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**NO. 342**

**NOTES ON THE BIRDS OF KWAJALEIN ATOLL,  
MARSHALL ISLANDS**

**BY**

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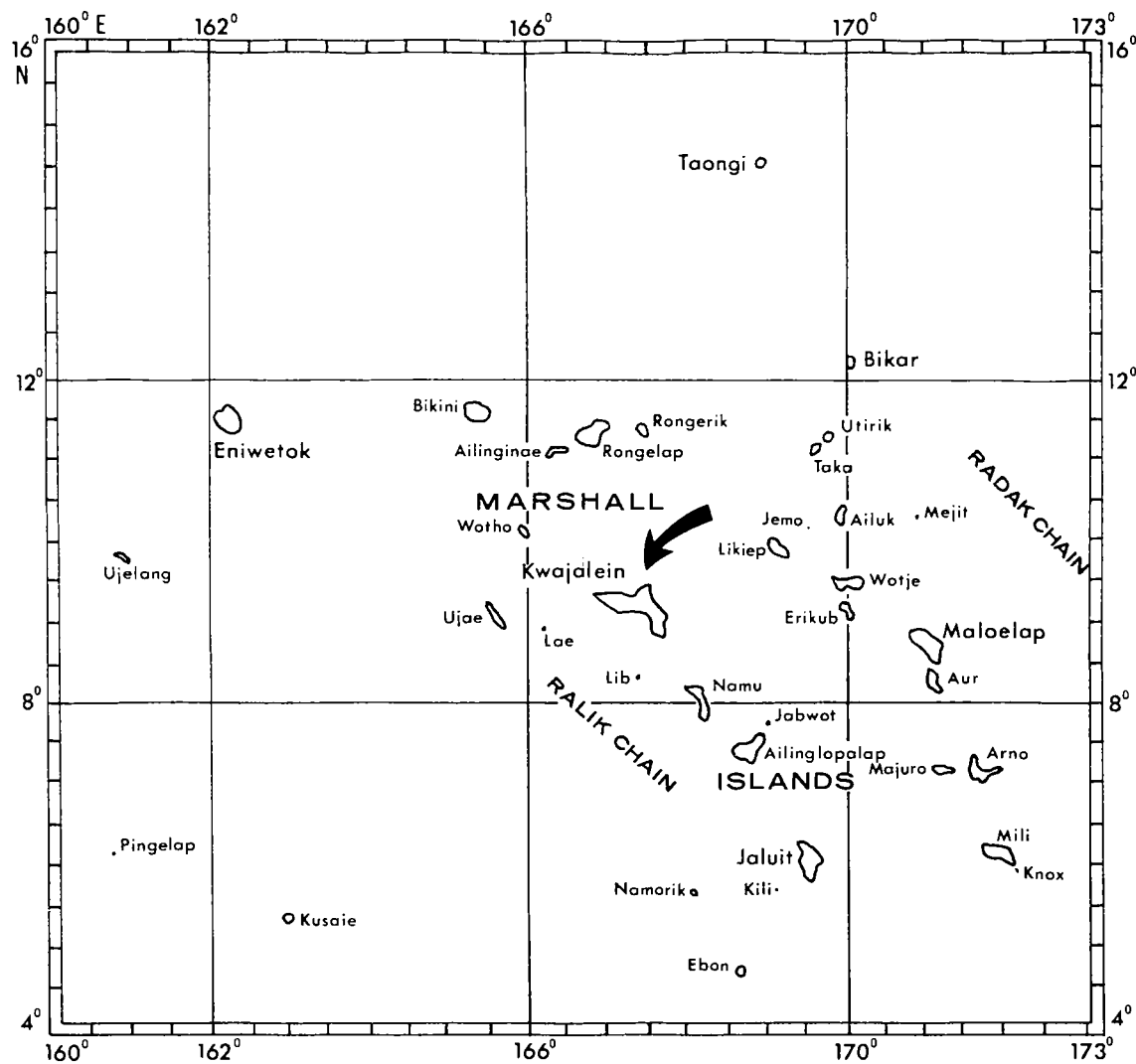


Figure 1. Location of Kwajalein Atoll in the Marshall Islands.

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Introduction

Kwajalein is a crescent-shaped atoll that lies between  $09^{\circ}25'$  and  $08^{\circ}40'N$  and between  $166^{\circ}50'$  and  $167^{\circ}45'E$ , near the center of the western (Ralik) chain of the Marshall Islands (Figure 1). Composed of more than 90 islets, largely uninhabited, Kwajalein Atoll extends about 75 miles from southeast to northwest. It has a land area of about 6 square miles (3,854 acres) (Global Associates 1987), an increase of about 263 acres over the original area that was brought about by filling of land on Kwajalein, Roi-Namur, and Meck Islands.

As of June 1987, the population of the atoll was about 12,200 and composed of about 9,560 Marshallese and 2,639 non-indigenous persons affiliated with the U.S. Army Kwajalein Atoll (USAKA) facility. The three islands of Ebeye (8,600; mostly Marshallese), Kwajalein (2,390) and Roi-Namur (249) hold over 90% of the population (Global Associates 1987).

During March 1988, I made ornithological observations on ten islands (Figure 2). Part of a survey requested by the U. S. Army Corps of Engineers, the observations helped determine the terrestrial wildlife resources of the atoll as baseline data for an environmental impact statement. Derral Herbst, a botanist with the U. S. Fish and Wildlife Service, also participated in the survey.

We lived on Kwajalein Island, and on a typical day we flew to one of the outer islands by helicopter at about 0700 and returned between 1400 and 1630 (Table 1). Most of the islands surveyed were small, 40 acres or less, and I could easily walk their perimeters and much of the interior in a few hours. A bicycle made surveying the larger islands of Roi-Namur and Kwajalein much easier. I counted birds and noted their behavior, stage of nesting, location, and habitats. I also casually observed other terrestrial vertebrates but did not attempt a comprehensive survey.

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Table 1. Itinerary of ornithological survey conducted on Kwajalein Atoll in March 1988.

Date	Depart Kwajalein Island	Time Spent Surveying Island	Island Surveyed	Arrive Kwajalein Island
8th Tues.		1530-1800	Kwajalein	1100
9th Wed.	0700	0715-0920	Ennylabegan (Carlos)	0925
10th Thur.	0710	0720-1455	Ennylageban	1505
11th Fri.	0738	0805-1542	Legan	1556
12th Sat.- 13th Sun.	1140	1200- -1223	Roi-Namur	1245
14th Mon.	0733	0750-1601	Illeginni	1621
15th Tues.	0825	0905-1545	Gagan	1615
16th Wed.	0745	0805-1505	Gellinam	1556
17th Thur.	0742	0802-1442	Omelek	1502
18th Fri.	0702	0717-1252	Eniwetak	1305
19th Sat.- 20th Sun.			Kwajalein	
21st Mon.	0704	0721-1445	Meck	1510
22nd Tues.	0915	0937-1603	Illeginni Island	1623
23rd Wed.	0706	0712-1448	Ennylabegan	1455
24th Thur.	0729	0742-1517	Legan	1529
25th Fri.	0740	0812-1530	Gagan	1557
26th Sat.- 27th Sun.	0704	0723- -1223	Roi-Namur	1243
28th Mon.- 29th Tues.			Kwajalein	
30th Wed.	1034			



The combined area of the islands surveyed in March was 1,408 acres, a little more than a third of the total land area. Brief descriptions of the islands and their habitats are given below.

Ennylabagen, or Carlos covers 124 acres, lies 8 miles northwest of Kwajalein, and orients generally northwest-southeast along the atoll rim. One village occupies the northern end, and another is situated in the south-central portion (Figure 3). The central portion of the island contains various facilities, a helipad, and a variety of open antennae fields (Figure 4) interspersed with scrubby areas and low forest. The northern and southern ends are more heavily forested, and the southern end provides the best habitat for birds. A thick stand of Pemphis trees grows along the southeastern shore; Cocos and Pisonia trees dominate the rest of the area. A trail follows the outer perimeter of the island's southern (Figure 5).

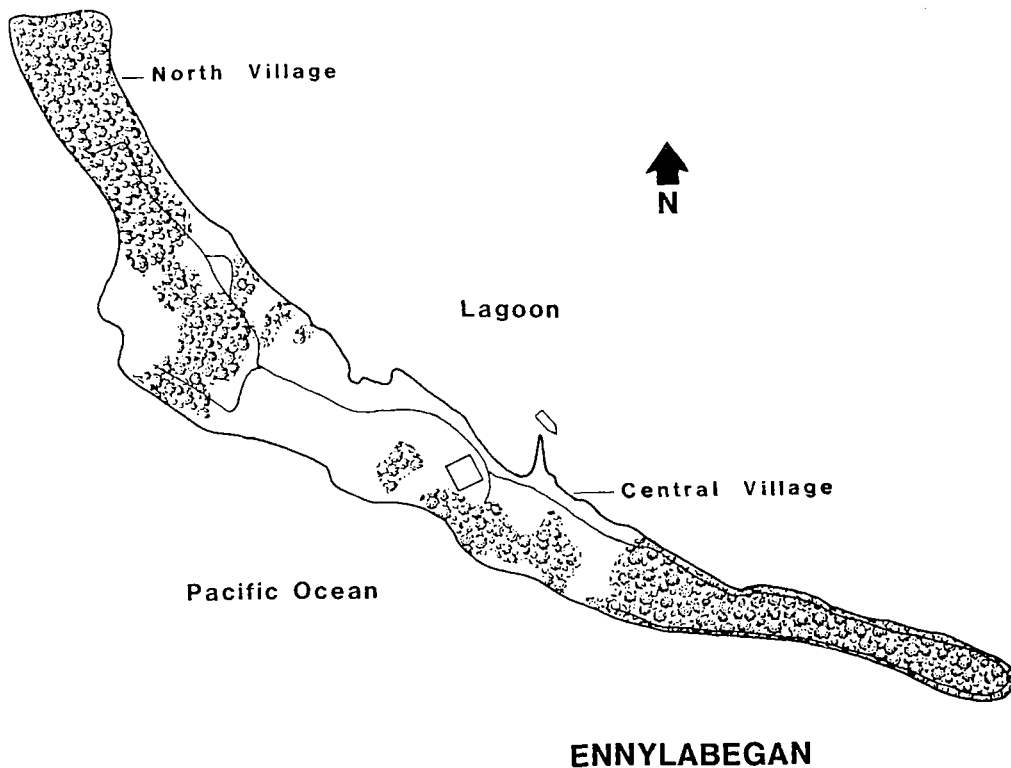


Figure 3. Ennylabagen Island. Principal area of shorebird concentration is WNW of the helipad.



Figure 4. Looking W at large antenna field near helipad on Ennylabagen, 10 March 1988. (All photographs, unless otherwise stated, were taken by the author in March 1988).



Figure 5. Trail through southeastern forest on Ennylabagen. Stand of Pemphis to right.

Western (ocean) shores are largely rubble with some pronounced rock ledges near the northwest point. Eastern (lagoon) shores are more sandy, but their location opposite Ebeye and Kwajalein has led to much accumulation of trash and debris.

Legan, (18 acres), lies north of Ennylabagen on the atoll's western rim about halfway between Ennylabagen and Illeginni. It is hook shaped with the point running northeast from the south end (Figure 6). The helipad and other facilities are on the southern portion of the hook and comprise about 20% of the island's area. About 70% is forested (Figure 7) with the remainder being two interior pools oriented north-south in the island's midsection (Figure 8). Pemphis, interlaced with Cassya vines, grows so densely around the pools that access is difficult. At the larger pool's northern end open Cocos permits a fairly easy approach. The perimeter is largely coral rubble with than on the western side forming a ridge about 10 feet higher than the interior. The only sandy beaches are on the east-central portion of the island. The lagoon area of this shore and north of the hook is very shallow, and a large, sandy expanse is exposed at low tide.

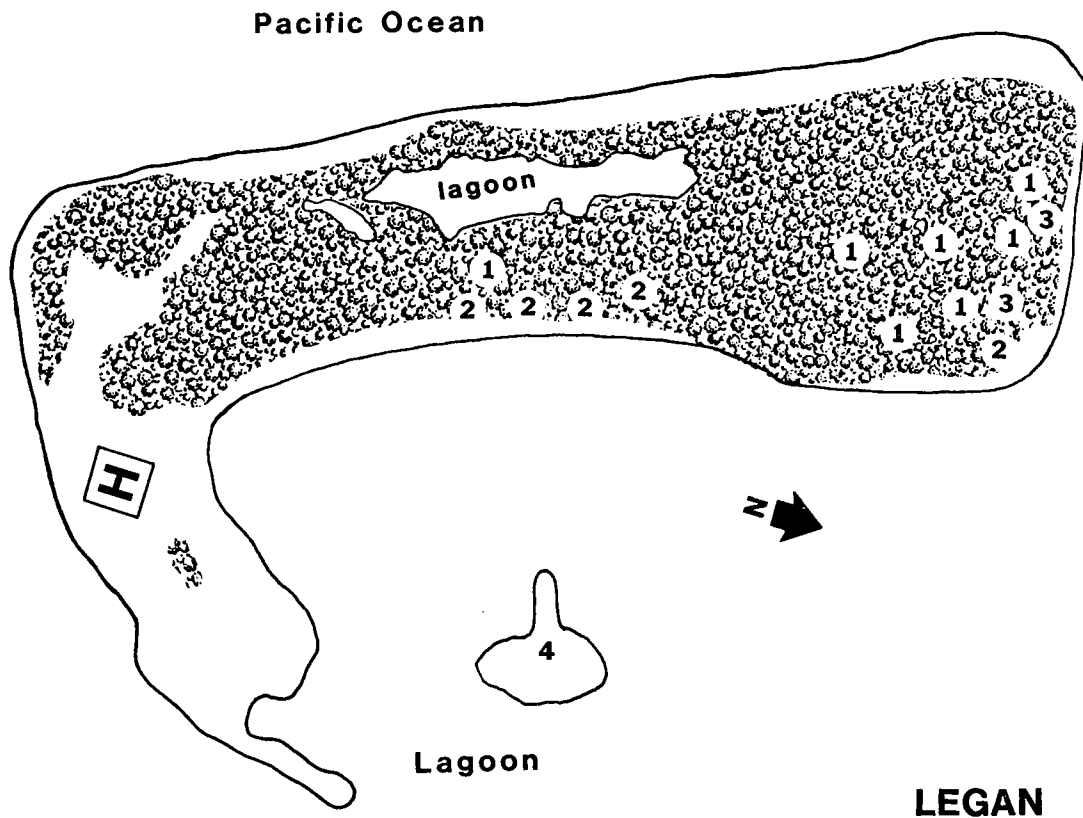


Figure 6. Legan Island. (1) Nesting area of White Terns; (2) nesting area of Brown Noddies; (3) nesting area of Black Noddies; (4) roosting area of Crested and Black-naped Terns.





Figure 7. Looking south at forest on northern end of Legan from point at northeastern corner marked 2 in Figure 6.



Figure 8. Northern (larger) interior pool on Legan from the north. Cassytha entangled vegetation in background.

Illeginni is 31 acres and lies on the southwestern rim. Also hook-shaped, it lies with its long axis essentially from west-northwest to east-southeast with the hook pointing north into the lagoon (Figure 9). A helipad at the west end is connected by a road down the center of the island to the facilities and harbor at the east end (Figure 10). The central portion of the east end has been artificially elevated to about 40 feet. Perhaps 70% of the island has been cleared, but at least some of this area, particularly along the central road, is covered by rank undergrowth. The principal forest stands remaining are on the west end, fringing the east end, and on either side of the central road on the island's southern half. The shoreline of Illeginni is mostly medium to coarse coral rubble with occasional patches of sand. The water along the southern third of the western shore is very shallow and usually provides exposed areas and tide-pools where herons and shorebirds forage. North of Illeginni is an isolated smaller island (Figure 11) of perhaps one acre that is scantily vegetated and which can be reached dryshod at low tide. It has broad, sandy beaches from the south along the lagoon side to the north spit and a rough rubble-lined ocean shore.

