

# Wintering ground fidelity and other features of Pacific Golden-Plovers *Pluvialis fulva* on Saipan, Mariana Islands, with comparative observations from Oahu, Hawaiian Islands

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We radio-tagged and uniquely color-banded Pacific Golden-Plovers *Pluvialis fulva* wintering on Saipan, Mariana Is. ( $n = 36$ , of which 24 were radio-tagged), and Oahu, Hawaiian Is. ( $n = 10$ , all radio-tagged) in spring 2005. The birds departed in late April from both locations, and their transmitter frequencies were then monitored from small aircraft in several regions of Alaska. The only signals detected were those of four Oahu plovers. During southbound passage in August, one of the Saipan birds was sighted in Japan. Fall returns to the study sites were 72% (26/36) on Saipan and 90% (9/10) on Oahu. Each of the Oahu birds reoccupied its previous wintering territory. Because most Saipan plovers were non-territorial and often difficult to locate, we probably did not find all returnees during fall surveys. Thus, the actual fidelity at Saipan was likely similar to that on Oahu where returns in the first fall after banding averaged 86% over 21 seasons. Although connectivity between Saipan and Alaska remains a possibility, finding no radio-tagged Saipan birds in Alaska suggests linkage with nesting grounds in Siberia. The most likely route for northward passage from Saipan is via Japan. There are also possible connections with major *fulva* stopovers in Mongolia and adjacent Russia. Compared to plovers on Oahu, the Saipan birds were relatively lean and had much less alternate\* feathering. These features of Saipan plovers presumably reflect a spring migration strategy in which substantial fattening and prealternate molting occurs at stopovers while en route to breeding grounds. To what extent unusually dry conditions on Saipan in spring 2005 might have influenced pre-departure fattening and molting is uncertain.

## INTRODUCTION

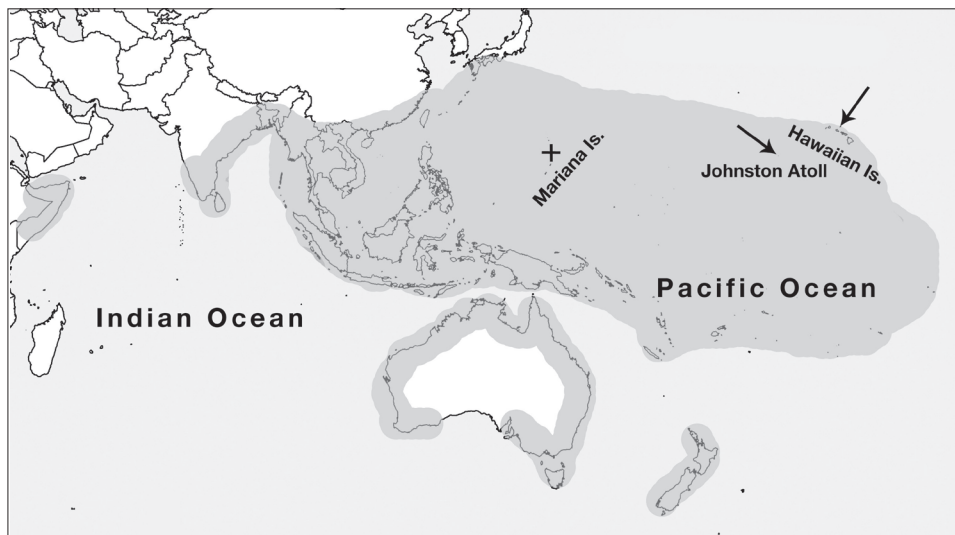
Pacific Golden-Plovers *Pluvialis fulva* winter in coastal and upland habitats across an immense region of the world including the Hawaiian Islands, Japan, insular Pacific, Australia, New Zealand, Indonesia, Philippines, southeastern Asia, India, and northeastern Africa (Hayman *et al.* 1986, Johnson & Connors 1996). In this vast wintering area, the only previous studies involving uniquely banded plovers (many also radio-tagged) were conducted in the central Pacific on the island of Oahu, Hawaii and at Johnston Atoll. These investigations demonstrated a major migratory link between Oahu and breeding grounds in Alaska, plus strong site fidelity on wintering grounds with marked individuals reoccupying the same territories season after season (Johnson *et al.* 2001, 2004a,b). In an effort to expand knowledge of this species on its winter range, we present findings from Pacific Golden-Plovers banded and radio-tagged on Saipan in the western Pacific (Fig. 1).

