirds for only several months to 1.5 yr (Baker 1951; Jenkins 1981; Williams and Grout 1985; Commonwealth Northern Mariana Islands, Div. of Fish & Wildlife-DFW and Guam Div. of Aquatic & Wildlife Resources-GDAWR, unpubl. field notes).

STUDY AREA AND METHODS

The Mariana Islands form an archipelago of 15 islands from 13°14' to 20°31'N and 144°40' and 146°05'E in Micronesia (Fig. 1). The islands lie about 1700 km south of Japan, 2100 km east of the Philippines, and 1800 km north of New Guinea. Guam is the southernmost and largest island (540 km²) in the Marianas. The other main southern islands of Saipan, Tinian, and Rota range in size from 85–123 km². Guam and Saipan provide the best habitat for migrating shorebirds, with intertidal beaches and flats, freshwater wetlands, and mowed lawns occupying much larger areas

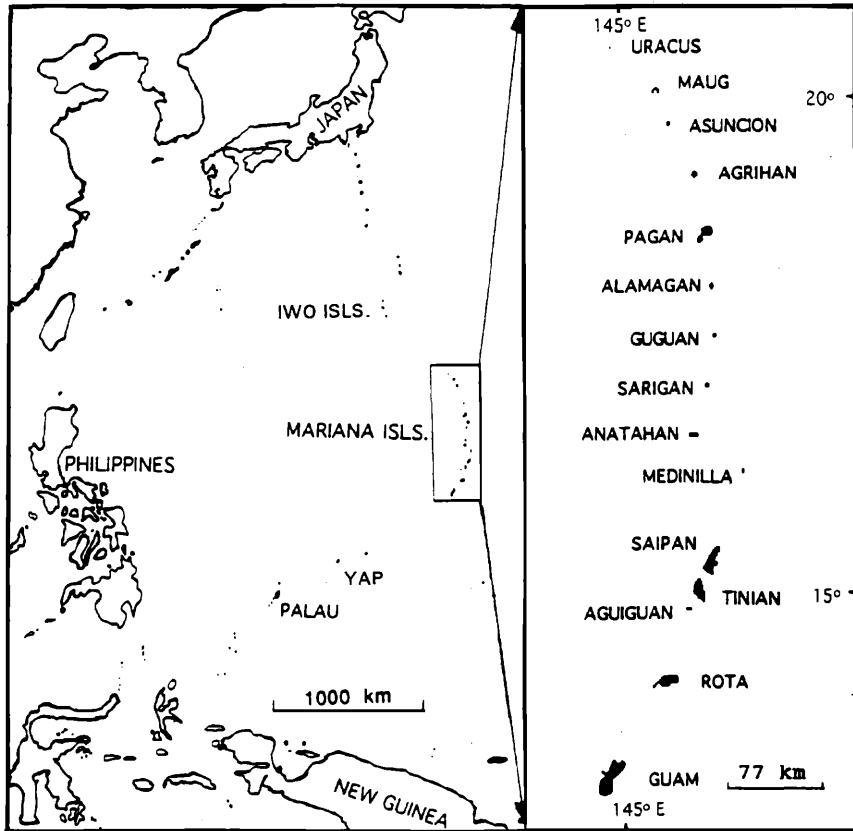


FIGURE 1. The Mariana Islands and their location in the western Pacific.

than on Rota and Tinian. The remaining islands in the chain are much smaller (1–48 km²) and, except for rocky shores, a short airstrip, some open fields and two brackish lakes, their steep volcanic terrain offers little appropriate habitat for shorebirds.

Surveys of shorebirds were conducted primarily on Saipan and Guam, with infrequent observations made on the other islands. Shoreline counts were made on foot or from vehicles and were conducted at low tide during daylight hours. Surveys were not made during periods of high winds or moderate to heavy rains. Survey sites were chosen because of the relatively large numbers of shorebirds present at them, and were not necessarily representative of shorebird populations island-wide.