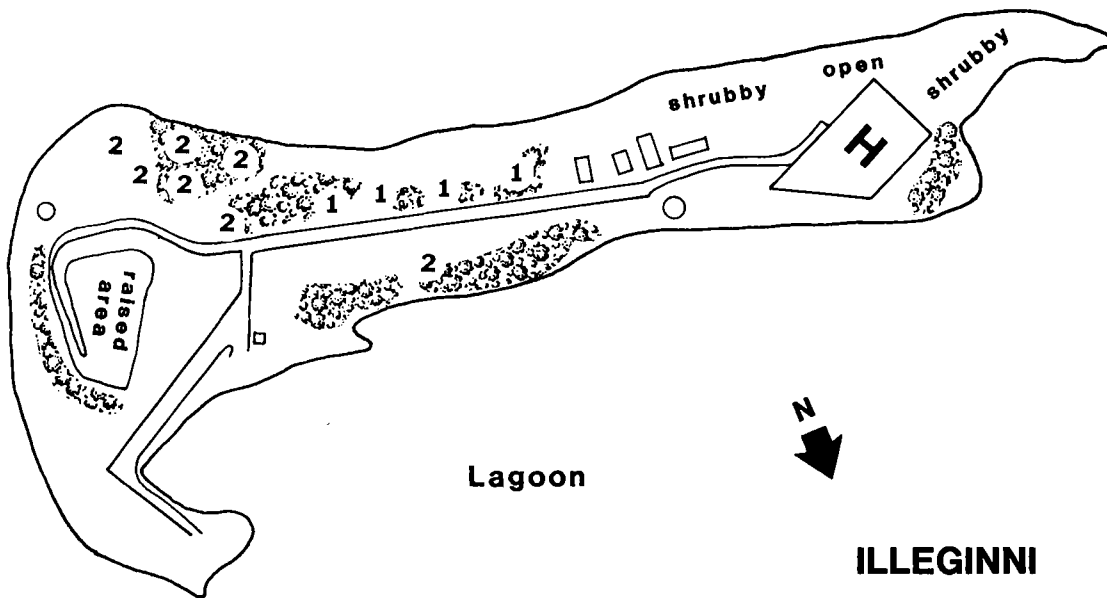


Figure 9. Illeginni Island. (1) Nesting area of Brown Noddies; (2) nesting area of Black Noddies.

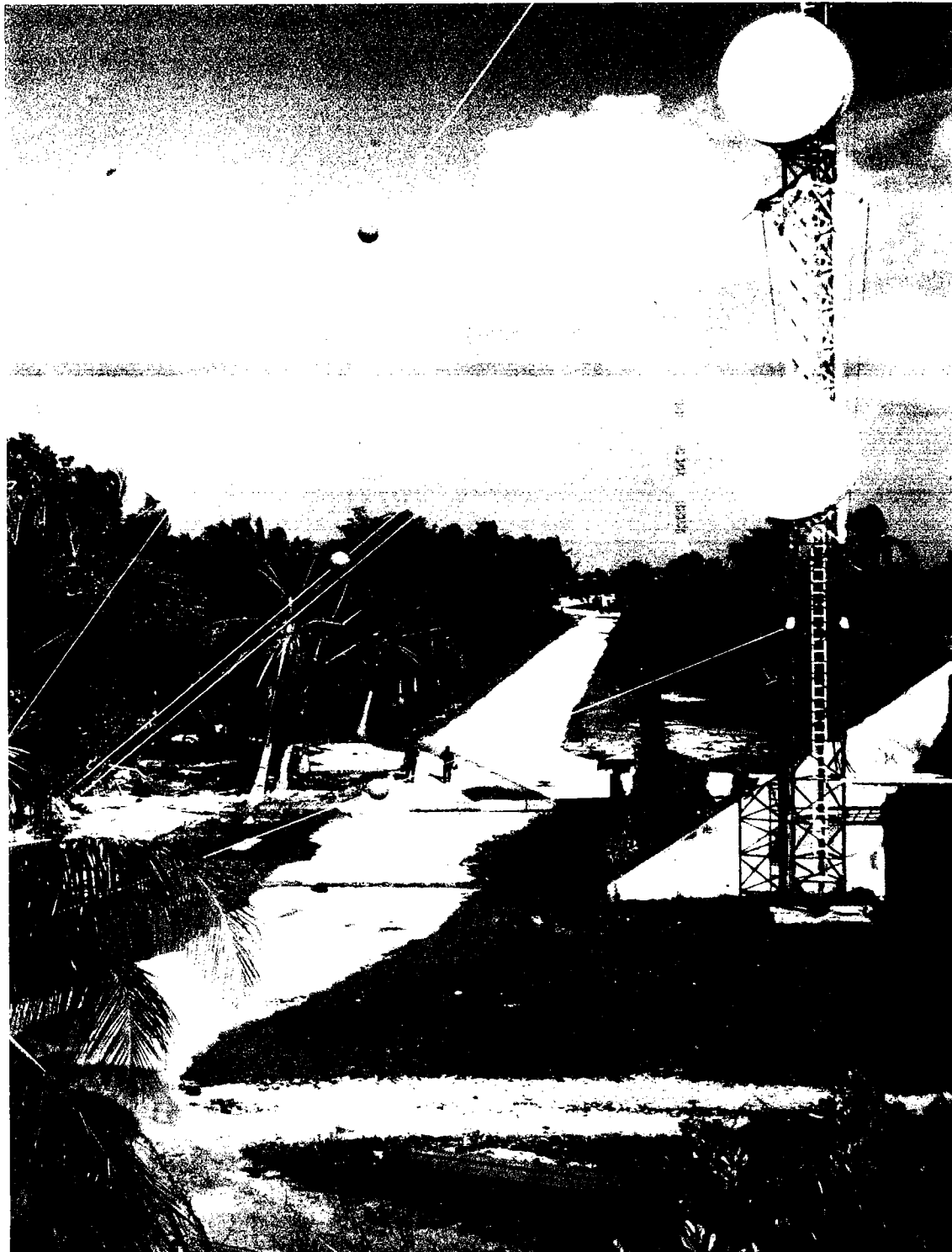


Figure 10. Illeginni Island looking west-northwest from the elevated area on the east end. Coconuts to the left of the central road are the principal nesting area of Brown Noddies.



Figure 11. Illiginni Island, looking north toward isolated northern island.

Roi-Namur covers 398 acres and lies about 50 miles north-northeast of Kwajalein from which it may be reached by daily flights. It was formed from the three islands of Roi, Enedrikdrik, and Namur. The western portion (Roi) contains an airstrip, residential and work areas, and a golf course and is largely open with only scattered stands of shrubs and trees (Figure 12). The south tip of Roi has an extended sandy point that is attractive to shorebirds and resting terns. The eastern portion (Namur) has several large facilities and a large inlet (Figure 13). This portion is much less developed and contains more forest and scrubby area. Docking facilities are located on the southern (lagoon) shore, and sandy beaches are found on southern, western, and northern shores. The eastern and north-eastern shores of Namur are rocky, and at low tide provide attractive foraging habitat for shorebirds.

Gagan is the last island in a string of about a dozen running southeast from Roi-Namur. It is a 6-acre oblong that runs north-south, and about half the island has been cleared. A helipad, buildings, and a dock are found on the southern third of the island; and the center of the island has been cleared to the north tip (Figures 14, 15). A small grove runs east-west across the south end (Figure 16) and shrubs and trees line the shores of the northern two-thirds of the island. Those on the western (lagoon) when I visited and many lacked leaves. The eastern and southern shores are rough rubble, and the western shore is sandy. A small sand-spit

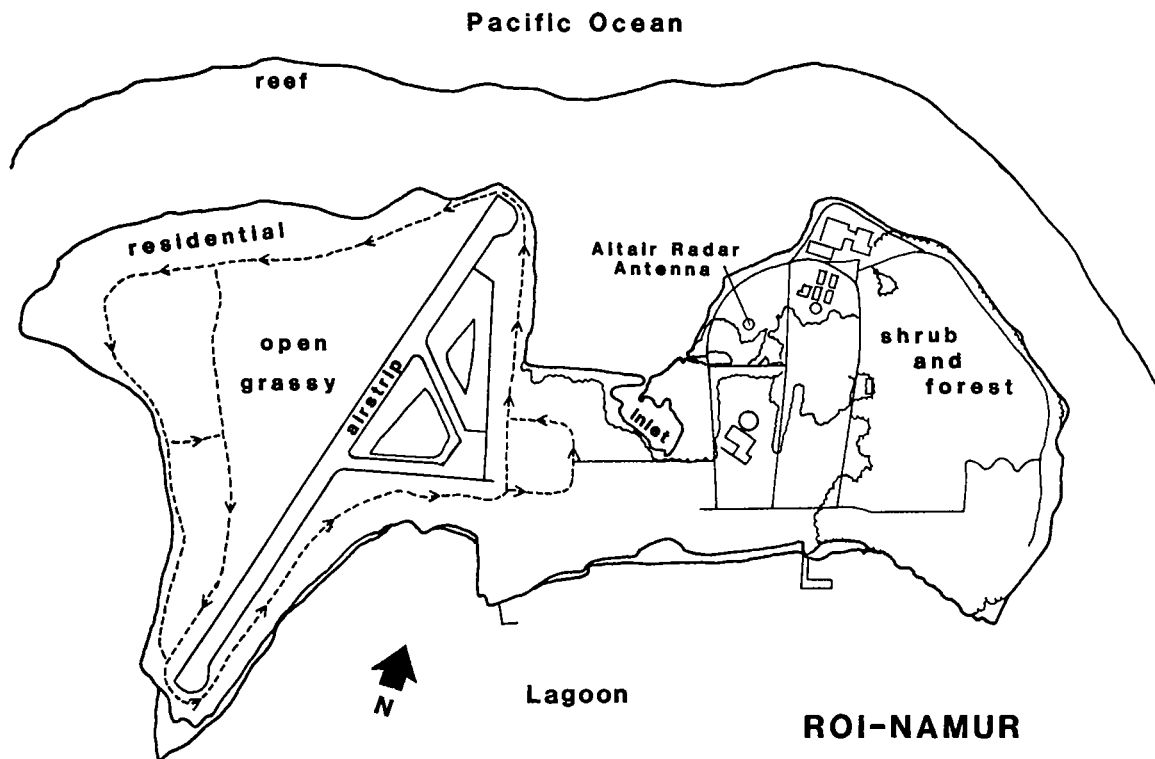


Figure 12. Roi-Namur Island. Dotted lines show route of shorebird surveys.

extends off the north tip of the island (Figure 17), and a much larger one is south of the piers at the southwestern corner. Areas to the north and along the lagoon shore are shallow and at low tide expose rocks that are used by roosting terns.

Gellinam, Omelek, Eniwetak, and Meck are all on the atoll's southeastern rim and about due north of Kwajalein. Five-acre Gellinam is long and narrow and runs roughly north-northeast to south-southwest (Figure 18) Little native vegetation remains; most of the island has been cleared for the helipad and structures on the southern three-quarters of the island. A Pisonia forest running across the northern portion contains a substantial Black Noddy (Anous minutus) colony. Sandspits extend to the north and south and a pile of large rock blocks at the north end (Figure 19) provides an attractive roosting area for Black-naped Terns (Sterna sumatrana).

Omelek Island is small (8 acres) and roughly triangular with points to the northeast, west, and south (Figure 20). Sandspits lie off the northeast and south points with some rough coral rubble along the north side. About 80% of the island has been cleared for the



Figure 13. Roi-Namur Island. Inlet from ocean on Namur. Sandy area to left is favored by Wandering Tattlers for roosting.

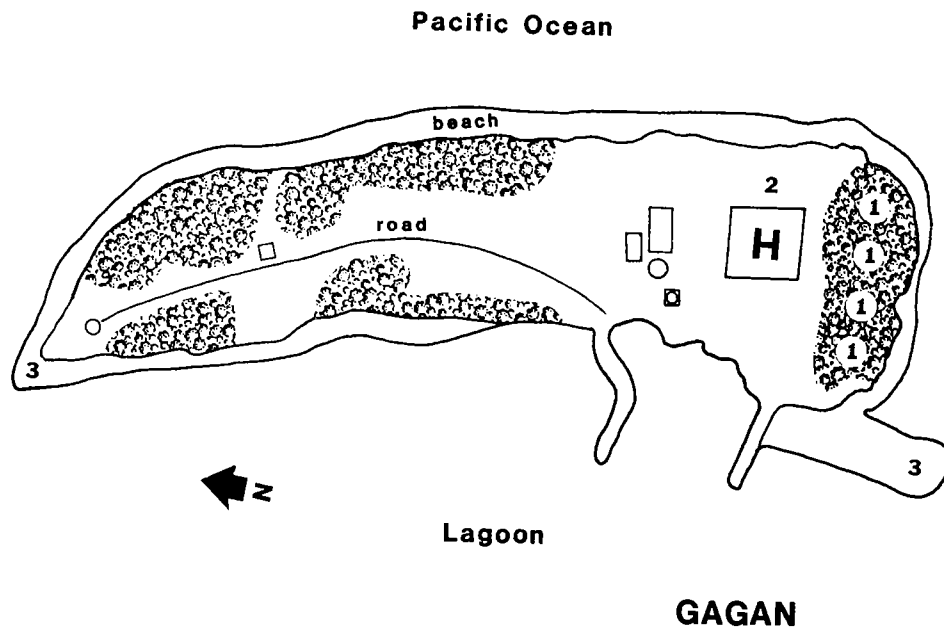


Figure 14. Gagan Island. (1) Presumed nesting area of White Terns; (2) nesting area of Black-naped Terns in 1979; (3) principal roosting area of Black-naped Terns.

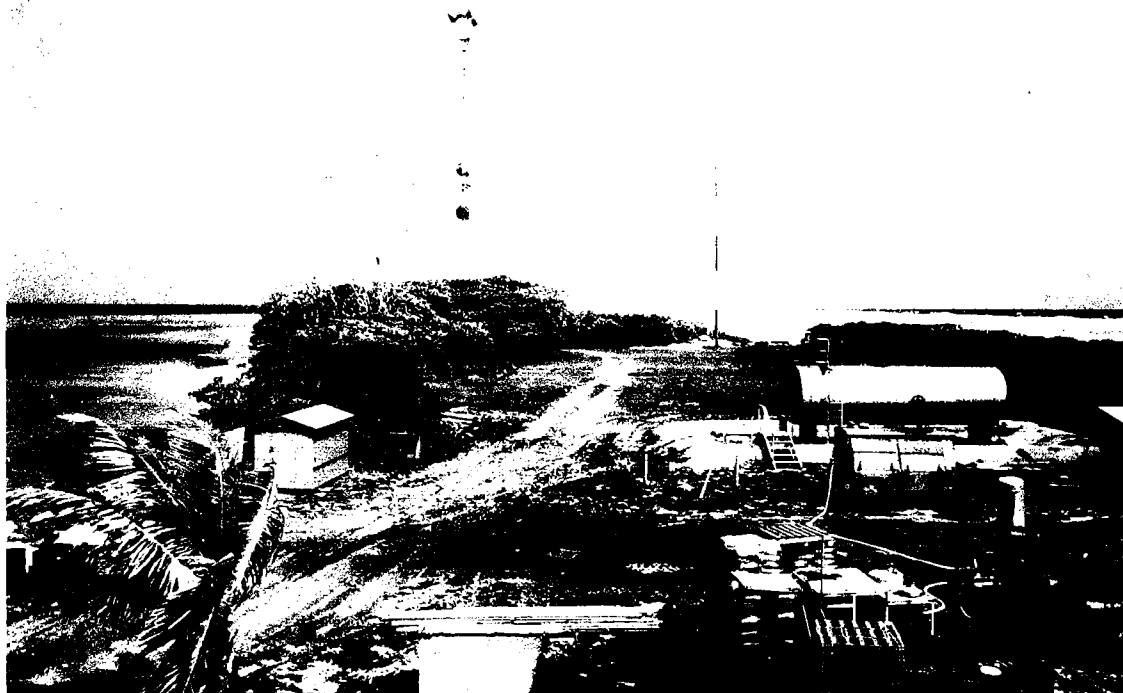


Figure 15. Gagan Island. Looking north from facilities at the south end of the island.