## METHODS

Over the period 30 March–9 April 2005, we captured with mist nets a total of 36 Pacific Golden-Plovers at their wintering grounds on Saipan, Mariana Islands. The birds were caught at five sites in the towns of Koblerville, Susupe, and Garapan, (all close to 15°10' N, 145°40' E). Each of the sites contained areas of low grass in which the plovers foraged and loafed. The number netted at each site was as follows: 13 Southern High School (Koblerville), 13 American Memorial Park (Garapan), 6 Running Track (Susupe), 3 Elementary School (Koblerville), 1 International Airport (Susupe). We recorded the usual morphometric dimensions: wing length (flattened, straightened primaries) to the nearest 1.0 mm; total head length (posterior occipital to tip of bill), bill length (along culmen to junction with feathering on forehead), and tarsus length (tibio-tarsal joint to distal end of tarsus) to 0.1 mm. Each measurement followed the technique illustrated

\* This paper uses the molt terminology of Humphrey & Parkes (1959) in which alternate plumage is breeding plumage and basic plumage is non-breeding plumage.





**Fig. 1.** Shading indicates the winter range of the Pacific Golden-Plover. Prior to this investigation, studies of marked wintering birds were conducted at only two sites – Oahu, Hawaiian Is. and Johnston Atoll (arrows). Cross shows the location of Saipan.

by Howes & Bakewell (1989). Based on wear of retained juvenal primaries (Johnson & Johnson 1983, Johnson & Connors 1996), the sample consisted of 12 adults and 24 first-year birds. Prealternate molting was not advanced sufficiently in any of the birds for clear determination of sex. We uniquely color-banded each plover on its tibiotarsi, and on 24 individuals (7 adults and 17 first-year) we glued a 1.8 g, 14-week life span transmitter (Holohil Systems, Carp, Ontario) to feather stubs on the lower back (see Warnock & Warnock 1993). Each transmitter had a different frequency, and attachment was temporary as radios would be expected to fall off during summertime prebasic molting on the tundra (Johnson & Connors 1996). Our fieldwork preceded migratory departure by about three weeks, thus we have no knowledge of weights when the birds left Saipan. During the capture period, the attached transmitters averaged about 1.5% of total mass (mean = 118 g, Table 1). For additional information on capture, marking, and determination of age and sex, see Johnson & Johnson (1983), Johnson & Connors (1996), Johnson *et al.* (1997, 2001).

We conducted island-wide surveys of Saipan during the 30 March–9 April period to estimate the total wintering population of plovers. The migratory departure of marked birds from Saipan was monitored daily (by RG) with a hand-held

receiver and visually until 25 April. Further observations of marked plovers on Saipan were made (by RG) in late summer during 11–25 July and post-migration in the fall during 30 Oct–5 Nov.

As an adjunct to radio-tagging on Saipan, OWJ & PMJ returned to Hawaii where they uniquely color-banded and radio-tagged (with Holohil 1.8 g, 11-week transmitters) ten plovers captured during 14–16 April at a wintering ground on Oahu. The birds were caught with mist nets at the Hawaii State Veterans Cemetery (HSVC) located near the town of Kaneohe. About 70 plovers winter annually at the HSVC and all are territorial on cemetery lawns. The captured birds were sexually dimorphic (i.e. all had well-developed alternate plumage), and our sample comprised two first-year males, five adult males, one first-year female, and two adult females. Post-banding, OWJ & PMJ monitored spring departure until 29 April, and documented the fall return of marked birds during 27–31 Oct.

In Alaska, cooperating U.S. Fish and Wildlife Service biologists monitored plover radio frequencies in various regions of western and southwestern Alaska (Fig. 2) using fixed-wing aircraft equipped with VHF receiving antennae. The routes and dates of the aerial surveys were as follows: Cold Bay to Nelson Lagoon, one flight on 18 May; King Salmon to Cape Seniavin (four flights) and to Cinder Lagoon (one flight) over the period 28 April–18 May; Dillingham to Cape Peirce including a large inland segment of the Togiak National Wildlife Refuge, 4 flights over the period 28 April–2 June; Bethel northward to Mountain Village thence to St. Michael, one flight on 9 June; Kotzebue to Deering, two flights on 26 and 27 May.