On Saipan, we made over 450 visits to shore sites ($n = 247$ visits), wetlands ($n = 182$), and the Saipan International Airport ($n = 28$ visits) from June 1987 to May 1991 and from July 1992 to June 1993. Two beach sites were sampled twice monthly. Tanapag Beach is a 1-km-long stretch

of beach and sandy intertidal flats partly vegetated with seagrass (*Enhalus acoroides* and *Halodule uninervis*). Birds seen at an old seaplane ramp at the south end of the beach were included in counts at this site. The second location was the Puerto Rico mudflats, a 17-ha site south of Saipan's municipal dump. Counts also were made with less regularity at 15 freshwater wetlands, as well as at the airport, which has large grass fields, a rainwater catchment reservoir, and ephemeral rainwater puddles. Surveys on Saipan were made in both halves of each month during most years of the study. We calculated the mean number of birds present for the years we have data. When two surveys were conducted during the same half-month period, count results were averaged for the period before calculating a mean across years.

Observations on Guam were made at two primary sites. Dungcas Beach is located on the west-central side of the island and features a 1.5-km-long intertidal sandflat. Togcha Beach is a shallow intertidal reef flat on the east side of Guam that is 2.4-km long and 300–400-m wide. Other locations included large mowed fields on several military bases and a number of sites with freshwater, including natural and human-made wetlands, several aquaculture ponds, and a landfill. Censuses were made twice monthly from March 1980 to October 1981. However, in the remaining years, data were taken from irregular counts made each month in autumn, with fewer counts made in the spring. Very few censuses were made in the summer.

RESULTS

A total of 46 species of shorebirds has been recorded to date in the Mariana Islands (Reichel and Glass 1991, Wiles et al. 1993), although four of these species are considered hypotheticals because of insufficient documentation. This list includes 36 members of the family Scolopacidae, one oystercatcher, one stilt, seven plovers, and one pratincole.

Information on seasonality and abundance is summarized below for the 28 species seen most regularly. Information on habitats regularly used by these species in the Marianas is included in Figure 2. We regard only one shorebird, the Pacific Golden-Plover, as abundant. Three others (Gray-tailed Tattler, Whimbrel, and Ruddy Turnstone) were common, being consistently present during migration and through the winter (Fig. 2). In addition, these birds usually summered in the Marianas in small numbers. We classified five species as uncommon migrants (Mongolian Plover, Wood Sandpiper, Wandering Tattler, Common Sandpiper, and Rufous-necked Stint). Smaller numbers of these birds were recorded annually, and a few individuals of each overwintered. An additional 37 species were classified as rare migrants, vagrants, or accidentals. Species were listed as migrants to the Mariana Islands if the archipelago lies between their breeding and wintering grounds, and listed as vagrants if not. Species that do not migrate in the region and recorded only once were classified as accidental. In the following accounts, we defined very small numbers as meaning fewer than 10 birds seen per year and small numbers as 10–50 individuals seen per year throughout the island chain as a whole. Acci-

TABLE 1. Very rare and accidental shorebird species in the Mariana Islands.

Species	Status ^a	References ^b
Oriental Pratincole (<i>Glareola maldivarum</i>)	vRV	4
Snowy Plover (<i>Charadrius alexandrinus</i>)	RV	5, 9, 16
Eurasian Oystercatcher (<i>Haematopus ostralegus</i>)	A	10
Greater Yellowlegs (<i>Tringa melanoleuca</i>)	A	4
Nordmann's Greenshank ^c (<i>Tringa guttifer</i>)	A	7, 8
Common Redshank (<i>Tringa totanus</i>)	RV	1, 2, 4, 5
Spotted Redshank (<i>Tringa erythropus</i>)	A	11
Green Sandpiper (<i>Tringa ochropus</i>)	vRV	3, 15
Little Curlew (<i>Numenius minutus</i>)	vRM	4, 7
Bristle-thighed Curlew (<i>Numenius tahitiensis</i>)	RV	4, 11, 15
Far Eastern Curlew (<i>Numenius madagascariensis</i>)	vRM	3, 13, 14, 15
Eurasian Curlew (<i>Numenius arquata</i>)	vRV	2, 3
Black-tailed Godwit (<i>Limosa limosa</i>)	vRM	4, 11, 12
Great Knot (<i>Calidris tenuirostris</i>)	vRM	2, 3
Little Stint (<i>Calidris minuta</i>)	A	4
Temminck's Stint (<i>Calidris minuta</i>)	RV	4, 15
Long-toed Stint (<i>Calidris subminuta</i>)	vRM	2, 3, 11
Pectoral Sandpiper (<i>Calidris melanotos</i>)	vRM	4, 6, 7, 16
Dunlin (<i>Calidris alpina</i>)	RV	7, 9, 15
Curlew Sandpiper (<i>Calidris ferruginea</i>)	vRM	5, 16
Dowitcher spp. (<i>Limnodromus</i> spp.)	vRV	2, 15

^a A = accidental, v = very, R = rare, V = vagrant, M = migrant.