Figure 16. Small grove of open Pisonia at the south end of Gagan Island.



Figure 17. Rubble spit at the north end of Gagan Island.

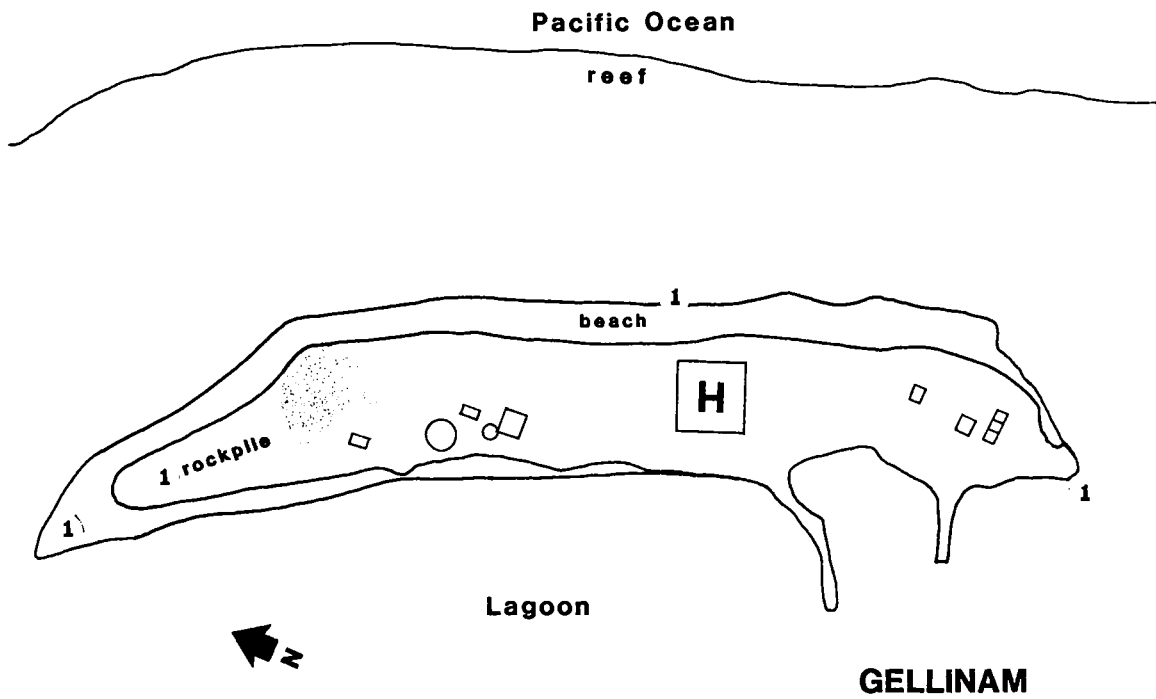


Figure 18. Gellinam Island. (1) Roosting area of Black-naped Terns. Shaded portion shows area occupied by nesting Black Noddies.





Figure 19. Looking southeast from northwest end of Gellinam Island. Coral rubble used for roosting by Black-naped Terns to left; Black Noddy colony in center.

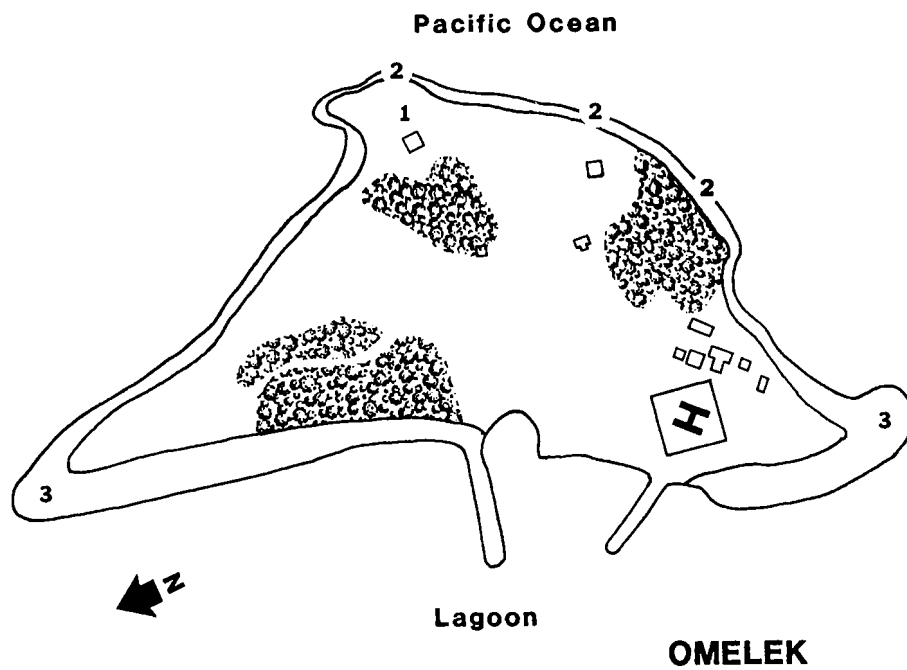


Figure 20. Omelek Island. (1) Areas where Black-naped Terns may nest; (2) other areas likely to hold Black-naped Tern nests; (3) principal roosting areas of Black-naped Terns.

helipad on the northeast point and for other facilities. The remaining area consists of scattered patches of low forest.

Eniwetak (15 acres) is within sight of Meck, is oblong, and orients west-east along the atoll rim. Two long breakwaters extend off the west end; and a helipad sits on the southeast corner (Figure 21). The southern side of the island has been cleared, and a road runs to facilities at the eastern tip. Most of the island, the northern three-quarters, holds a luxuriant Pisonia forest that is much used by nesting seabirds. That portion towards the western end of the island is more open (Figure 22); the densest, largest remaining forest, and that used to a greater degree by Black Noddies is towards the eastern end. Southern and eastern shores have emergent reef and rocky rubble. A sand beach, the widest seen on the survey, extends from the northeast along the north side of the island to the southwest.

Meck has 55 acres that extend almost north and south. More developed than the other islands surveyed, it was enlarged from fill and retains few natural features. The eastern half and southeastern two-thirds of the island are occupied by an airstrip that has a helipad about two-thirds of the way towards its northern tip (Figure 23). The portion of the island east of the airstrip is largely occupied by buildings and warehouses. The northeastern portion is elevated perhaps 40 feet or more (Figure 24) and contains various facilities. Most of the island is bordered by rough stone walls. The only sandy beach is found along the northwestern perimeter.

Kwajalein is the largest island of the group (748 acres), and it forms a crescent at the southeastern corner of the atoll (Figure 25). The island is highly developed and virtually no natural habitat is left. Most of the northeastern portion of the island is residential with large numbers of imported plants. Along the northern shore are piers, docks, a dump, and a wide variety of shops, warehouses, and other facilities. The southern portion of the crescent is largely taken up by aircraft facilities and the runway. Northwest of the runway is "Mount Olympus," a man-made area 70 feet high and the first site of missile launches from the atoll. A golf course and a fenced enclosure containing ammunition bunkers fill the area between the runway and the beach. Southeast of Mount Olympus and beyond the southwest end of the runway is an elevated area that overlooks much of the southeastern portion of the island. This elevated area ("the Plateau") and areas south and west of the runway provide the best habitat for migratory shorebirds on the island (Figure 26). These areas receive little disturbance during the week but the activities of cyclists and joggers on the weekends keep the birds somewhat wary.

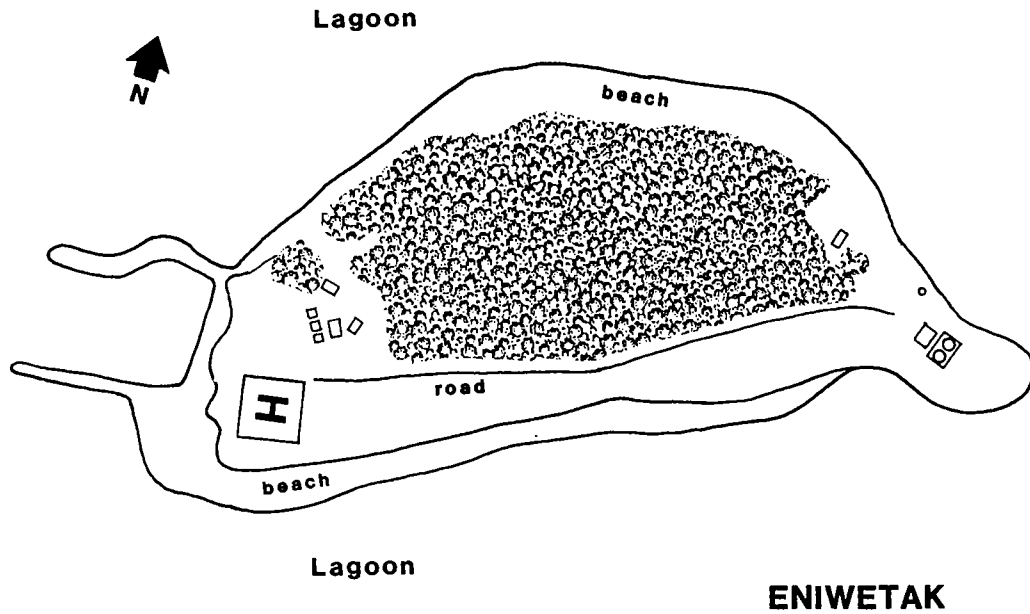


Figure 21. Eniwetak Island. Black Noddies nest throughout the forested area but are more abundant in the northern and eastern portions.



Figure 22. More open forest along north shore of Eniwetak Island, looking east.

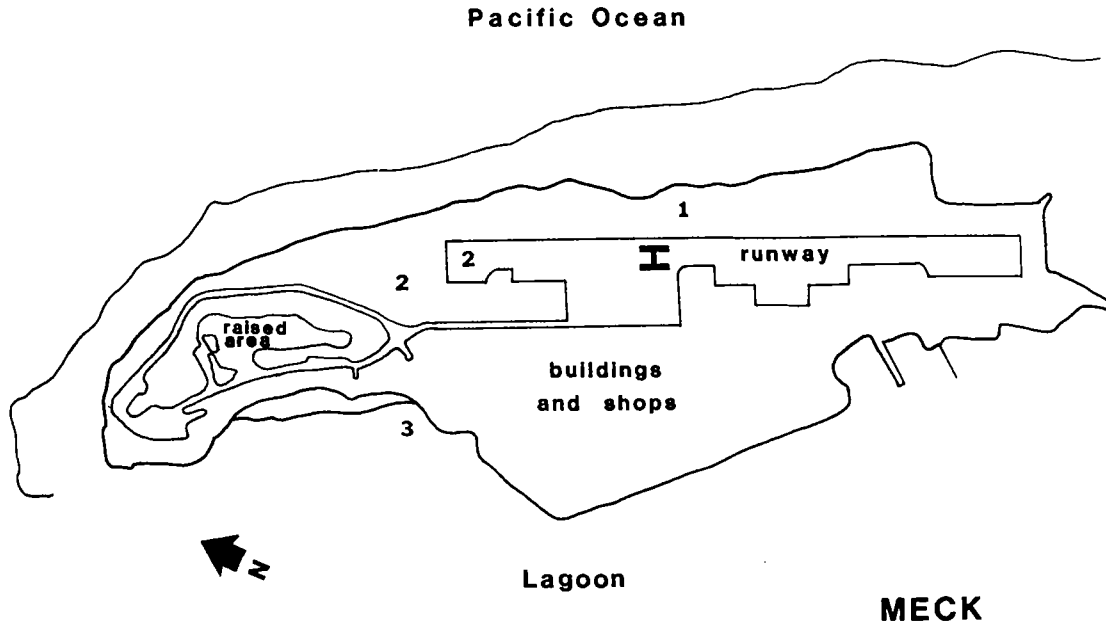


Figure 23. Meck Island. (1) Nesting area of Black-naped Terns; (2) primary shorebird roosting areas; (3) area preferred for foraging by Crested Terns.



Figure 24. Looking towards raised northwestern portion of Meck Island. Area in foreground is preferred roosting area of shorebirds.

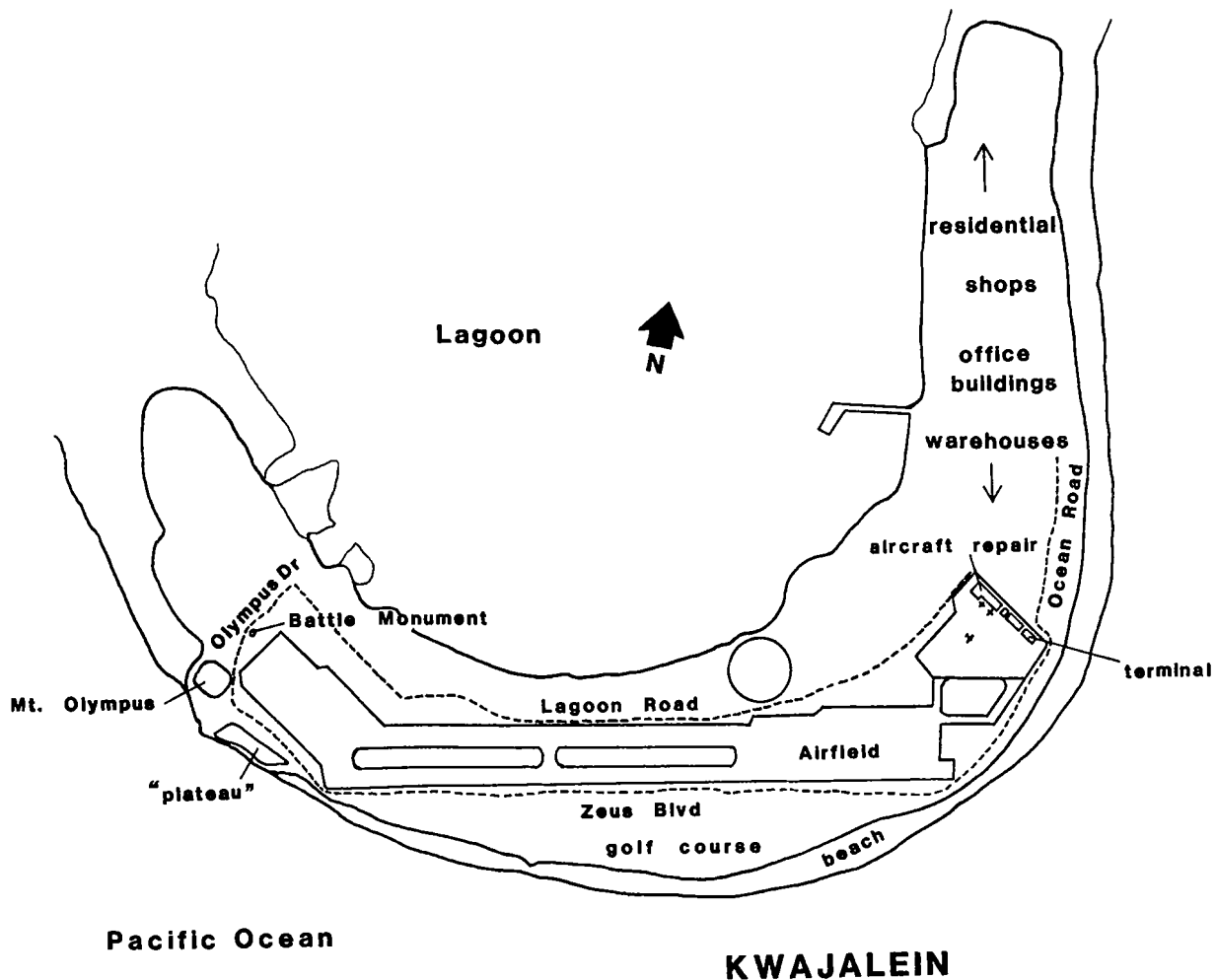


Figure 25. Kwajalein Island. Dotted line shows route of shorebird surveys.