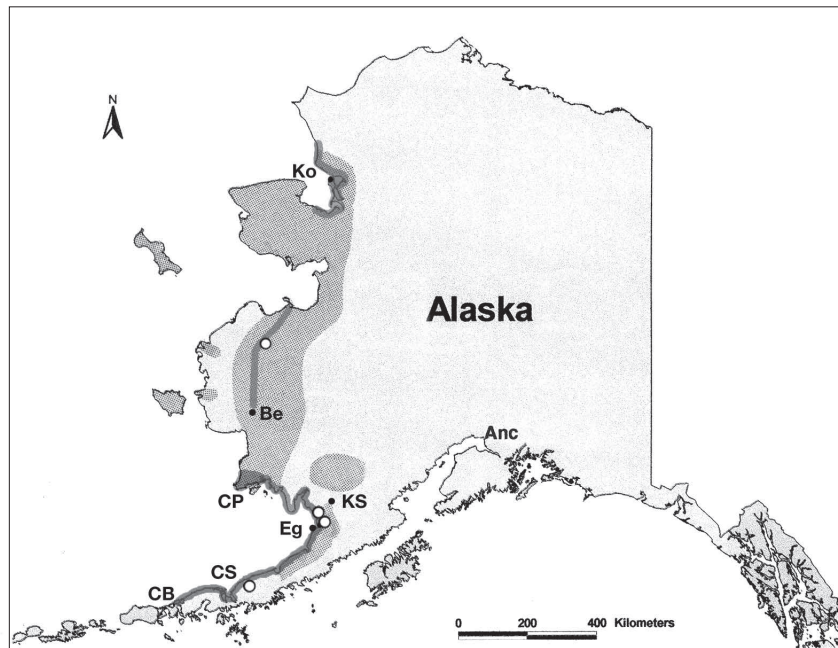
**Table 1.** Length (mm) and mass (g) measurements of Pacific Golden-Plovers captured on Saipan. Data shown as means $\pm$ SD (range, *n*).

Adult wing	169 $\pm$ 5.0 (158–178, 12)
First-year wing	164 $\pm$ 4.2 (156–174, 24)
Total head	57.5 $\pm$ 1.3 (54.5–59.7, 36)
Bill	23.6 $\pm$ 0.9 (22.0–25.7, 36)
Tarsus	44.4 $\pm$ 1.5 (42.3–48.2, 36)
Mass adult birds	125 $\pm$ 17 (88–145, 12)
Mass first-year birds	115 $\pm$ 15 (92–148, 24)
Mass (ages pooled)	118 $\pm$ 16 (88–148, 36)

## RESULTS

Morphometric features and weights of the plovers captured on Saipan are shown in Table 1. Mean wing length of adults was significantly longer than that of first-year birds ( $t = 3.21$ ,  $P = 0.003$ ,  $df = 34$ ). The difference reflects the over-winter wear of retained juvenal primaries. Other linear dimensions of the two age groups were essentially identical, thus measurements are pooled in the table. Although adults averaged





**Fig. 2.** Grey shading represents the known breeding range of Pacific Golden-Plovers in Alaska (see Johnson *et al.* 2004a, Savage & Johnson 2005). Darker grey areas within the breeding range indicate routes that were aerial monitored for radio-tagged plovers in spring 2005. Four birds (open circles) all tagged on Oahu were detected – 1 near Cape Seniaivn (CS), 2 near Egegik (Eg), and 1 north of Bethel (Be). Other abbreviations: Cape Peirce (CP), Cold Bay (CB), Kotzebue (Ko), King Salmon (KS), Anchorage (Anc).

heavier than first-year birds (125 vs. 115 g, Table 1) the difference in body mass was not statistically significant ( $t = 1.78$ ,  $P = 0.08$ ,  $df = 34$ ). All the linear dimensions in Table 1 fell within the range of variation found in much larger samples of *fulva*, the latter (all measured by OWJ) from breeding grounds in Alaska and wintering grounds on Oahu and Johnston Atoll (Johnson & Johnson 2004). Mean weight of the 10 HSVC plovers was 168 g (range = 151–204 g); the linear dimensions of these birds were not recorded.