^b 1. Stinson et al. 1991; 2. Wiles et al. 1993; 3. Stinson et al. 1991; 4. Glass et al. 1990; 5. Wiles et al. 1987; 6. Pyle and Engbring 1987; 7. Williams and Grout 1985; 8. Williams 1987; 9. Engbring and Owen 1981; 10. Maben and Wiles 1981; 11. Jenkins 1981; 12. Jenkins 1978; 13. Baker 1951; 14. Hartert 1898; 15. DFW and GDAWR files; 16. G. Wiles, pers. obs.

^c Hypothetical-uncertain record.

Smaller but significant numbers of golden-plovers passed through the Marianas from early March to as late as the third week in April during northward migration. A few birds in non-breeding plumage or incomplete nuptial plumage remained during most summers.

Mongolian Plover (*Charadrius mongolus*)—Uncommon migrant. This species was observed annually in low numbers, with Guam typically attracting more birds than Saipan. Records of Mongolian Plovers exist for nearly the entire year (Fig. 2). Data from Saipan suggest that abundance was greatest from January to mid-April (Fig. 3). Jenkins (1981) also obtained his highest counts in March and April 1978, while Maben (GDAWR files) found numbers to be largest in November 1980 and January 1981. A few birds occasionally summered on Guam.

A Mongolian Plover seen at Togcha Beach on 19 Dec. 1991 had been wing-tagged at Shunkunitai, Nemuro-Shi in northeastern Hokkaido, Japan on 25 Aug. 1991 (T. Mundkur, pers. comm.). A similarly marked bird resided at Togcha Beach from 13 Sep. 1992 to 24 Jan. 1993.

Greater Sand Plover (*Charadrius leschenaultii*)—Rare migrant. Very small numbers of Greater Sand Plovers were observed in most years, with

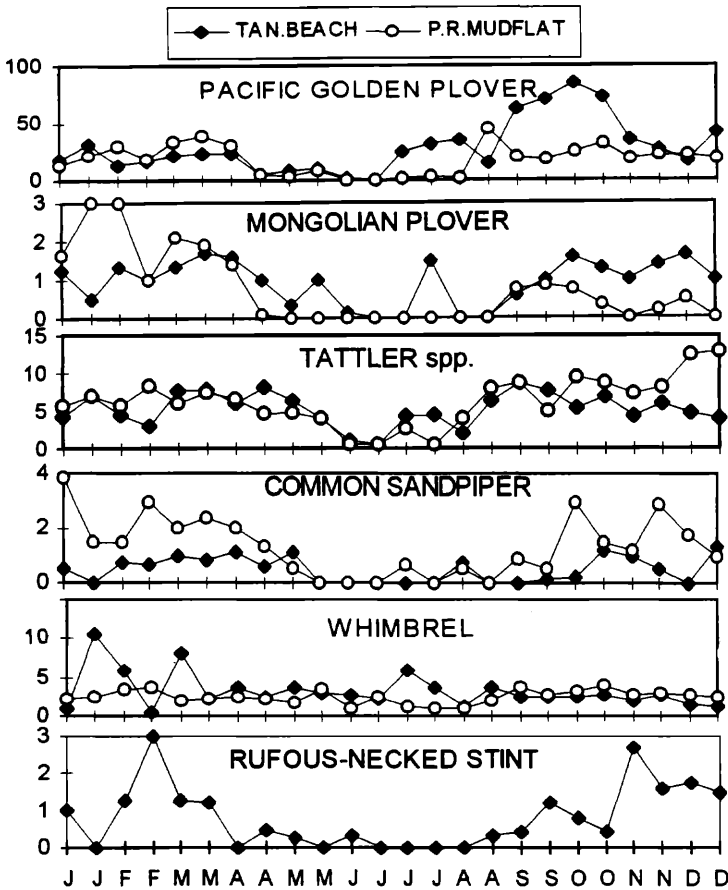


FIGURE 3. Bi-weekly mean number of six shorebird species at Tanapag beach and Puerto Rico mudflats on Saipan, 1987–1993. Rufous-necked Stints were regularly recorded only at Tanapag beach.

the majority of sightings made from early September to late December (Fig. 2).