#### The Avifauna of Kwajalein Atoll

The principal ornithological summaries of the Marshall Islands are Baker's (1951) "Avifauna of Micronesia" and Amerson's (1969) "Ornithology of the Gilbert and Marshall Islands." The latter includes much of the information obtained by the Smithsonian Institution's Pacific Ocean Biological Survey Program (POBSP) during the mid and late 1960's. Amerson's work compiled avifaunal lists for all the atolls in the Marshall Islands and summarized the status of the birds of the area. He reported 30 species from Kwajalein.



Figure 26. Looking northwest from the elevated area on western Kwajalein towards the overrun at the west end of the runway. Lawn areas in the mid-ground were much used for foraging by shorebirds including Bar-tailed and Hudsonian Godwits and Curlew Sandpiper.

The principal source of new information for the atoll since that report is a note by Schipper (1985) that added another 16 species. This report adds eight more and deletes one to bring the total known from the island to 53. The status of these birds is briefly summarized in Table 2.

Prior to the present survey, the birds of Kwajalein and Roi-Namur were best known because they are easy to reach and because more humans live on them. Little or no information is available for the eight outer islands surveyed or on the rest of the more than 80 islets.

Recent unpublished notes and photographs of the atoll's birds, largely for Roi-Namur Island, were provided by William Schipper who keeps a daily list of the numbers of birds seen there. These lists have been helpful in determining seasonal occurrence for species such as the Great Frigatebird (*Fregata minor*) and provided much information on numbers and dates of occurrence that was not provided in his earlier paper. Also incorporated in this account are additional data provided by Schipper for the period April-November 1988. The number of days per month per year in which Schipper made observations is given in Appendix Table 2.

Table 2. List of the Birds of Kwajalein Atoll

<u>Species</u>	<u>Status</u>
Mottled Petrel	Rare offshore migrant.
Wedge-tailed Shearwater	Uncommon offshore visitor.
Sooty Shearwater	Common offshore migrant.
White-tailed Tropicbird	Rare visitor.
Red-tailed Tropicbird	Rare visitor.
Brown Booby	Uncommon resident. Known to breed only on Oniotto Island.
Red-footed Booby	Uncommon resident and common offshore visitor. Known to breed only on Oniotto Island.
Great Frigatebird	Uncommon resident but frequent visitor in small numbers. Known to breed only on Oniotto Island.
Pacific Reef Heron	Common resident. Known to breed only on Roi-Namur, but almost certainly breeds on other islands in the atoll.
Cattle Egret	Rare vagrant.
Canada Goose	Accidental vagrant.
Green-winged Teal	Uncommon migrant.
Mallard	Rare migrant.
Northern Pintail	Uncommon migrant.
Garganey	Accidental vagrant.
[Gadwall]	Hypothetical.
Northern Shoveler	Uncommon migrant.
Tufted Duck	Accidental vagrant.
Black-bellied Plover	Uncommon migrant.
Lesser Golden-Plover	Abundant migrant.

Table 2 (cont'd). List of the Birds of Kwajalein Atoll

<u>Species</u>	<u>Status</u>
Mongolian Plover	Uncommon migrant.
Common Ringed or Semipalmated Plover*	Accidental migrant. Not previously reported from Kwajalein Atoll.
Greater Yellowlegs	Accidental migrant.
Lesser Yellowlegs	Accidental migrant.
Marsh Sandpiper	Accidental migrant.
Wood Sandpiper	Accidental migrant.
Wandering Tattler	Common migrant.
Gray-tailed Tattler	Uncommon migrant.
Whimbrel	Common migrant.
Bristle-thighed Curlew	Uncommon migrant.
Black-tailed Godwit	Rare migrant.
Hudsonian Godwit	Accidental migrant.
Bar-tailed Godwit	Uncommon migrant.
Ruddy Turnstone	Abundant migrant.
Sanderling	Uncommon migrant.
Pectoral Sandpiper	Accidental migrant.
Sharp-tailed Sandpiper	Uncommon migrant.
Curlew Sandpiper	Accidental migrant.
Ruff	Accidental migrant.
Latham's Snipe	Accidental migrant.
Oriental Pratincole	Accidental vagrant.
Franklin's Gull	Accidental vagrant.
Great Crested Tern	Common resident. Has not been found nesting on Kwajalein but probably breeds there.



Table 2 (cont'd). List of the Birds of Kwajalein Atoll

<u>Species</u>	<u>Status</u>
Black-naped Tern	Common resident. Known to breed only on Gagan, Meck and, Gellinam; probably breeds elsewhere as well.
Little Tern	Accidental visitor.
Sooty Tern	Uncommon offshore visitor.
Brown Noddy	Common resident. Known to breed or has bred on Debuu, Edgigen, Edjell, Gagan, Illeginni, Legan and Obella Islands; probably breeds on other islands as well.
Black Noddy	Abundant resident. Known to breed or has bred on Debuu, Edgigen, Edjell, Gagan, Gellinam, Illeginni, Legan, and Obella Islands.
White Tern	Common resident. Known to breed or has bred on Debuu, Edgigen, Edjell, Eniwetak, Ennumennet, Gagan, Kwajalein, Legan, Obella, and Roi-Namur Islands; probably breeds on other islands as well.
Fork-tailed Swift	Accidental vagrant.
Sacred Kingfisher	Accidental vagrant.
Common Mynah	Introduced; now extirpated.
House Sparrow	Introduced; now extirpated.
Eurasian Tree Sparrow	Introduced; common resident.

#### Annotated List

English and scientific names in the species accounts and taxonomic sequence in which the species are listed follow the A.O.U. Check-list (A.O.U. 1983) for all species listed therein. English and scientific names for the rest follow Edwards (1982). The species accounts primarily provide information on numbers, habitat utilization, and breeding status. Numbers estimated for all species during this survey are also provided in Appendix Table 1. Such estimates are limited because they derive solely from diurnal observations. My

previous experience in other Pacific seabird colonies has shown that populations roosting at night might be much greater than those seen by day. In one instance, on Birnie Island in the Phoenix Group, a nocturnally roosting population of several hundred Black Noddies would have been missed completely by a diurnal survey.

During daylight, time of day continues to strongly influence population estimates. The number of birds present during the early morning and late afternoon is almost always greater than at midday when many birds are foraging at sea. This phenomenon was particularly striking in the White Terns (Gygis alba) observed at Legan. Two to three times as many birds were seen in the early morning than later in the day. Similar daily variation in numbers present has been noted in a wide variety of central Pacific seabirds, among them Red-footed Boobies (Sula sula) and Great Frigatebirds roosting on Johnston Atoll (Schreiber and Schreiber 1986).

The stage of the breeding cycle is also critical in determining population numbers. Even in equatorial Pacific seabird populations where some individuals may breed in every month, adults and young usually disperse after the young fledge. Because little information is available on breeding seasonality at Kwajalein or at other atolls in the Marshalls, I cannot be certain whether breeding species were at peak numbers during the March 1988 survey. Black Noddies, which were at roughly comparable stages of breeding on the different islets, may have been near peak numbers. Shorebirds such as the Lesser Golden-Plover (Pluvialis dominica) may use Kwajalein both as a stopping place and a wintering area. Such species are more numerous in fall when their ranks are swelled by young than in the spring when numbers are diminished by winter attrition.

Other examples of how numbers may be estimated erroneously are discussed by Schreiber and Schreiber (1986). In one particularly vivid example, banding studies of White Terns showed that estimates of nests present might underestimate total numbers on one atoll by two orders of magnitude and that the maximum number seen at any time represented no more than 5% of the numbers using the atoll throughout the year. Thus, the estimate of 75 White Terns present on Legan in March 1988 might indicate that as many as 1,500 terns use the islet annually.

Other problems in estimating tropical seabird populations are also provided in more detail by the Schreibers. Dunnet (1980, 1982) discussed estimation problems for seabirds of colder waters. Many of the problems, such as accuracy of single surveys, are common to both areas; and the differences are more of degree than type.

For the reasons discussed in these sources, it would be best to assume that data on numbers presented herein consistently underestimate the use of Kwajalein by seabirds.

## Species Accounts

MOTTLED PETREL (Pterodroma inexpectata)

Schipper saw a Mottled Petrel approximately 100 ft from the reef's edge at the southeastern corner of Roi-Namur on 11 June 1987 (Clapp and Schipper 1990). This sighting is the only record for Kwajalein and for Micronesia, but the species probably occurs more frequently in the tropical western Pacific than this single record might suggest.

Mottled Petrels regularly migrate through the tropical Pacific to winter in the north Pacific (A.O.U. 1983). The northward migration, primarily from mid March to May (King 1970, Nakamura and Tanaka 1977, Ainley and Manolis 1979), largely passes through the western Pacific with smaller numbers passing through Hawaii. Presumably the bird off Roi-Namur was a late migrant.

WEDGE-TAILED SHEARWATER (Puffinus pacificus)

Wedge-tailed Shearwaters are uncommon offshore visitors to Kwajalein that were first reported by Anderson (1981) who saw three or four off the eastern side of the atoll on 3 July 1976. Schipper (1985) subsequently recorded them off Boggerik Island on 10 May 1980 and off Roi-Namur 24-30 May 1981. In 1987, they were recorded from Roi-Namur on seven occasions from 13 May to 15 July with a peak of 13 birds on 21 June, but they were recorded only once in 1988 when three were seen on 9 July (Schipper in litt.)

This species breeds widely on islands of the tropical Pacific (A.O.U. 1983), but in the Marshall Islands it has been found breeding only on Taongi, Bikar, Taka (Amerson 1969), and Enewetak Atolls (Hailman 1979, Temme 1990).

SOOTY SHEARWATER (Puffinus griseus)

Sooty Shearwaters are common off Kwajalein during migration but were not recorded there until 20 November 1979 when Schipper (1985) found a carcass along a road on Roi-Namur (Figure 27). Schipper (in litt.) has seen migrants offshore from mid May (13 May 1987, 16 May 1983) to early July (5 July 1987) with an isolated sighting on 7 August 1982. A dying bird found 25 May 1981 and sightings of about 200 passing offshore on 22 and 23 May 1981 (Schipper 1985) and of 5 and 10 birds, 13 and 14 June 1987, respectively, suggest a peak migration in late May and early June.

These shearwaters are common migrants in the central Pacific and have been recorded at sea in the Marshalls as early as April (1967) (Amerson 1969). The only previous reports from the Marshalls are one of two birds seen near Majuro Atoll on 10 or 11 June 1966 (Amerson



Figure 27. Sooty Shearwater found dead at Roi-Namur 20 November 1979. Photograph by W. L. Schipper.

1969) and two seen at Bikini Atoll 16 May 1986 (Garrett and Schreiber 1988).

Amerson reported this species and the Short-tailed (Slender-billed) Shearwater (*Puffinus tenuirostris*) from Eniwetak Atoll citing Pearson and Knudsen (1967). These authors only stated that either or both species had been sighted and did not specifically confirm the presence of either. The only unequivocal record for the Marshall Islands is an adult female collected at Kinajon Island on 21 April 1933 (Yamashina 1940). This record, mentioned by Baker (1951) and Serventy (1953), was later reported as a record from Ine Island, Arno Atoll by Amerson (1969).

#### WHITE-TAILED TROPICBIRD (*Phaethon lepturus*)

The only record for Kwajalein Atoll is an adult that Schipper (1985) saw flying over Ennubirr Island on 25 May 1981. This pantropical species is widespread in the Pacific but is a relatively uncommon breeder in the Marshall Islands, where it has been found breeding only on Bikar, Erikub, and Jaluit Atolls (Amerson 1969).

Amerson also listed this species as a breeding bird of Enewetak Atoll based on Woodbury's (1962) comment that "A single bird flushed

from scaevola shrubs where it was obviously nesting but the nest was not found, March 17 [1962], Kate [Muzin] islet. This was the only bird observed but it was near red-tailed [tropicbird] nests." This statement does not adequately document breeding because the habitat and situation in which the bird was found are atypical for the species. Very likely that the bird was simply resting in the area.

#### RED-TAILED TROPICBIRD (Phaethon rubricauda)

An adult seen flying over Omelek Island at 0929 on 17 March 1988 is the only record for Kwajalein Atoll (Clapp and Schipper 1990). The bird lacked the central tail feathers and the bill was salmon rather than the bright reddish-orange usually found in central Pacific representatives of this bird. The Red-tailed Tropicbird breeds widely in the tropical Pacific and in the Marshalls has been found nesting at Taongi, Bikar, Taka, and Enewetak atolls (Woodbury 1962, Fosberg 1966, Pearson and Knudsen 1967, Carpenter et al. 1968, Amerson 1969).

#### BROWN BOOBY (Sula leucogaster)

Brown Boobies breed widely in the Marshall Islands (Amerson 1969) but are uncommon on Kwajalein where they are only known to breed at Oniotto Island (Schipper 1985). The size of the breeding population is unknown, but it is probably quite small judged by how seldom birds are seen elsewhere on the atoll. None were seen during the March 1988 survey.

Brown Boobies are seen regularly off Roi-Namur where Schipper's observations (1985, in litt.; Table 3) indicate that they occur more frequently from May to November. Peak numbers seen were 10 or more on only 6 days: 20 on 10 February 1985, 15 on 26 September 1987, 11 on 11 April 1983, and 10 each on 2 August 1981, 10 June 1987, and 27 September 1987.

Fosberg (field notes) recorded a Brown Booby flying with frigatebirds at Eniwetak Island on 23 January 1952, and others were seen on buoys and feeding offshore the atoll in the mid 1960's (Amerson 1969).

#### RED-FOOTED BOOBY (Sula sula)

A Red-footed Booby flying off the northern side of Roi-Namur on 26 March was the only one I saw during the survey. This species has been found breeding on Kwajalein Atoll only on Oniotto Island (Schipper 1985), but it is a common breeder elsewhere in the Marshalls (Amerson 1969). No information is available on the size of the breeding population or on breeding habits at Kwajalein.

Table 3. Numbers and frequency of occurrence of Brown Boobies seen by at Roi-Namur, October 1979–November 1988 (1).

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2)	1.3	20.0	1.8	6.0	3.2	2.5	1.9	6.7	6.3	5.0	2.2	0.0
3)	3	1	6	2	12	8	8	3	7	7	10	0
4)	.09	.03	.09	.04	.18	.13	.11	.06	.13	.10	.16	.00

1) Number of days per month and per year in which Schipper tabulated observations is given in Appendix Table 2.

2) Mean number seen for days in which observed.

3) Numbers of days observed during month.

4) Percentage of days in month of observation in which seen.

Red-footed Boobies have been seen with great regularity off Roi-Namur Island (Schipper in litt.), occasionally in large numbers. Such flocks are probably birds foraging from colonies on nearby atolls.

Analysis of Schipper's observations reveals no particular seasonal pattern of occurrence or abundance. He has recorded flocks of more than 125 birds on five occasions: 400 on 25 May 1987, 310 on 10 October 1980, 189 on 31 March 1983, 148 on 25 July 1980, and 128 on 13 July 1980.

#### GREAT FRIGATEBIRD (Fregata minor)

This species was seen only occasionally in March 1988. Two roosted atop a tall Pisonia tree on Eniwetak Island on 18 March, and a dead one was found along the shore at the beach crest. Another was seen flying over the north point of Ennylabagen on 23 March, and one flew over the northeastern residential portion of Kwajalein Island on 24 March. Two flew over the west-central portion of Legan the same day, and two more flew over the north portion of Namur on 26 March. These birds have also been recorded at Loi Island (Baker 1951) and an unknown number breed on Oniotto Island (Schipper 1985).