In contrast to the colorful sexually-dimorphic plumages of HSVC plovers, the 36 birds captured on Saipan had basic and partial alternate feathering. Incoming alternate feathers of Pacific Golden-Plovers are especially evident ventrally on the breast and belly (see Johnson & Johnson 1983). Based on the appearance of these plumage areas, the 36 Saipan birds were categorized as follows: 16 showed no evidence of molt, 6 were in very early prealternate molt (a few dark feathers), and 14 ranged from about one-fourth to one-half dark feathering (Fig. 3). These descriptions also apply to plovers we observed during our island-wide surveys, though several somewhat darker-plumaged individuals (probable males) were seen.

Initial loss of signals from radio-tagged birds (indicating migration) was evident on Saipan by 14 April with numbers gradually diminishing day-by-day. Six radio-tagged birds were still present when RG's monitoring ended on 25 April. A colleague residing on Saipan continued to monitor these (using a hand-held receiver) and all had disappeared by 1 May. The timing of spring migration was consistent with earlier records of unmarked plovers departing from Saipan (Stinson *et al.* 1997). It is possible that a small number of marked birds (either with or without radios) did not migrate and over-summered on the island. According to Stinson *et al.* (1997) it is not unusual for a few plovers to remain on Saipan during the boreal summer. All of the ten birds radio-tagged

at the HSVC departed on spring migration over the period 21–29 April.

Three of the 36 marked birds at Saipan were found during the late July survey. One was still carrying a transmitter; the other two had not been radio-tagged. Whether these three birds were early returnees from breeding grounds or over-summering individuals is unknown. Twenty-six plovers (72% of the sample population) were observed during the Oct–Nov survey. There was no statistical difference ( $P = 1.00$  by Fisher's Exact Test) in return rates of birds that had been radio-tagged (17/24, 71%) and those that had not been tagged (9/12, 75%). Thus, as in earlier studies on Oahu (see Johnson *et al.* 2004a), the attachment of transmitters had no apparent effect on subsequent survival. All of the marked Saipan plovers found in the fall were on the previously described study sites, some on the same site where banded (14 birds), others on different sites (12 birds). This variation did not occur in Hawaii where 9 of the 10 birds radio-tagged on Oahu returned to the HSVC in the fall and reoccupied their previous territories.

Efforts to locate radio-tagged Saipan plovers by aerial monitoring in Alaska were unsuccessful and we have no knowledge of spring migratory destinations after birds departed the island. One individual, with transmitter still attached, was seen and photographed during fall migration by a birder near Tokyo, Japan (at the city of Ebina, Kanagawa Prefecture, 35° 26' N, 139° 23' E) on 13 and 20 Aug. The bird was foraging with other plovers on an uncultivated rice field. According to the observer, "the place is famous as an observation point of shorebirds in southward migration". This plover was not among those found on Saipan during the Oct–Nov survey. Four of the ten birds radio-tagged at the HSVC were detected in Alaska – three were on the Alaska Peninsula (two near the town of Egegik, one near Cape Seniaivn), and





**Fig. 3.** The feathering of plovers on Saipan in April 2005 ranged from basic (the bird on the left) to partial alternate (on the right). During the same time-frame, Oahu birds typically have completed the prealternate molt and are in full breeding coloration.

one was in the Yukon–Kuskokwim Delta region north of Bethel (Fig. 2).

The places where we captured birds constitute most of the suitable foraging and loafing habitat (i.e. short grass) for Pacific Golden-Plovers on Saipan. Elsewhere, much of the island is covered by dense forest and scrub or otherwise unusable by plovers. In addition to counts on the study sites, we searched for plovers on golf courses (there are five on Saipan, collectively about 500 hectares), lawns around hotels, and along mown roadsides. Overall, our counts indicated a total island plover population in late March–early April of 200–250 birds with almost all of them concentrated on our study sites. We found only a few plovers along roadsides and none on the golf courses or hotel grounds.