Common Ringed Plover (*Charadrius hiaticula*)—Rare vagrant. Common Ringed Plovers were found in very small numbers in most years, with more sightings noted in autumn than spring (Fig. 2). A few individuals wintered on Guam.

Little Ringed Plover (*Charadrius dubius*)—Rare migrant. Very small numbers of this species were noted in less than half of all years. All sightings occurred on Guam and involved only one or two birds. Records were more common in the autumn from late August to early December, but were scattered during the spring (Fig. 2).

Black-winged Stilt (*Himantopus himantopus*)—Rare migrant. This spe-

cies was first recorded in the Mariana Islands in 1986, and since then, a few individuals have been seen in most years. Nearly all records were from late August to mid-December (Fig. 2). Stilts collected on Saipan and Rota were of the Eurasian race *himantopus*, as are most stilts that visit Japan (Brazil 1991), and not from New Guinea where the Australian race *leucocephalus* is found (Beehler et al. 1986, Hayman et al. 1986).

Common Greenshank (*Tringa nebularia*)—Rare migrant. Sightings occurred from August to April in most years, being somewhat more common in autumn (Fig. 2). Birds occasionally overwintered, such as one bird that was regularly observed at a tidal flat on Saipan from 19 Oct. 1992 to 27 Mar. 1993. All recent sightings on Guam and Saipan have involved one or two individuals, although King (1962) reported five birds at a coastal mudflat on 24 Apr. 1960.

Marsh Sandpiper (*Tringa stagnatilis*)—Rare migrant. A few Marsh Sandpipers visited Saipan and Guam in most years. Records exist from late August to late April, but autumn records predominated.

Wood Sandpiper (*Tringa glareola*)—Uncommon migrant. Small numbers of Wood Sandpipers were observed annually on Saipan and Guam. Nearly all records were from late August to late April (Fig. 2). Counts at freshwater wetlands on Saipan were highest from November to January, suggesting that a fair number of birds spent the winter. Peaks during migration also occurred in September and March–April.

Wandering Tattler (*Heteroscelus incanus*)—Uncommon migrant. This species is typically regarded as less common than *H. brevipes* in the Marianas (Pratt et al. 1987, Williams and Grout 1985). However, Wandering Tattlers tend to select rocky coastlines as their preferred habitat and these sites are difficult to survey because of poor access and rough surf conditions. Because this type of shoreline is predominant on nearly all islands in the Marianas, it is possible that *H. incanus* will be found to be at least as common as *H. brevipes* in the archipelago, once better data is obtained. Wandering Tattlers were seen in all months. Birds were most common from mid-August to late May, with a few individuals summering.

Gray-tailed Tattler (*Heteroscelus brevipes*)—Common migrant. Because of the difficulty in separating this species from the Wandering Tattler when birds are in winter plumage, we usually identified and recorded individuals only at the generic level. Gray-tailed Tattlers were by far the more common species at the sites regularly censused on Saipan and Guam, and they ranked with Pacific Golden-Plovers as the most consistently seen species at shore sites. This may wrongly give the impression that *H. brevipes* is considerably more numerous than *H. incanus*.

Modest numbers of Gray-tailed Tattlers were recorded on Saipan and Guam each year. Survey results from beaches on Saipan revealed that fall migration begins in July and peaks in September and October (Fig. 3). Baker (1951) also noted that migration began in about mid-July. Small numbers of birds summered on Saipan and Guam.

Common Sandpiper (*Actitis hypoleucos*)—Uncommon migrant. This species was recorded annually in small numbers. Common Sandpipers

were an early fall migrant, with sightings beginning in July and peaking in October and November. Abundance reached similar levels during spring migration, with the highest numbers recorded from February to early May (Fig. 3). Some birds overwintered in the Marianas.