All birds seen during the March survey were adult females. Schipper (1985) has also observed a preponderance of females at Roi-Namur and other islands in the northern portion of the atoll.

Observations of frigatebirds at Roi-Namur suggest more frequent occurrence there December–July (Table 4) with peaks occurring during periods when few of the species breed at other central Pacific breeding stations. Because this species migrates west from central Pacific breeding stations following breeding (Clapp unpub.), it seems

Table 4. Numbers and frequency of occurrence of Great Frigatebirds seen by Schipper at Roi-Namur, October 1979–November 1988.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1)	1.0	4.0	1.8	1.7	2.7	1.6	1.5	2.0	0.0	1.5	1.0	1.0
2)	6	8	22	15	17	12	8	3	0	4	3	3
3)	.17	.21	.32	.31	.26	.20	.11	.06	.00	.06	.05	.14

1) Mean number seen for days in which observed.

2) Number of days observed during month.

3) Percentage of days of observation in which seen.

likely that a fair proportion of the birds seen at Kwajalein are transients.

Numbers seen at Roi-Namur, or at other islets of the atoll, are usually four or less on any given day. Peak numbers seen on Kwajalein Atoll are: 30 during a flyover of Oniotto on 10 February 1980 (Schipper 1985, in litt.), many dozens over Kwajalein Island on 23 January 1952 (Fosberg 1966), and nine and seven over Roi-Namur on 16 May 1982 and 9 March 1980, respectively.

#### PACIFIC REEF HERON (Egretta sacra)

Reef Herons occur widely on Kwajalein (Schipper 1985) and have been reported previously from Ebeye, Enebuoj, Enelakken, Kwajalein, Loi, Lojjaiong, Lojjairek, and Roi-Namur islands (Yocum 1964, Fosberg 1966, Amerson 1969, Schipper 1985).

Sightings of birds on islands visited more than once and observations at Roi-Namur (Schipper 1985) suggest that Reef Herons tend to remain in the same locality. The total using the atoll is unknown, but if the entire population on the atoll is probably no more than 100 birds.

Breeding at Kwajalein Atoll was first documented in April 1987 when Schipper (pers. comm) found a pair nesting about 8–10 ft up a Pandanus tree. The nest (Figure 28) was found when Schipper noticed a white morph bird repeatedly flying in a line towards the heavily vegetated "jungle" portion of northern Namur. This bird had breeding plumes and often displayed them when alighting at the nest. A single downy chick was first noted 25 May and at least two downy young were present by 29 May. When the young fledged is unknown, but they were still in the nest on 26 June. One of these young, identified by its distinctive mottled plumage, was sitting on the edge of a rectangular cement pond on 7 September 1987 and was seen on Roi-Namur again in the spring of 1988.



Figure 28. Nest site of Reef Heron in Pandanus on Roi-Namur.  
Photograph by W. L. Schipper, September 1979.

Reef Herons probably breed at other islands of Kwajalein Atoll, but no nests were found in March 1988 despite careful searches of potential nesting areas. Records of breeding elsewhere in the Marshalls (Anderson 1981, Carpenter et al. 1968) and in the western Pacific (authors cited in Baker 1951) suggest peak breeding in June and July; but egg sets taken in Polynesia (Mayr and Amadon 1941) suggest a more extended breeding season in other parts of the range.

Birds seen during this survey mostly foraged in tide-pools and on reef-flats (Figure 29), where they presumably took fish, crustaceans, and mollusks (cf. Marshall 1951, Woodbury 1962). Others foraged on grassy areas, but usually near the shoreline. Birds on Ennylabagen seemed particularly prone to feed in grassy fields; they also feed in such areas on Roi-Namur (Schipper pers. comm.). Food taken in grassy areas is presumably largely insects and other invertebrates, but Schipper (pers. comm.) has noted them feeding on lizards and rats. They have previously been recorded capturing the Azure-tailed Skink (Emoia cyanura) at Arno Atoll in the Marshalls (Marshall 1951) and presumably do so at Kwajalein. Local informants also said that they feed on rats on Ujai Atoll (Fosberg, pers. comm.)

Reef Herons occur in three plumage morphs: completely white; dark blue-gray; and "mottled," white variegated with varying amounts of blue-gray. The latter are not juveniles as birds are known to breed





Figure 29. "Mottled" Reef Heron foraging in tidal pool along the northwestern shore of Roi Island, 26 March 1988.

in these plumages. Mayr and Amadon (1941) indicated that both gray and mottled birds also had gray and mottled juvenal plumages, but they also pointed out that the juvenal plumage of the white morph is mottled. Consequently, the proportion of mottled birds in the population should be greatest following the breeding season and remain high until juveniles molt into the first adult plumage.

Observations during this survey, compared with those made at Eniwetak Atoll (Table 5), seem fairly consistent with a summer breeding peak although the ratios reported by Temme (*in* Hailman 1979) seem anomalous. Mayr and Amadon's ratio of color morphs for Micronesia was based on museum specimens and varies drastically from other observations reported from the Marshalls. It may have resulted from a selective bias if collectors avoided taking mottled birds on the assumption that most were juveniles.

Numbers of birds seen and the number of each plumage morph observed are summarized by island below.

Ennylabagen - Two were seen 9 March, four 10 March, and not less than five on 22 March. The birds (two blue, two mottled, one white) were seen along the perimeter and in the fields northwest and

Table 5. Proportions of Reef Heron color morphs observed at Kwajalein Atoll and elsewhere in the Marshall Islands (1)

<u>Area or Atoll</u>	<u>Total Birds</u>	<u>Period</u>	<u>Percentage of birds</u>			<u>Sources</u>
			<u>white</u>	<u>mottled</u>	<u>gray</u>	
Micronesia	50	Throughout year	40	6	54	(2)
Ujelang	45	Throughout year	29	31	40	(3)
Eniwetak	57	Jun.-Sep. 1966	47	25	26	(4)
Eniwetak	13	Nov. 1977	31	31	38	(5)
Eniwetak	23	Mar.-Apr. 1978	26	26	48	(6)
Bikini	19	May 1986	58	11	32	(7)
Kwajalein	26	Mar. 1988	31	42	27	(8)

(1) Table adapted from Hailman (1979); (2) Mayr and Amadon 1941; (3) Anderson 1981; (4) Carpenter et al. 1968; (5) Hailman 1979; (6) Temme in Hailman 1979; (7) Garrett and Schreiber 1988; (8) this study.

northeast of the helipad. The birds seemed to prefer the northwest shore where as many as four were seen at once.

Legan - Two were seen 11 March, a white bird foraging at the north end of the interior lake and a dark morph that flushed from the rough coral shore along the southwestern portion of the island. Four were present 24 March, a mottled bird that flushed from the north end of the lake to alight 20 feet up a palm, two white birds that flew over the interior lake, and a dark bird that flushed from the northern shore.

Illeginni - Six Reef Herons were present on 14 March and at least five were present 22 March. The plumage ratio of 14 March (two blue: three mottled: one white) varies from that seen 22 March by only the increase of one mottled bird. Birds were most abundant from the northwestern coast to the northeastern shore and at low tide foraged in pools just north of the main part of Illeginni and around the isolated sandy island just to the north.

Roi-Namur - During my visits to Roi-Namur, herons were most frequently seen along the southwestern shore of Roi and in tide-pools off the northern end of the runway. A minimum of four were present 26-27 March, one white, two mottled, and one blue-gray.

Gagan - One strongly mottled bird foraged from the northern two-thirds of the western beach to the northern point on 15 March. A white bird foraged in tide-pools along the western side on 25 March and rested there on a large concrete block.

Gellinam - None seen.

Omelek - One white bird foraged on the western reef at low tide on 17 March.

Eniwetak - None seen.

Meck - None seen.

Kwajalein - A strongly mottled Reef Heron foraged in a tide-pool among grass east of Mt. Olympus on 12 March, and a lightly mottled bird fed there on 17 March. A bird with entirely white plumage flew over the outer reef south of the runway on 19 March, and a white bird with a blue patch on the back foraged around a raised bunker near there on 20 March.

The absence of Reef Herons from the residential and work areas of the island presumably results from continual disturbance by the inhabitants. More probably occur at Kwajalein Island than I recorded, but the numbers there are proportionately lower than at some of the less disturbed islands with much smaller reef areas.

#### CATTLE EGRET (Bubulcus ibis)

This rare visitor to Kwajalein was first seen there when a bird in breeding plumage was found on the southern end of Roi-Namur on April 1980. It was last seen on 10 May, but another was seen near the Caribou Lounge on Kwajalein Island on 24 October 1981 (Schipper 1985). Schipper (1985) suggested that this was the same bird seen nearly 17 months earlier, but I think it more likely that it was a different individual. Schipper (in litt.) saw another Cattle Egret at a rain pool on Roi-Namur on 1 March 1987. This bird was seen on eleven other occasions during the ensuing two months and was last seen on 28 May.

Cattle Egrets are widespread and common migrant in Micronesia (Pratt et al. 1987) and are also an abundant introduced resident in the main Hawaiian Islands. The birds seen on Kwajalein could have been from either the western Pacific or Hawaii.

#### CANADA GOOSE (Branta canadensis)

Two banded Aleutian Canada Geese (B. c. leucopareia) that straggled to Roi-Namur in late 1979 (Schipper 1985, Springer et al. 1986) are the only ones recorded in the Marshall Islands. The first goose was seen about 26 November and died a few days later; the second was observed 3-6 December. Both birds were from a deme listed as an "endangered species" by the U. S. Fish and Wildlife Service. They had been reared at Amchitka Island in the Aleutian Islands National Wildlife Refuge and were transplanted with other birds 250 miles west to Agattu Island in the western Aleutians. The geese had

been taken there in the hope that the young would follow wild adults to the usual wintering grounds in the San Joaquin Valley of California. Two of these geese instead wandered some 3,000 miles south to Kwajalein Atoll.

This species occurs regularly in Hawaii but is rarely found in more tropical waters. Pratt et al. (1987) indicated, without reference, a record of one or more birds at Tarawa in the Gilbert Islands (now Kiribati). If valid, this record would be the only other Pacific record south of Hawaii. Aside from an introduced population in New Zealand (A.O.U. 1983), the records of Canada Geese from Kwajalein (at ca 9°20' N) and Tarawa (ca. 01°30' N) are the southernmost known occurrences for the species.

#### GREEN-WINGED TEAL (Anas crecca)

These teal, uncommon migrants to the Marshall Islands, have been recorded four times at Kwajalein Atoll. According to a secondhand account (Yocum 1964), a flock of about 74 was present on Kwajalein sometime between September 1959 and February 1960. The other records are for three female-plumaged ducks seen on Roi-Namur, one in November 1978, another in 31 October 1979, and a third on 1 January 1980 (Schipper 1985).

Green-winged Teal occur regularly in the Hawaiian and Marianas Islands (Pratt et al. 1987), but there are very few records for more tropical islands. South of these northern groups, this teal has been recorded on Angaur Island, Palau (Engbring and Owen 1981), on Jaluit in the Marshall Islands (Reichenow 1901, Schnee 1901), and on Palmyra Atoll in the Line Islands (Clapp and Sibley 1967).

#### MALLARD (Anas platyrhynchos)

The only published record of Mallards on Kwajalein (and in the Marshall Islands) is a secondhand report of two flocks of about 12 birds each that were seen on Kwajalein Island during the winter of 1959-60 (Yocum 1964). Ducks were seen at Illeginni Island on three occasions during the past several years; at least one was a drake Mallard (K. Jourdan, pers. comm.)

Mallards are relatively uncommon migrants to the tropical Pacific and have been seen most frequently, if irregularly, in the main and northwestern Hawaiian Islands. Elsewhere in the tropical Pacific, the species has been recorded at Tarawa in the Gilbert Islands (Child 1960), at Sarigan in the northern Mariana Islands, on Yap (Pratt et al. 1987), on Palmyra in the Line Islands (Munro 1944), and on Penrhyn, Suvarov, and Pukapuka Islands in the northern Cook Islands (Pratt et al. 1987).

NORTHERN PINTAIL (Anas acuta)

Northern Pintails are the most widespread and abundant of anatic migrants to the tropical Pacific. They have occurred more frequently on Kwajalein Atoll than any other duck, with all dated records occurring from November to March.

"Several" were seen on Kwajalein Island during the winter of 1959-60 (Yocum 1964) and six specimens, two males and four females, were collected from rain pools along the runway on 2 to 9 November 1964 (Amerson 1969). Schipper (1985, in litt.) has since recorded female-plumaged birds frequently during the fall and winter on Roi-Namur and on Kwajalein. One or more were seen on Kwajalein and Roi-Namur in November 1978 (Schipper 1985), and one or more were seen on Roi-Namur in March 1979. Subsequent observations on Roi-Namur are of one to three ducks seen on 18 October-23 November 1980, one to two seen on 23-27 October 1981, a flock of 12 on 5 November 1987 of which one to two were present to 19 November with one remaining until 21 December, and two to seven seen repeatedly during the period 27 September-11 November 1988. Eight, five, and 14 were seen on Kwajalein on 8 and 12 October and on 5 November 1988, respectively.

[GARGANEY (Anas querquedula)]

Schipper saw a male in winter plumage on Roi-Namur on 2 November 1988 (Figure 30) as it foraged with several Northern Pintails (Clapp and Schipper 1990). This Palearctic breeder winters south to eastern China, New Guinea, and Australia (A.O.U. 1983) but has been recorded infrequently in the tropical Pacific except for the Mariana Islands where it regularly occurs (Glass et al. 1990).

Elsewhere, the species has been recorded in Palau (Pratt et al. 1987) and has been seen more than a dozen times in Hawaii (Spear et al. 1988). The only other record from the tropical Pacific is from Wake Island where two specimens were collected 23 December 1983 (Clapp and Schipper 1990).

NORTHERN SHOVELER (Anas clypeata)

This widespread holarctic duck has been recorded on Kwajalein five times. An unspecified number, one of which was shot, were present on Kwajalein Island in the fall and winter of 1959-60 (Yocum 1964); and two, a male and an unsexed bird, were collected there on 3 November 1964 at fresh water ponds along the runway. Schipper (1985, in litt.) thrice found them on Roi-Namur, one female-plumaged bird on 2 November 1980, another on 5 November 1987, and 1-3 from 7-31 October 1988.