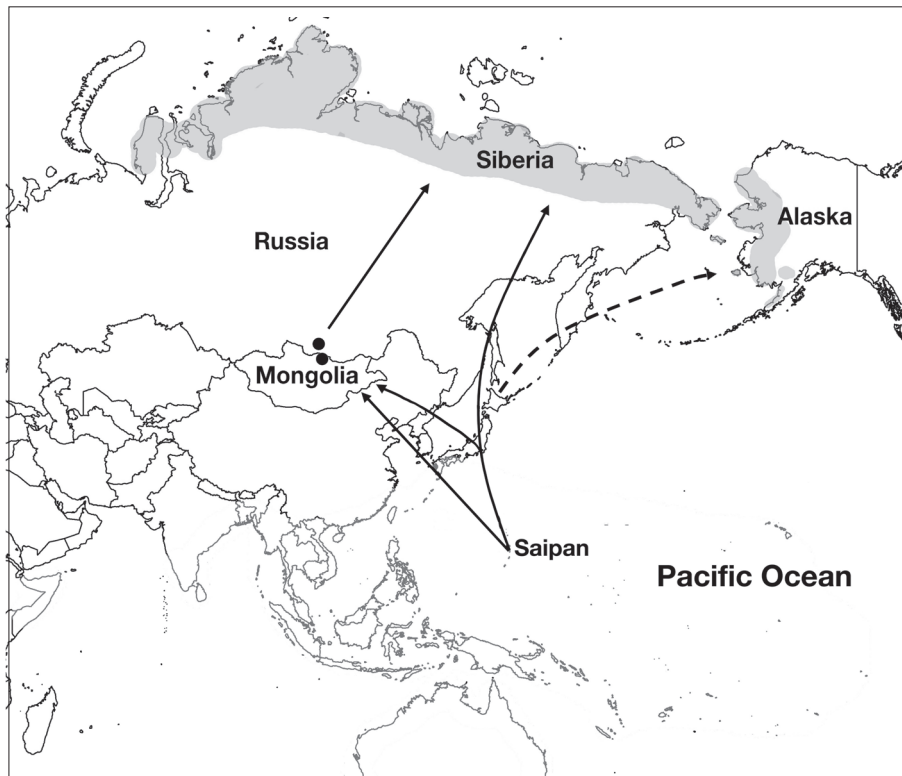
## DISCUSSION

Previous studies indicate that the fat-free mass of Pacific Golden-Plovers is about 105 g (Johnson *et al.* 1989), thus the birds netted on Saipan during 30 March–9 April 2005 (mean weight = 118 g, Table 1) were relatively lean. Plovers captured on Oahu wintering grounds during the same 11-day period in other years averaged 150 g (range = 106–190 g,  $n = 102$  birds caught from 1980–1992; Johnson *et al.* 1989, OWJ unpublished data). The difference between the Oahu and Saipan samples (32 g) was very significant ( $t = 10.12$ ,  $P < 0.0001$ ,  $df = 136$ ). We have no weight measurements of plovers at or near departure from Saipan. However, it is reasonable to assume that most of the individuals we handled would not have had sufficient time (and possibly insufficient resources, see below) to store a quantity of fat similar to birds nearing departure from Oahu. Our records of the latter (plovers captured during 20–27 April 1989–2002) indicate mean

weight of 173 g (range = 140–228 g,  $n = 144$ ; Johnson *et al.* 1989, OWJ unpublished data). Presumably, the respective weights of Saipan and Oahu plovers reflect differing spring migration strategies. Birds leaving Oahu must complete a lengthy nonstop transpacific flight of about 4,000 km to landfall in Alaska (Johnson *et al.* 1989) with arrival at stopovers or breeding grounds that may still be snow-covered. By comparison, landfalls on migratory pathways northward from Saipan are substantially closer and resources at potential stopovers are probably less variable than in the far north. Landfall in Japan, for example, lies approximately 2,300 km from Saipan and there are numerous islands along the route.

The possibility of a migratory link between Saipan and Alaska remains an open question, however the difference between the two sample groups (0/24 Saipan birds vs. 4/10 Oahu birds detected in Alaska) suggests that the migratory route of Saipan plovers does not arc eastward to Alaska but instead leads to breeding grounds in Siberia. On that assumption, departure from Saipan in late April relative to arrival on the Siberian nesting range in late May–mid June (see Johnson & Connors 1996) indicates that the birds must be spending lengthy periods of time at stopovers en route. Furthermore, the weights and plumages of plovers captured on Saipan suggest that considerable fattening and molting occurs at stopovers. Pacific Golden-Plovers are uncommon at shorebird stopover sites in the Yellow Sea region where numerous reports indicate relatively few *fulva* (<1% of their estimated population on the East Asian–Australasian Flyway, see Barter 2002, Bamford & Watkins 2005) amidst huge gatherings of other species (e.g. Moores 1999, Barter *et al.* 1998, 2000, 2002, Barter & Riegen 2004). By contrast, large numbers of transient *fulva* (both spring and fall) occur in Japan (Brazil 1991, Fujioka *et al.* 1998a,b). Thus, we suspect that at least