Terek Sandpiper (*Xenus cinereus*)—Rare migrant. Only a few individuals of this species were observed in the Marianas. Records show that it occurs almost exclusively as a passage migrant from late August through November (Fig. 2). The only spring sighting was from Pagan on 26 Apr. 1989 (Stinson et al. 1991).

Whimbrel (*Numenius phaeopus*)—Common migrant. Whimbrels were present in the southern Marianas in all seasons. Survey data from Saipan showed that abundance was highest from January to early March, with lower but fairly stable numbers noted during the rest of the year (Fig. 3). Observations on Guam indicated that numbers are often much smaller in the summer, although Jenkins (1981) did record a sizable summering population in 1978. Flocks sometimes roosted on large open lawns at high tide, especially at the Saipan airport. An unusually large aggregation of 100 birds roosted on the roof of a large warehouse next to inner Apra Harbor, Guam, in December 1989. Two individuals collected recently on Saipan belong to the subspecies *N. p. variegatus* (R. E. Johnson, pers. comm.), which breeds in eastern Russia (Hayman et al. 1986, Lane 1987).

Bar-tailed Godwit (*Limosa lapponica*)—Rare migrant. This species was much more common than the Black-tailed Godwit, with a few individuals noted in most years. Most records were from mid-September to early December and from mid-March to early May, but a few birds occasionally overwinter (Fig. 2).

Ruddy Turnstone (*Arenaria interpres*)—Common migrant. Williams and Williams (1988) considered Ruddy Turnstones to be the second most common species of shorebird in the Marianas, after the Pacific Golden-Plover. Our records indicate that Gray-tailed Tattlers are more common at shore sites than turnstones and that turnstone abundance is usually much lower than the numbers they observed in the fall of 1983. Although Williams and Williams (1988) tallied a maximum of 235 turnstones on a single day on Guam in 1983, we estimated that in most years, only 300–500 birds may normally stopover in the Marianas in the autumn. Ruddy Turnstones were present in modest numbers each year during migration and throughout the winter. A few birds often spent the summer on Guam (Jenkins 1981). On Saipan, turnstones used the shore sites unpredictably and sporadically. We do not present bi-weekly means because they were heavily skewed by rare records of flocks of 10 and 25. Turnstones were more consistently seen at large fields, and data from airports on Saipan and Rota (counts in 30 months) indicated they are more abundant in fall. This supports Thompson's (1973) theory that the turnstone's spring migration is generally non-stop through the western Pacific.

Sanderling (*Calidris alba*)—Rare migrant. One to five Sanderlings were seen in most years on Saipan and Guam. They were present from mid-August through April, with a few individuals rarely overwintering (Fig. 2).

Our only summer record was a flock of five observed from early May to mid-July 1980 at Duncas Beach by A. Maben (unpubl. data). Groups usually contained one to three birds, and sometimes occur in close association with flocks of Rufous-necked Stints.

Rufous-necked Stint (*Calidris ruficollis*)—Uncommon migrant. This was the most common stint in the Marianas, with small numbers seen annually, usually beginning in late August and continuing through April or May. Abundance appeared to be greater on Guam than Saipan. Two peaks in fall migration occurred on Saipan (Fig. 3), which may coincide with the arrival of adults in September and juveniles in November and December. A similar migration pattern has been documented in Australia (Paton and Wykes 1978). During spring migration, numbers were highest in February and March. Some birds wintered on Guam, but none or very few seem to do so on Saipan. Additionally, there were scattered records of Rufous-necked Stints on Guam during the summer months.

Sharp-tailed Sandpiper (*Calidris acuminata*)—Rare migrant. Small numbers of Sharp-tailed Sandpipers were seen annually in the Marianas. This species is primarily a fall transient, with most records occurring from mid-September to mid-December. There is a record of an unusually large aggregation of 28 birds from Saipan in January 1979 (Glass et al. 1990).

Ruff (*Philomachus pugnax*)—Rare migrant. This species was noted in very small numbers in about half of all years, with the majority of sightings falling between late August and late November. Glass et al. (1990) reported an unusually large flock of 30 Ruffs in October–November 1986. The few spring records are from Guam and Rota.