The Northern Shoveler winters commonly in Hawaii and irregularly in small numbers in Micronesia (Pratt et al. 1987) but is much less

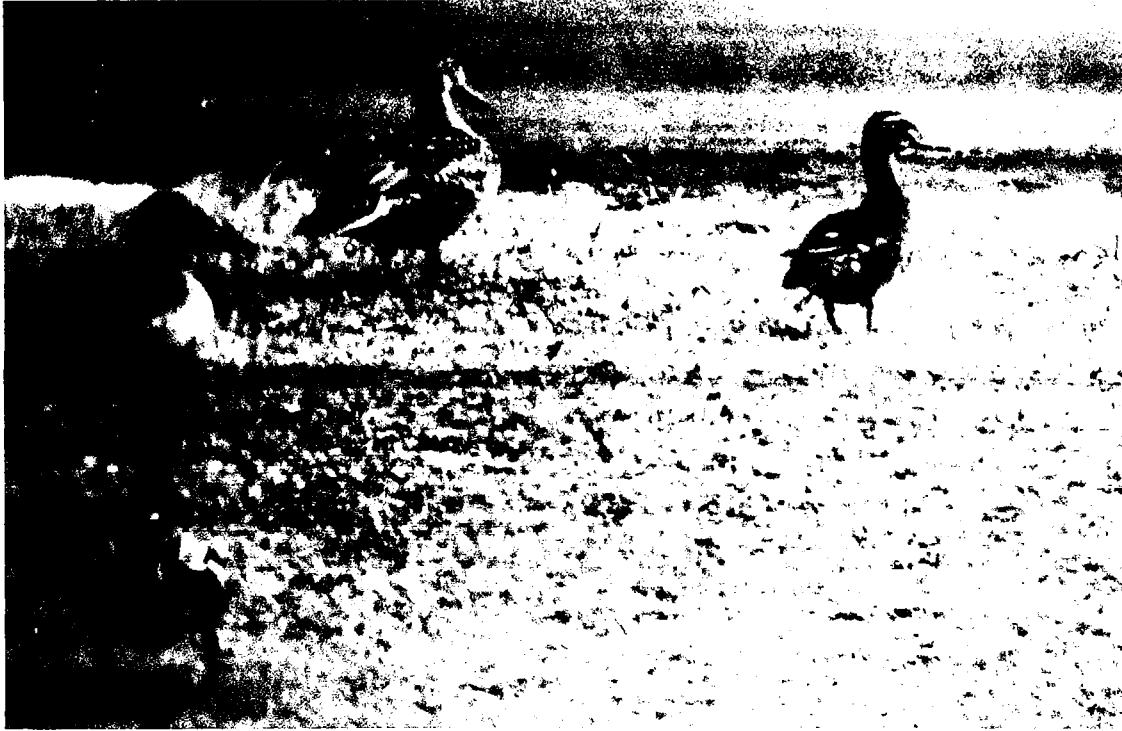


Figure 30. Garganey (center) with Northern Pintails on Roi-Namur Island. Photograph by W. L. Schipper, 2 November 1988.

common elsewhere in the tropical Pacific. Other atolls at which it has been recorded include Makin (North 1894) and Tarawa (Morris 1963) in the Gilbert Islands, Palmyra in the Line Islands (Clapp and Sibley 1967), and at Kauehi in the Tuamotus (Baker 1951).

#### GADWALL (*Anas strepera*)

Yocum (1964) reported that W. W. Fennell found this to be the most numerous of more than 200 ducks seen on Kwajalein during the winter of 1959-60. This implies that perhaps 100 birds were present as Fennell indicated that he had seen 75 teal in one flock.

While the other species of ducks reported by Fennell are among those fairly widespread as migrants or vagrants in the Pacific, this record of the Gadwall is the southwesternmost report of this species in the tropical Pacific and the only record west of the Hawaiian Islands. Even in Hawaii the species is uncommon and a report of that many Gadwall there would immediately rouse suspicions as to the competence of the observer. Pyle and Engbring (1985) regarded this record as probably erroneous, and it seems best to remove this species from the list of those known to occur at Kwajalein.

### TUFTED DUCK (Aythya fuligula)

This Palearctic diving duck occurs casually in the Hawaiian Islands and in western Micronesia (A.O.U. 1983, Pratt et al. 1987). The one Kwajalein record is a female that I collected (USNM 494852) on 2 November 1964 from ponds along the edge of the runway on Kwajalein Island (Amerson 1969). The specimen is a young of the year and was very light (423 g), suggesting that it was starving.

### Shorebirds

Almost 40% of the birds known from Kwajalein are sandpipers and plovers. Many are migrants but others remain to winter. These shorebirds typically comprise a third or more of all species seen on surveys of tropical islands conducted during migrations. This was also true in March 1988, with shorebirds comprising 10 of the 20 species observed. Shorebirds find the grassy fields of the golf courses on Kwajalein and Roi-Namur and other open areas of these islands, and those on Meck and Ennylabagen, good areas for foraging. Runways, taxiways, and helipads are much used as resting areas. As a consequence, shorebird populations, with the likely exception of reef-foraging tattlers, are probably larger on the environmentally more disturbed islands than when the islands were unmodified. In some instances, as on Kwajalein, Meck, and Roi-Namur, shorebirds comprise the vast majority of birds present.

During this survey, I periodically counted all the birds that could be seen on Kwajalein Island with an 8x, 30 binocular. The route went from the Sand's bachelor's quarters south along Ocean Drive and around the airstrip on Zeus Boulevard, Olympus Drive, and Lagoon Road ending at the aircraft repair shop (Figure 22). This allowed census of all shorebirds except for a very small proportion on the south side of the golf course and the magazine bunkers. Approximate times at which censuses were conducted are given in Appendix Table 3.

Similar counts were made on Roi-Namur on 12, 26, and 27 March. The latter two were on a route around the airstrip and west on Pandanus Road, south on Speedball Road, and then east at Explosive Storage Building Number 1 (building 8002 in Global Associates 1987) to the south end of the airstrip. The survey on 12 March was similar but followed Speedball Road to the south end of the airstrip. These routes provided relatively less coverage of the entire island than did the one on Kwajalein. Totals for the 12 March count were much lower than those on 26 and 27 March and only the latter were considered in making the final estimate of island populations.

I also explored other areas of Roi-Namur to determine the proportion of the shorebird populations that was represented by the area censused. Because much of Namur provides only mediocre shorebird habitat, I consider that my counts represented probably

about 85% of the Ruddy Turnstone (Arenaria interpres) population, 75% of the Lesser Golden-Plover population and perhaps no more than 60% of the Whimbrel (Numenius phaeopus) population.

Numbers of shorebirds observed during the counts on Kwajalein are summarized in Table 6. Totals for Lesser Golden-Plovers and Ruddy Turnstones were adjusted to include birds counted on the grass in front of the terminal but that usually could not be identified to species because of poor lighting and distance from the observer. Two Wandering Tattlers (Heterocelus incanus) and a Bristle-thighed Curlew (Numenius tahitiensis) were seen in the count area but not during formal counts.

Counts on other islands (Table 7) show that the Ruddy Turnstones and Golden-Plovers also are the most abundant shorebirds there. Counts of Golden-Plovers, Whimbrels, and Ruddy Turnstones at Roi-Namur (Tables 8, 9, 12) suggest that populations decline in March and increase in April before dropping to summer lows. Some of the wintering birds may depart in March before migrants arrive from the south.

1

Table 6. Shorebird counts made on Kwajalein Island in March 1988.

<u>Date</u>	<u>Time</u>	<u>RT</u>	<u>LGP</u>	<u>WH</u>	<u>HG</u>	<u>BTG</u>	<u>STS</u>	<u>CS</u>
2 20th	1800-1915	(230)	(177)	6	-	1	-	-
23rd	1653-1831	417 <sup>3</sup>	184	5	1	-	-	1
24th	1700-1832	323	184	4	-	-	7	-
25th	1627-1808	372	151	3	1	-	6	1
28th	0713-0846	213	158	5 <sup>4</sup>	-	1	13	-
28th	1520-1639	337	93	5	-	-	1	-
29th	0830-0957	289	149	3	1	1	4	1

(1) RT: Ruddy Turnstone, LGP: Lesser Golden-Plover, WH: Whimbrel, HG: Hudsonian Godwit, BTG: Bar-tailed Godwit, STS: Sharp-tailed Sandpiper, CS: Curlew Sandpiper

(2) Because of a rainsquall this count went only as far as the invasion battle monument.

(3) This count is probably too high because birds seen flying into the tarmac near the aircraft shop late in the day may have been counted earlier around the airstrip.

(4) Includes three birds counted on the plateau at the northwest end of the airstrip.



1

Table 7. Counts and estimates of shorebird numbers on the other islands in March 1988

		<u>RT</u>	<u>LGP</u>	<u>Tat.</u>	<u>WH</u>	<u>BTC</u>	<u>BTG</u>	<u>Totals</u>
	2		3					
ENN	9th	65 (75)	94 (125)	2 (10)	9 (10)	-	-	170 (220)
	10th	27 (40)	88 (100)	12 (20)	7 (8)	-	-	134 (168)
	23rd	49 (60)	88 (100)	4 (15)	6 (8)	-	-	147 (183)
LEG	11th	21 (25)	16 (20)	10 (10)	-	2	-	49 (77)
	24th	19 (25)	13 (15)	4 (10)	-	2	-	38 (52)
ILL	14th	11 (15)	13 (15)	7 (10)	4	1	-	36 (45)
	22nd	19 (20)	25 (30)	5 (10)	3	1	-	53 (64)
GAG	15th	2	5	1	-	-	-	8
	25th	1	3	1	1	-	-	6
GEL	9th	9	4	1	-	-	-	14
OME	17th	10	3 (5)	2	1	-	-	15 (18)
ENI	19th	-	6	1	-	-	-	7
MEC	20th	16 (20)	57 (60)	1 (3)	5 (7)	-	1	80 (91)
	4							
Totals		141 (161)	210 (255)	35 (48)	20 (23)	3	1	410 (491)

(1) RT: Ruddy Turnstone, LGP: Lesser Golden Plover, Tat.: tattlers (all tattlers heard but one appeared to be Wandering Tattlers), WH: Whimbrel, BTC: Bristle-thighed Curlew, BTG - Bar-tailed Godwit

(2) ENN: Ennylabagen, LEG: Legan, ILL: Illeginni, GAG: Gagen, GEL: Gellinam, OME: Omelek, ENI: Eniwetak, MEC: Meck.

(3) Figures alone are raw counts; those in parentheses give estimates if these differ from the counts.

(4) Totals include the largest estimate and count if more than one visit was made to an island.

#### BLACK-BELLIED PLOVER (Pluvialis squatarola)

Black-bellied Plovers have been recorded at Kwajalein four times. A female was collected (USNM 494822) on Kwajalein Island on 3 November 1964 (Amerson 1969) and at least three sight records exist for Roi-Namur. Schipper (1985, in litt.) saw one there on a sandy beach on 15 November 1981, another was present 3 February to 17 August 1987 and a third was seen and photographed during the period 16 March-6 April 1988 (Schipper in litt., pers. comm., Figure 31). The second bird, in non-breeding plumage, showed no evident change in



Figure 31. Black-bellied Plover on Roi-Namur Island, March 1988.  
Photograph by W. L. Schipper.

plumage throughout the period. He saw a third winter-plumaged bird on Roi on 21 December 1987 at the end of the runway. It maintained a territory and vigorously chased away Lesser Golden-Plovers. A sighting on 16 March 1988 may have been of this or another bird (Schipper pers. comm., in litt.).

The only other record for the Marshall Islands is an undetailed report of seven seen on Eniwetak Atoll during late July 1945 by D. A. Gleize and D. Genelly (Anon. 1945). To this unsatisfactory record from Eniwetak may be added a specimen (USNM 544243) collected by the POBSP at Engebi Islet, Eniwetak Atoll, on 11 December 1968.

Black-bellied Plovers are uncommon winter visitors to Micronesia (Palau, Yap, Mariana Islands, Truk) and to Hawaii and have been reported once from Manuae in the Cook Islands (Holyoak 1981) and from Malden in the Line Islands (Clapp and Sibley 1967)

#### LESSER GOLDEN-PLOVER (Pluvialis dominica)

This species and the Ruddy Turnstone were found nearly everywhere on the atoll, but they differed in distribution and behavior. Plovers held territories and were relatively uniformly scattered over grassy areas. On Kwajalein Island different parts of the island held

about the same numbers of plovers from day to day (Table 8). Turnstones fed in flocks that were highly mobile and moved from one area to another.

Table 8. Numbers of Lesser Golden-Plovers and Ruddy Turnstones seen on parts of the Kwajalein Island shorebird census (1)

Area	Species	Number counted on March:								Mean
		<u>17</u>	<u>20</u>	<u>23</u>	<u>24</u>	<u>25</u>	<u>28</u>	<u>28</u>	<u>29</u>	
Golf course	GP			14	30	30	42	26	40	30.3
	RT			18	16	29	37	67	23	31.7
Runway margin	GP			49	32	22	19	13	19	25.7
	RT			45	4	15	1	20	7	15.3
Stop sign to Mt. Olympus	GP		2	14	19	14	9	4	11	10.4
	RT		19	27	42	38	16	32	16	27.1
Plateau	GP	3					1	1	1	1.5
	RT	1								.25
Battle memorial field	GP	5	12	7	3	7	8	0	12	6.8
	RT	19	12	13	23	15	1	20	7	13.8
Fields N of Mt. Olympus	GP	5	9	9	9	6	6	1	8	6.6
	RT	19	13	13	10	10	4	21	8	12.3
"Dump road" field	GP	0	6	2	3	1	4	1	3	2.5
	RT	20	4	11	10	10	1	0	5	7.6
N to Coral Sands	GP			10	14	13	16	1	9	10.5
	RT			55	60	27	13	9	8	21.5
Coral Sands to helipad	GP	15		13	14	21	15	8	18	14.9
	RT	13		5	17	35	2	15	6	13.3
"O" field	GP	2		5	--	4	4	1	5	3.5
	RT	44		48	--	50	9	8	8	27.8
Helipad field	GP			3	2	4	0	0	4	2.2
	RT			25	54	77	0	16	1	28.8
Helipad to aircraft shop	GP			5	3	4	4	0	3	3.2
	RT			1	10	27	4	0	2	7.3

(1) Times areas were surveyed and a more detailed description of the area covered are given in Appendix Table 2.

(2) No birds were present due to a softball game in progress.

Observations on Kwajalein and elsewhere in the Marshall Islands clearly show a principal period of occurrence from September through early April although a few plovers are usually present throughout the year. Judged from daily counts made on Roi-Namur (Table 9, Schipper in litt.), some spring migrants may be present into early May. Early fall migrants begin arriving on Roi-Namur in mid July (53 were counted by Schipper on 19 July 1987). Peak migration occurs in April and in September and October. Comments on plovers on individual islands are given below.

Ennylabagen - Plovers were common in the vicinity of the helipad and on nearby fields. The large field northwest of the helipad (Figure 32) held roughly 70% of the total population of about 100 birds (72, 62, and 74 counted on 9, 10, and 23 March respectively). The rest were scattered widely and rather evenly about the rest of the island. Most were in cleared areas but a few were found on trails through the forest and in ones and twos along the rocky shore.

About 5-10% of the birds seen on 9 March had attained full or nearly full breeding plumage. By 23 March perhaps 20% were in full breeding plumage.

Legan - A total of about 20 presumably represented the limited amount of habitat available in the interior of the island. About 25% were found resting or foraging on the small grassy area around the helipad with the rest found along the perimeter on both sandy and



Figure 32. Golden-Plovers (and a few Ruddy Turnstones) on Ennylabagen Island, 23 March 1988.

rubble shores. The principal concentration was on the secluded interior lake where about ten birds were found on each visit. Only a few of the plovers on the interior lake were seen foraging; the area seemed to be used primarily as a resting area.

Illeginni - Lesser Golden-Plovers on Illeginni largely occurred around the helipad, along the roads, and, at low tide, on the exposed flats north of the island. The heavy growth of Wedelia in the open areas bordering the central road denies this area to plovers or other shorebirds. The overall density of the vegetation here and elsewhere on the island would account for the low numbers (ca. 25) of plovers on an island this size. The only concentration noted was ten birds on and around the helipad on 22 March. This open area is highly attractive to this species, and the helipad itself is the primary roosting site on the island.

Roi-Namur - Counts on 26 and 27 March 1988 gave totals of 153 and 186 plovers, respectively. Assuming 80% coverage results in an estimate for the island of about 230 birds, larger than peak numbers recorded by Schipper (Table 9) for this month but representing a more thorough census. The only previous estimate of plover numbers on Roi is one of 200 birds on 4 November 1964 (Amerson 1969).

Lesser Golden-Plovers are well distributed over Roi and may be found everywhere except in heavily vegetated areas. I found no distinct concentrations but plovers as well as turnstones and Whimbrels roosted in some numbers on exposed flats on the western side of Roi.

Table 9. Numbers of Lesser Golden-Plovers seen by Schipper at Roi-Namur, October 1979–November 1988.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1)	56	38	47	67	14	24	17	19	53	44	41	86
2)	200	100	242	260	56	141	88	114	285	222	203	251

(1) Mean number seen per days observed. Examination of Schipper's daily tallies for shorebirds shows that these totals are often less than the number that must have been present. This is especially true for this species and the Ruddy Turnstone. Consequently, these tables provide no more than an indication of relative monthly abundance.