**Fig. 4.** Solid lines indicate possible spring migratory routes from Saipan. Black dots show major Pacific Golden-Plover stop-over sites in Mongolia and Russia (see text). Based on our results, an Alaska link (dashed line) seems unlikely, but the question warrants further study. Grey shading represents the species' breeding range.

some migrants from Saipan traverse the western Pacific via Japan (Fig. 4) as suggested by the presence of our marked bird at Ebina. Another possible migratory link for Saipan birds, particularly during spring passage, involves stopovers at inland regions such as the Torey Depression (see Johnson 2003) and the Selenga River Delta (Fefelov 2003) in northeastern Mongolia and adjacent Russia. Saipan plovers could reach the latter areas via a northwesterly flight by-passing Japan, or via a dog-leg movement from Japan (Fig. 4). Large spring aggregations of Pacific Golden-plovers have been reported at the Torey and Selenga locations, and these stopovers are probably of hemispheric importance for the species. Additional details about the two sites (and others in the same general region likely to host significant numbers of transient *fulva*) can be found in the Ramsar database at: [www.wetlands.org](http://www.wetlands.org)

Although the variation in mass between adult and first-year Saipan plovers (Table 1) was not statistically significant, the numbers suggest that adults were out-competing younger birds for available resources. Notably, the grassy areas where we captured plovers on Saipan were extremely dry, a condition that may have reduced the availability of prey. Rainfall on Saipan for the period January to April in each of the five years (2000–2004) preceding this study averaged 47.6 cm, whereas precipitation during the same period in 2005 was 23.9 cm. The potential relationship between precipitation, insect abundance, and spring fattening of plovers at Saipan needs additional study.

Unlike the HSVC plovers (each with a specific territory and thus easily observed), the marked Saipan plovers were mostly non-territorial. They tended to be in flocks difficult to approach closely, and the birds often foraged in grass tall enough to obscure the bands on their legs. Given these vari-

ables, it is almost a certainty that some banded birds went unrecorded during the fall survey. Therefore, the return rate of 72% is a minimal estimate of fidelity at Saipan. The actual rate there was probably similar to fidelity on Oahu where the average return of territorial plovers was 86% (239/277 over 21 seasons) in the first fall after banding (Johnson *et al.* 2001, 2004a, OWJ unpublished data).

The non-territorial pattern of behavior among Saipan plovers probably results from lack of habitat coupled with frequent disturbance by humans. Except for grasslands within the airport property (territorial plovers were relatively common there), human activities involving joggers, school children at play, and athletic events occurred regularly at each of our study sites forcing plovers to move elsewhere. Unrestrained dogs (we saw many on the island) probably cause additional disturbance. The absence of plovers on Saipan golf courses and hotel grounds was puzzling as these are places where this bird often winters in Hawaii. This finding raises questions about why such areas on Saipan are unattractive to plovers. A key factor might be excessive use of insecticides – a possibility that warrants further investigation.

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and radio-tagging. Oahu funding was provided by private donors participating in Kolea Watch, a program (administered by the Hawaii Audubon Society) that provides educational opportunities for people of all ages interested in Pacific Golden-Plovers. Our banding and radio-tagging on Oahu was facilitated by Miles Okamura who kindly permitted access to the Hawaii State Veterans Cemetery. Many people helped with the capture and monitoring of marked plovers there – we are particularly indebted to Annette Kaohelaulii. The U.S. Fish and Wildlife Service provided the aircraft necessary for aerial monitoring in Alaska. The following individuals arranged and/or participated in those flights: Fred Broerman, Dave Cox, Tyrone Donnelly, Sonja Lapinski, Paul Liedberg, Rob MacDonald, Tina Moran, Nathan Olson, James Richardson, Haldre Rogers, Susan Savage, Kristin Sesser, Kristine Sowl, Robert Sundown, Patrick Walsh, and Brendan Williamson. Hama Shinjirou found the marked plover in Japan, and Minoru Kashiwagi reported the sighting to us. Humphrey Sitters reviewed and edited the manuscript.

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