Snipe spp. (*Gallinago* spp.)—Rare migrants. Small numbers of snipe were seen annually in the Marianas. Two species, Swinhoe's Snipe (*G. megala*) and Common Snipe (*G. gallinago*), have been collected in the archipelago, but two others, Latham's Snipe (*G. hardwickii*) and Pintail Snipe (*G. stenura*), are known only from suspected sightings. Field identification of Asian *Gallinago* is extremely difficult (Hayman et al. 1986), thus we were unable to identify most snipes to species. Based on collected individuals, Swinhoe's Snipe is considerably more common than the other species. Single Common Snipe have been collected on Saipan and Rota (Takatsukasa and Yamashina 1931, Stinson et al. 1991) and this species has been seen twice on Guam. Hypothetical records of Latham's Snipe come from Saipan (Stinson et al. 1991) and Pintail Snipe from Tinian and Rota (Pyle and Engbring 1987). Records of all snipe were combined for Fig. 2 and indicate that birds were most common from late September to early January. A few individuals probably wintered in the Marianas.

DISCUSSION

Islands in Micronesia offer little habitat for most species of migrating and wintering shorebirds due to their small sizes, typically narrow intertidal zones, and lack of extensive mudflats (Parish et al. 1987). This is probably the major reason for the limited use of these islands as stopover sites during migration by shorebirds and why many species probably over-

fly the region. Of the 46 species of shorebird recorded, 30 breed in the Palearctic or Alaska and regularly winter in Micronesia or further south in Australia, New Guinea, and on other Pacific islands (Hayman *et al.* 1986). An additional 12 species recorded in the archipelago have Eurasian wintering ranges extending as far east as Japan, the Philippines, or central Indonesia. Two species, the Common Ringed Plover and Little Stint, winter primarily in Africa and southwestern Asia, while two others, the Greater Yellowlegs and a dowitcher *sp.*, normally winter in the New World.

Overall abundance.—Turnover rates among migrant shorebirds in the Marianas have never been assessed with marked birds, so it is difficult to estimate the numbers of birds passing through or wintering in the islands. It is clear however, that the archipelago is not a major stopover or wintering area for shorebirds, except for the Pacific Golden-Plover which migrates through in relatively large numbers. We estimate that 5000–20,000 plovers transit the archipelago and that perhaps a few thousand overwinter. All other species exhibit much lower abundance. Migrating Whimbrels, Ruddy Turnstones, and Gray-tailed Tattlers probably each total no more than several hundred individuals per season, even though we classify them as common. For species we regard as uncommon, perhaps about 50–200 individuals of each visit the islands.

The data summarized here may not be indicative of the numbers and species composition of migrants aloft (Williams and Williams 1988). Our few observations of some shorebird species (e.g., Far Eastern Curlew, Bar-tailed Godwit, Great Knot, and Latham's Snipe) support the hypothesis that they migrate nonstop when crossing the Pacific between eastern Asia and Australia (Barter and Hou 1990, Parish *et al.* 1987, Williams and Williams 1988).

Regional comparisons.—It is difficult to compare shorebird occurrence among Micronesian island groups due to the lack of systematic surveys. Palau and Yap, the westernmost Carolines are located only 800 km and 1300 km east of the Philippines, respectively. Palau and Yap might be expected to have greater shorebird diversity and abundance than the Marianas because of their closer proximity to Asia, but observations suggest that the number and diversity of shorebirds are similar for the three island groups (J. Engbring, *pers. comm.*). In absolute numbers, only the Rufous-necked Stint is considerably more numerous in Palau, with flocks of up to 300 birds present in winter (Engbring 1988). Species diversity appears to decline rapidly in the eastern Carolines, with 25 species recorded in Chuuk, 14 in Pohnpei, and 12 in Kosrae (Baker 1951, Pyle and Engbring 1985). Further observations will likely increase these figures somewhat. Census data are not available for these islands, so it is not known if shorebird abundance shows a corresponding decrease with greater distance from Asia. The Iwo and Ogasawara Islands, to the north of the Marianas do not attract large numbers of shorebirds because these islands lack the wide tidal flats found at a few sites on Guam and Saipan (Brazil 1991; Y. Yamamoto, *pers. comm.*).