(2) Peak number recorded.

Gagan - On 15 March one plover was seen on the western side of the island, two on the grass around the helipad, and two more in the grass north of the helipad. Three were seen on 25 March, one on the helipad and two along the island's shores.

Gellinam - Four plovers were seen, one on the sandy southeastern beach, two near the helipad, and one with a flock of

eight Ruddy Turnstones in an open grassy area just south of the Black Noddy colony.

Omelek - One seen along the east side of the island, another in the grass at the north end, and one on the helipad.

Eniwetak - Two to three were seen in grassy areas of the island, and another four were on the rocky flats off the eastern and southeastern portion of the island.

Meck - About 50 plovers were at the northern end of the airstrip and in the low vegetation beyond. A few were seen along the shores of the island on both sandy and rocky beaches.

Kwajalein - Peak counts on 24 and 25 March were 184 birds. Two counts of the northeastern portion of the island on 19 and 20 March gave 28 and 26 plovers, respectively, and examination of areas that could not be seen on the counts suggests that other areas held about another 60 birds. I estimate a total of about 270 present in March 1988, with a small proportion in nearly full breeding plumage by the end of the month.

Plovers on Kwajalein were widely distributed (Table 8) and foraged along hard roads and in yards on the northeastern part of the island as well as in any other open area. Plovers were highly territorial, and in one instance one was seen chasing a Ruddy Turnstone. Plovers were active at night in inhabited lighted areas but were very wary. Some roosted on the roofs of buildings during the night. Roosting concentrations (to ca. 50 birds) formed on the overrun beyond the southwestern end of the runway and on the tarmac in front of the terminal.

#### MONGOLIAN PLOVER (Charadrius mongolus)

The records for Kwajalein Atoll are single birds seen on Roi-Namur on 10 and 12 November 1981, on 3-30 October, 6 November and 11-12 December 1982, and on 8 August 1987; three seen 3 July 1988 and two seen 21, 28 and 29 August 1988 (Schipper 1985, in litt.)

Other published records of this east Asian species in the Marshall Islands are sightings of single birds on Enewetak Islet, Enewetak Atoll in November 1977 and in the fall of 1978 (Hailman 1979), four on Aomon Islet, Enewetak Atoll on 16 November 1978 (Temme 1990), and one to two birds at Ujelang Island, Ujelang Atoll from 7 September to 5 December 1975 and from 26 November 1976 to 18 February 1977 (Anderson 1981). Hailman (1979) suggested that the records from Eniwetak might have been of the similar appearing Greater Sand Plover (Charadrius leschenaultii), but unpublished observations and collections of C. mongolus on Enewetak Atoll suggest that it is a regular visitor there (Clapp ms.).

There is but a single record for this species further east in the Pacific, one found at Lisianski Island in the Northwestern Hawaiian Islands in September 1967 (Clapp and Wirtz 1974); at least four have straggled to the western United States (A.O.U. 1983). Thus it appears that the Marshalls represent the easternmost area to which this species regularly migrates.

COMMON RINGED (Charadrius hiaticula)  
or SEMIPALMATED PLOVER (C. semipalmatus)

Schipper saw one or the other of these species on Kwajalein Island on 8 and 12 October and 5 November 1988. The bird was in non-breeding plumage, in which these two are very difficult or impossible to distinguish (Pratt et al. 1987). The call note, described as a whistled "chu-weet", sounds more as if it were a Semipalmated Plover than a Ringed, but both species could occur on Kwajalein. On both days the plover was seen feeding on the northern portion of the water catchment basin between the taxiway and the runway, usually solitarily but sometimes with Ruddy Turnstones.

The Nearctic Semipalmated Plover straggles fairly regularly to Hawaii and to the eastern Pacific while the palearctic Ringed Plover has been reported on Palau, Saipan, Guam, and Midway (Pratt et al. 1987, Glass et al. 1990). Some of these records are inadequately documented, however, as is a record of the Semipalmated Plover from Jaluit.

Most of the well documented records of small Charadrius in the central Pacific are of Semipalmated Plovers. Specimens of Semipalmated Plover have been taken in Hawaii and the northwestern Hawaiian Islands (Clapp 1968a, Ely and Clapp 1973, Clapp and Wirtz 1974), on Baker Island not far to the east of the date line (Clapp 1968b), and on Johnston Atoll, southwest of Hawaii (Amerson and Shelton 1976). Thus, it seems considerably more likely that the bird (or birds) seen on Kwajalein was a Semipalmated Plover, but it is impossible to so state on the data presently available.

GREATER YELLOWLEGS (Tringa melanoleuca)

The only record for Kwajalein is a bird seen briefly at a rain-pool on Roi-Namur on 21 October 1978 (Schipper 1985). This North American breeding bird is only rarely found in the tropical Pacific. Nearly all previous records are from the main Hawaiian Islands; the only well documented record elsewhere is a male collected on Jaluit Island, Jaluit Atoll on 12 May 1932 (Kuroda 1934)

Other reports of birds, poorly documented, from Wake Island and on Rarotonga, Cook Islands (Pratt et al. 1987) as well as a recent sight record from Rota (Glass et al. 1990) may have been this species. I examined the original data for the Wake record and it is

not strong enough to identify the bird as other than either Greater or Lesser Yellowlegs, Tringa sp.

#### LESSER YELLOWLEGS (Tringa flavipes)

A Lesser Yellowlegs feeding with a Sharp-tailed Sandpiper at a rain-pool on Roi-Namur was seen and photographed on 27 September 1987 (Figure 33) and another foraging bird was seen on 8 November 1988 on Kwajalein Island along the northernmost catchment basin between the runway and the taxiway (Clapp and Schipper 1990).

These sightings are the only records of Lesser Yellowlegs for Kwajalein and for the Marshall Islands. This North American species is rarely seen in the tropical Pacific and along the Asiatic coast, but it has been recorded ten times in New Zealand (Clapp and Schipper 1990) and is seen regularly in Hawaii (Pratt et al. 1987). The only other records for the tropical Pacific are a specimen from Johnston Atoll (Amerson and Shelton 1976) and a recent sight record from the Tuamotu Archipelago (Intes 1988).

#### MARSH SANDPIPER (Tringa stagnatilis)

Late on the afternoon of 26 September 1987, Schipper saw a Marsh Sandpiper at a temporary rain pond along a dike behind water tanks on Roi-Namur. The bird was wary, but could be approached as closely as 50 feet. It was not found the following day despite a careful search (Clapp and Schipper 1990).



Figure 33. Lesser Yellowlegs foraging with Sharp-tailed Sandpiper on Roi-Namur Island, 27 September 1987. Photograph by W. L. Schipper.



This Palearctic sandpiper breeds east to Siberia (A.O.U. 1983) and winters south to Australia (Lane 1987) and is known from western Micronesia (Pratt et al. 1987). The bird on Roi-Namur is the only one recorded in eastern Micronesia or anywhere else in the central Pacific (Clapp and Schipper 1990).

#### WOOD SANDPIPER (Tringa glareola)

Schipper (1985) saw and photographed a single bird on Roi-Namur on 16 October 1982 following a period of steady, strong southwest winds. The only other published records for the Marshalls are of one bird seen 9 and 21 November 1977 on Aomon Islet, Enewetak Atoll, and one to three seen and photographed there 24 and 25 March and 7 and 8 April 1978 (Temme 1985). In addition, a specimen in the U.S. National Museum was collected on Enewetak Atoll on 8 September 1968 (Temme 1990).

This Palearctic species is a fairly common migrant in western Micronesia (Pratt et al. 1987, Glass et al. 1990), but has been recorded elsewhere in the tropical Pacific only in the Northwestern Hawaiian Islands (Pratt et al. 1987).

#### WANDERING TATTLER (Heteroscelus incanus)

Wandering Tattlers are a widespread and common migrant and winter visitor to Kwajalein Atoll with a few birds remaining during the summer. It has been previously recorded from Kwajalein, Roi-Namur, Loi, Bigej, and Guguegeegue Islands (Yocum 1964, Fosberg 1966, Amerson 1969, Schipper 1985) but always in small numbers. Said to be most common in late fall and winter (Schipper 1985), it almost certainly occurs on most islands of the atoll. Comments on birds seen at individual islands are given below.

Ennylabagen - Tattlers were scattered fairly regularly along the rocky shores of the island's western side. Probably three-quarters of approximately 20 birds found were along this shore with four together on the rocky ledges on the northwestern side of the island.

Legan - On both visits about half the population of 10 tattlers roosted or foraged in the interior lake. Most of the rest were on coral rubble lining the western shore, but one was seen on the sandy beach on the eastern side.

Illeginni - The total population of about ten seems small considering the amount of habitat available. A few were seen along the eastern and western shores but most were on flats exposed by low tide at the northern end of the island.

Roi-Namur - As on Legan, tattlers tend to concentrate on the interior lake. Fifteen were seen there at 1439 on 26 March 1988 resting on the sand beneath Pemphis bushes on the inlet's western shore (Figure 34). Others were scattered in small numbers along rocky shores at low tide, particularly on the western side of Roi and on the northeastern side of Namur. The total population of the island probably did not exceed 30 birds. I estimated that perhaps 25 birds were here on 4 November 1964 (Amerson 1969) on a less thorough survey. Schipper's observations (Table 10) at Roi-Namur suggest similar population levels and peaks, but data are too few to provide much information on periods of migration.

Table 10. Numbers of Wandering Tattlers seen by Schipper at Roi-Namur, October 1979-November 1988.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1)	3.4	4.0	4.1	4.0	2.0	4.5	3.6	3.4	5.3	5.9	5.9	8.1
2)	11	15	15	16	8	8	8	14	15	21	12	13

(1) Mean number seen per days observed.  
 (2) Peak number recorded.



Figure 34. Fifteen tattlers roosting on Roi-Namur 26 August 1982. Lesser Golden Plover walking towards camera and Pectoral Sandpiper roosting in the left foreground. Photograph by W. L. Schipper.

Gagan - The single bird seen on both visits was on flats at the northern end of the island.

Gellinam - One Wandering Tattler was seen along the eastern shore.

Omelek - Two were seen along the eastern shore on 17 March.

Eniwetak - One was present on the rocky reef-flat off the eastern and southeastern shores.

Meck - One bird was seen sitting atop large, open, coral rubble on the upper western shore. Perhaps a few more were present, but the number found is surprisingly low considering the amount of available habitat.

Kwajalein - Wandering Tattlers were seen much more frequently on the outer islands than on Kwajalein (Table 7) but this difference may result from the difference in the way these islands were surveyed. The outer perimeters of the eight outer islands were walked in their entirety while only a relatively small proportion of equivalent habitat was covered on Kwajalein.

A count I took on Kwajalein on 8 March suggests that populations may be greater than indicated by casual observation. This count focused on birds using the northeastern flats at low tide from the Sand's bachelors' quarters to the north point. During this 20-minute count, I recorded 40 Ruddy Turnstone, 12 Lesser Golden-Plovers, and 4 Wandering Tattlers. The tattler proportion (7.1%) of the total was only a little less than the same proportion (9-10%) on the outer islands.

Outer islands may possess relatively higher numbers of Wandering Tattlers than these figures suggest because these islands have more shoreline relative to island area and because the situation in which they were surveyed on Kwajalein would tend to maximize the proportion of tattlers present. Keeping this in mind, I estimate that the number of Wandering Tattlers using Kwajalein Island was probably not less than 25 birds.

#### GRAY-TAILED TATTLER (Heteroscelus brevipes)

The only bird certainly identified as this species during our survey was a bird heard and collected as it fed on the reef just north of Illeginni on 22 March. The specimen was a male that weighed 82 g and had undeveloped testes.

The only other island on Kwajalein Atoll where this species has been recorded is Roi-Namur. Three were collected there 4 November 1964 (Amerson 1969), and Schipper (1985) reported the bird was an uncommon migrant but provided no other details. Schipper's daily tallies indicate that usually no more than two Gray-tailed Tattlers

were seen at Roi. Their occurrence on Roi spans a period from 25 September (1987) to 11 May (1988). Peak numbers were nine on 12 March 1983, and 12 on 1 February 1983. The peak number reported elsewhere in the Marshalls, 10 at Ujelang on 10 February 1977 (Anderson 1981), suggests similar abundance on other atolls.

Even allowing for difficulties in distinguishing this species from the Wandering Tattler, it seems clear that this species is considerably less common than H. incana in the Marshall Islands. To date it has been reported only from Ujelang, Eniwetak, and Kwajalein Atolls, but the Wandering Tattler has been reported from over 80% of the islands and atolls comprising the group (Amerson 1969).

#### WHIMBREL (Numenius phaeopus)

Whimbrels are widespread migrants and winter residents in the Marshall Islands. They are widespread on Kwajalein Atoll and are considerably more abundant than their congener the Bristle-thighed Curlew. Observations during the March 1988 survey were as follows:

Ennylabagen - An estimated 8-10 birds were present on all visits. The field just northwest of the helipad, which held the largest concentrations of other shorebirds, also had the largest number of Whimbrels with four or five birds seen there on each survey. Whimbrels, like plovers, were widely distributed in open areas, but were even more likely to be found along the shore.

Legan - None seen.

Illeginni - The three to four Whimbrels seen on the two visits foraged along the northern shore and north to the isolated islet.

Roi-Namur - Seven were counted on the first visit to Roi-Namur and nine were counted on the second. As the survey counts missed some of the areas (e.g. near the Altair Radar) where these birds also occur, I estimate the island total was about 12-15 Whimbrels. Most were seen on grassy lawns and fields all over the island, and several were seen resting at the northern lake. A rocky shore exposed at low tide on the western shore of Roi attracted a roosting flock of eight on the afternoon of 26 March (Figure 35).

The only other record of Whimbrels at Roi is one of eight birds that I saw on 4 November 1964 (Amerson 1969). Schipper (1985) mentioned only that it was a common migrant on Kwajalein but provided no more specific details. His notes (in litt.) show that Whimbrels are even more common on Roi than during the March survey. He counted 15 birds or more on 11 occasions. His peak numbers of 24, 27, and 28 birds on 29 September 1988, 8 November 1979, and 20 December 1981, respectively, are the largest numbers recorded at any atoll in the Marshalls. At least a few Whimbrels may be present on Roi-Namur in

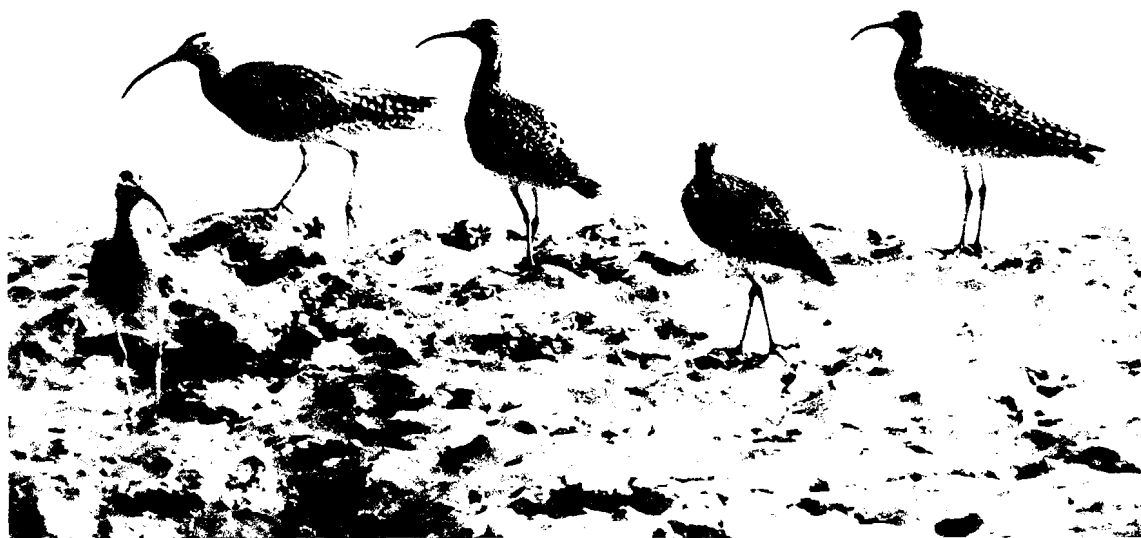


Figure 29. Flock of Whimbrels on Roi, 26 March 1988.

every month, but peak numbers are present from early October to mid April (Table 11).