Japan, eastern mainland Asia, and New Guinea, the large land masses lying north and south of the Mariana Islands, are the probable source of most shorebirds visiting the island chain during migration (Baker 1951, Williams and Williams 1988). Nearly all of the common and uncommon shorebirds in the Marianas are also common in Japan and New Guinea during the non-breeding season (Beehler et al. 1986, Brazil 1991). Only the Wandering Tattler, which has an oceanic migration route from Alaska and northwestern Canada to the tropical Pacific (Hayman et al. 1986), is considered rare in Japan and New Guinea. In contrast, about 17 species that are fairly common to abundant during migration in Japan and/or New Guinea occur only rarely or have not yet been reported in the Marianas. These species apparently either migrate predominantly through eastern Asia, or overfly Micronesia.

Seasonality.—Shorebird abundance and variety in the Marianas is greatest from September to April. Observations indicate that autumn migration, which is presumably enhanced by young of the year, is of longer duration and involves larger numbers of birds and species than does spring migration. Of the species for which there is sufficient information, approximately 15 are more common in the fall and first half of winter, at least four (Common Sandpiper, Grey-tailed Tattler, Rufous-necked Stint, Dunlin) appear to be equally common in the autumn and spring, and three (Black-bellied and Mongolian Plovers, Whimbrel) are more common in the winter and spring. About 11 species regularly overwinter in the Marianas in at least small numbers, of which Pacific Golden-Plovers, Mongolian Plovers, Whimbrels, both tattlers, Ruddy Turnstones, and Wood Sandpipers, are present in modest to large numbers. Only four or five species (Pacific-Golden Plovers, Gray-tailed Tattlers, Whimbrels, Ruddy Turnstones, and possibly Wandering Tattlers) regularly summer on the islands, with small numbers present. All of these individuals are assumed to be nonbreeders (Johnson 1979).

Habitat use.—Habitat use by each species of shorebird in the Marianas generally coincides with that known from other wintering areas (Hayman et al. 1986, Brazil 1991). Autumn migration coincides with the rainy season in the Marianas and flooding of seasonal wetlands. Most of the wetlands are covered with dense reed thickets and thus not used by shorebirds, but widely scattered sites have short grass, mud, and shallow pools of water, that provide habitat. Wet agricultural fields also are frequented by shorebirds in the fall. Depending on rainfall patterns for the year, most of these sites dry out in December or January and remain dry in the spring, and birds concentrate at the few sites where open water persists. On Guam, several small aquaculture farms occasionally have drained ponds that are highly attractive to shorebirds.

Human activity on the major southern Mariana Islands of Guam, Rota, Tinian, and Saipan has undoubtedly benefited some shorebird species by the creation of large open fields of short grass located at airports, military bases, golf courses, and antenna fields. They are a preferred habitat of

migrating and wintering Pacific Golden-Plovers and larger numbers of plovers may use these islands now than in prehistoric times.

Conservation.—Brown tree snakes (*Boiga irregularis*) were accidentally introduced to Guam probably from the Admiralty Islands shortly after World War II. Snake predation has resulted in the extirpation of most of the native forest birds and resident seabirds of Guam (Savidge 1987, Reichel 1991), and brown tree snakes may eventually colonize the neighboring southern Mariana Islands. Fortunately, there is no evidence that visiting shorebirds have been affected.

Shorebirds are not hunted by island residents in the Marianas, and shoreline habitats are not immediately threatened by reclamation, as in many locations in neighboring Asian countries. Nonetheless, shorebird habitats face a variety of problems in the island chain. Economic growth and rapidly expanding tourism have stimulated considerable development along coastlines during the last few decades. Four highrise condominiums and a hotel have been built at Duncas Beach in the past 20 years. The area is under increasing disturbance from jet skiers, fishermen, walkers, and dogs. At Togcha Beach, there are plans to construct a golf course nearby and the area is increasingly used by picnickers. The Puerto Rico mudflats are located next to Saipan's municipal dump. Garbage from the dump falls directly onto the reef flat and toxic substances may affect lagoon waters. Future military cutbacks may force the closing of several installations on Guam. This would reduce the extent of large mowed fields available to shorebirds.

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