Judged from Schipper's counts, migrants may begin arriving as early as late July. Some continue on to winter on islands farther south.

Gagan - The only bird seen was one that foraged off the northern end of the island on 25 March.

Gellinam - None seen.

Table 11. Numbers of Whimbrels seen by Schipper at Roi-Namur, October 1979-November 1988.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1)	5.3	3.7	4.2	4.9	2.0	4.5	3.6	4.4	5.5	5.6	6.0	7.1
2)	17	10	9	14	6	3	9	17	24	16	27	28

(1) Mean number seen per days observed.

(2) Peak number recorded.

Omelek - One was foraging on the rocky flats off the northwest shore on 17 March.

Eniwetak - None seen.

Meck - Most Whimbrels seen here roosted on the north end of the airstrip or foraged in the low vegetation just beyond the airstrip and in the grassy areas of the artificially raised northern end. A few were also seen along the southwestern shore. A maximum of five was seen flying together over the island's northern end and four, later joined by another bird, were together on the north end of the airstrip.

Kwajalein - Perhaps a maximum of eight Whimbrels were present on Kwajalein in March 1988, but usually five or fewer were seen. Earlier records include two seen 19 October 1960 (Fosberg 1966) and an estimated eight present in late October and early November 1964 (Amerson 1969). All were seen in the same areas as on the March 1988 survey.

Whimbrels were seen only on the western portion of the island largely from the southwestern end of the runway west, in March 1988. They foraged in grassy areas but were wary and seldom allowed a close approach. They seemed to prefer roosting in elevated areas. Two or three could be found regularly on the Cassytha-infested elevated plateau southwest of the runway, and two were found in the raised dump area on 20 March. Four were together atop a high area being excavated for sand north of Mt. Olympus on 28 March. The maximum number seen at once was five birds roosting on the overrun area on 28 March. Four were on the beach below the plateau on 29 March.

Although Kwajalein possesses much more foraging habitat for Whimbrels than do the other islands visited, the number found is relatively small, perhaps because these birds are more affected by human disturbance on Kwajalein than on Roi-Namur or Ennylabagen.

#### BRISTLE-THIGHED CURLEW (Numenius tahitiensis)

On atolls of the Marshalls where numbers or relative abundance of this species and the Whimbrel have been reported, the curlew is usually reported as less common than the Whimbrel (Anderson 1981, Schipper 1985, this survey). Nonetheless, the Bristle-thighed Curlew has been recorded from far more atolls (24) than the Whimbrel (15), (Amerson 1969, Temme 1990) suggesting that some of the earlier records for tahitiensis may well have been of phaeopus.

Previous records for Kwajalein Atoll include four seen on Roi-Namur on 4 November 1964 (Amerson 1969) and four seen there on 8 February 1980 (Schipper 1985, in litt.). Schipper (1985) also stated that he saw Bristle-thighed Curlews from Roi-Namur south to Debuu with the majority of sightings at Ennumennet. He gave no specific numbers or dates when curlews were seen at these islands.

Schipper suggested that curlews were most abundant on little-inhabited islands "where a silty ooze collects on the ocean side between the beach and the reef." This assessment of the habitat chosen may reflect more the habitat on the islands visited than the habitat chosen by the curlew. The curlews seen during this survey, and presumably wintering, on Legan and Illeginni were found in distinctly different habitats (see below).

A maximum of five birds were seen during the March survey. One was seen on Kwajalein's raised plateau on 12 March. It was roosting with a Bar-tailed Godwit (Limosa lapponica) but flushed and was not seen again.

Two were seen on Legan on both the 11 March and 24 March visits. On 11 March two flushed from the rubble on the northwestern side and another, possibly one of these two birds, was seen on the interior lake. On 24 March one was seen along the sandy beach on the east side of the island, and another flew into the interior lake to land about 15 feet up a Cassytha-infested Pemphis.

One was seen on both visits to Illeginni. On 14 March one was seen among the rubble on the western side of the isolated north island and on 22 March one was seen between this island and the northern tip of Illeginni.

#### BLACK-TAILED GODWIT (Limosa limosa)

Schipper saw and photographed two Black-tailed Godwits on Roi-Namur 4 September 1978 (Figure 36) and subsequently saw one to five of these godwits between 25 August and 20 October 1982 (Schipper 1985).

This Palearctic species has been reported widely as a vagrant in Micronesia, but it is more frequently encountered in the westernmost portions (Pratt et al. 1987, Glass et al. 1990). Schipper's records are the only ones for the Marshall Islands and are east of all other tropical Pacific records but one.

#### HUDSONIAN GODWIT (Limosa haemastica)

A Hudsonian Godwit was seen and photographed on Kwajalein Island in March 1988. It was first seen 11 March as it foraged alone on a lawn southwest of the western taxiway (Clapp and Schipper 1990). The godwit was seen on eight occasions from 11 to 29 March but became wary and was seen less often in late March. It was usually seen where first encountered, but it ranged from the field with the memorial northwest of the runway to the grassy areas just west of the runway's western end. It often used the raised area bordering the ocean for roosting and there associated with Whimbrels and a much larger Bar-tailed Godwit. When flushed, the Hudsonian Godwit sometimes flew with Whimbrels; but if both Whimbrels and the



Figure 36. Black-tailed Godwit on Roi-Namur, September 1978.  
 Photograph by W. L. Schipper.

Bar-tailed Godwit were present, it invariably flew with the latter. When foraging on grassy areas, it usually foraged by itself but occasionally was loosely associated with feeding Ruddy Turnstones and Lesser Golden-Plovers.

Schipper (in litt.) saw another, or possibly the same, Hudsonian Godwit on Kwajalein Island on 8 October 1988 as it fed with a Lesser Yellowlegs and Lesser Golden-Plovers (Clapp and Schipper 1990)

The only prior records of this Nearctic breeder in the tropical Pacific are two sight records from Fiji and one from Oahu, Hawaiian Islands. Australia has one sight record, but the species has been recorded fairly frequently in New Zealand (Clapp and Schipper 1990).

#### BAR-TAILED GODWIT (Limosa lapponica)

Bar-tailed Godwits occur regularly on Kwajalein but only in very small numbers. Earlier records include one on the southwestern portion of Kwajalein Island on 2 February 1956 (Fosberg 1966) and a male that I collected (USNM 494830) on Roi-Namur on 4 November 1964 (Amerson 1969). Schipper's (1985, in litt.) recent observations show the species is a regular migrant and winter visitor to Kwajalein and Roi-Namur with most present from November to April. Usually, one or



two birds were seen on Roi-Namur; three were seen 1, 16, and 31 January 1980.

These birds have been seen as early as 25 August (1982) and as late as 16 May (1980) and 26 May (1987). These dates are consistent with Stickney's (1943) conjecture that the usual period of occurrence in the tropical Pacific extends from late August to May.

A godwit seen on Roi-Namur on 5 and 7 June and 5 July 1981 presumably was a bird that over-summered. Such over-summering is uncommon but not unknown. Stickney (1943) mentioned nine specimens taken in Fiji on 22 and 23 June and suggested that such birds are largely not yet fully adult.

Two Bar-tailed Godwits were seen during the present survey. One, a large bird seen on the southwestern portion of Kwajalein on several occasions (see Table 6), was probably a female. It seemed to prefer to associate with the Hudsonian Godwit, but sometimes associated with Whimbrels or was found alone. It roosted in the low Cassyth-vegetation on the elevated plateau at the southwest end of the airstrip (Figure 37), but also foraged in grassy lawn just northeast of that area. It once flushed from sandy beach on the perimeter of this area.



Figure 37. Bar-tailed Godwit resting on raised area on Kwajalein Island, 13 March 1988.

The other Bar-tailed Godwit was a breeding-plumaged male seen on Meck Island on 21 March. There it roosted with a concentration of other shorebirds in low vegetation just north of the runway. The bird was very wary and attempts to collect it failed.

This species occurs regularly in small numbers in the Marshall Islands where it has been also reported from Arno, Eniwetak (Amerson 1969), Mejit Island, Bikini (Temme 1990), Majuro and Ujelang Atolls (Anderson 1981). Their period of occurrence in the Marshall Islands spans the dates from 21 October to 20 December (Ujelang) and 3 March (Arno) to 15 April (Ujelang).

#### RUDDY TURNSTONE (Arenaria interpres)

The Ruddy Turnstone is the most numerous shorebird migrant and winter resident on Kwajalein Atoll and may be regularly expected on any island. Unlike Lesser Golden-Plovers, they usually forage in small flocks and may form large aggregations for short periods. This is reflected in the sometimes great changes in day to day numbers on parts of Kwajalein Island (Table 8).

Kwajalein Atoll, with populations certainly well over 1,000 birds, may hold the largest wintering concentration in the Marshall Islands. This species is also the most abundant shorebird migrant at other atolls, but totals reported elsewhere are not nearly as large. Judged from observations at Roi-Namur (Table 12), some migrants remain as late as early May and others return from the north in July, as indicated by a count of 103 turnstones on 16 July 1987 (Schipper in litt.) Observations from the March 1988 survey are given below.

Ennylabagen - Between 60% and 80% of the 60-75 turnstones were found in and around the helipad and on the field just northwest of it. Small flocks, usually of 4-14 birds, were also frequently encountered in the open areas to both sides of the road north of the helipad. These turnstones were mostly found in open areas of the interior. A few were seen along the shore, and none were found in forested areas or in areas with heavy ground cover.

Legan - Flocks of six and seven birds were foraging in the grassy areas near the helipad on 11 and 24 March, respectively. Flocks of 15 and 10, respectively, were seen on those dates on the interior lake. A few were seen along the sandy and rubble-strewn shores.

Illeginni - On both visits most of the 15-20 turnstones were found along the western shore or on the exposed rocky flats just north of the island. The only birds seen in the interior were three near the helipad on 22 March.

Roi-Namur - Censuses on 26 and 27 March 1988 gave 330 and 276 birds, respectively. Allowing for birds in areas not covered, I estimate the island population was perhaps 375-400 birds. This total

is larger than any recorded by Schipper (Table 12) but is in the same order of magnitude as his larger counts. The only previous estimate is one of 200 made on 4 November 1964 (Amerson 1969).

Table 12. Numbers of Ruddy Turnstones seen by Schipper at Roi-Namur, October 1979–November 1988.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1)	58	69	84	87	31	30	33	42	49	41	45	111
2)	273	200	254	264	100	108	103	230	216	216	157	265

(1) Mean number seen per days observed. The sample size for December was only eight which may account for the disproportionately high mean for this month.

(2) Peak number recorded.

Gagan - One was seen at the northern end, another at the southern on 15 March. The single bird seen 24 March was at the northern point.

Gellinam - A flock of eight was seen along the east beach crest and another bird flushed from about 10–12 feet up in a tree on the western side of the Black Noddy colony. The nests in the area from which it flushed were too high for me to check, but turnstones have been noted as egg predators elsewhere in the Marshall Islands (Crossin and Huber 1970) and can be a significant source of nest loss in European larid colonies (Brearey and Hilden 1985).

Omelek - Five were seen on 17 March along the southeastern shore and five others were on the helipad.

Eniwetak - None seen.

Meck - About 16–20 foraged mostly along shores exposed at low tide. The number seems low for an island this size but may relate to the relatively small amount of grassy area in which to forage. Numbers of other species (plovers, Whimbrels) were relatively much larger and may reflect the greater ease with which these species forage in the low, forb ground cover.

Kwajalein - Counts on Kwajalein reached a maximum of 417 on 23 March, but this total is probably larger than the number actually present in the area surveyed because some birds were very likely counted more than once. Observations suggested that relatively few birds occurred in areas not covered by the census. Taking into account these observations as well as the census data, I estimate the total island population was about 450 birds. The only prior estimate

of numbers during the wintering period is one of 200-300 in October-November 1964 (Amerson 1969).

Substantial concentrations of turnstones formed in the evening and morning on the tarmac outside the aircraft repair shop. There turnstones are regularly fed "Hill's Science Pet Food" and I was informed (W. Dudley pers. comm.) that at least two individuals regularly feed them. Three counts here on the mornings of 23 to 28 March ranged from 123-130 birds with a peak of 210 on the morning of 29 March. The largest foraging group seen elsewhere was one of 102 birds around the Zar transmitter shielding fence on 15 March. Resting birds seem particularly attracted to the sandy parts of the ballfields where a flock of 62 turnstones was seen 29 March.

#### SANDERLING (Calidris alba)

Sanderlings are uncommon migrants at Kwajalein. None was found during the March 1988 survey, but the species has previously been noted at Kwajalein, Roi-Namur (Amerson 1969, Schipper 1985) and Ennumennet Islands (Schipper 1985). Preferred habitat on Kwajalein is exposed sandy areas, few of which were visited during the March survey or by earlier observers. Sanderlings on Kwajalein roost on rocks at high tide (Schipper 1985) and have been found along the airstrip on Kwajalein Island (Amerson 1969).

Usually only one or two birds are seen. The largest numbers recorded on Roi-Namur were three on 23 November 1980 and six on 11 December 1982 (Schipper in litt.). Numbers recorded elsewhere in the Marshall Islands suggest that the species is an uncommon migrant and winter resident throughout the group. The peak numbers reported from other atolls in the Marshalls are seven at Ujelang Atoll (Anderson 1981) and nine at Bikini Atoll (Temme 1990).

Records kept at Roi-Namur (Schipper in litt.) suggest that a few Sanderlings winter there in some years. All but one of the records for Roi-Namur (and Kwajalein) fall between 30 August (1988) and 30 April (1980). A bird seen on Roi-Namur 6 and 9 July 1980 was presumably an early migrant. Observations over a two-year period at Ujelang Atoll (Anderson 1981) reveal a similar pattern with dates of occurrence spanning a period from 28 October to 6 May (both 1976). These dates span all records of this species in the Marshall Islands.

#### PECTORAL SANDPIPER (Calidris melanotos)

The only record of this Nearctic species on Kwajalein is of two seen by Schipper (1985, in litt.) on Roi-Namur. One was present from 20 to 30 October 1982, and one was seen 12 and 19 March 1983 (Figure 2). The only other records for the Marshall Islands are a male (USNM 494814) collected 20 October 1964 on Lojrong Island, Taka Atoll (Amerson 1969), and a bird seen on Enekune Island, Ujelang Atoll from 13 to 24 September 1975 (Anderson 1981).

Pectoral Sandpipers breed in northern North America and on the Arctic coast of central and eastern Siberia (A.O.U. 1983); but in the tropical Pacific they have been recorded regularly only in the Hawaiian Islands (Pratt et al. 1987).

#### SHARP-TAILED SANDPIPER (Calidris acuminata)

About 25 Sharp-tailed Sandpipers, nine of which were collected, were present on Kwajalein Island in early November 1964 and provided the first record for the atoll (Amerson 1969). More recent observations by Schipper (1985), largely on Roi-Namur, led him to conclude the species is a regular fall migrant. He noted that it arrives in October but provided no other specifics about length of stay or numbers seen.

Schipper (in litt.) has now recorded these sandpipers on Roi-Namur from as early as 26 September to as late as 7 February (both 1982). Peak numbers recorded in 1988 were 30 and 17 on 20 and 31 October, respectively, 22 on 3 and 5 November, and 19 on 11 November. Peaks in earlier years were considerably less: 13 on 20 October 1979, 10 on 18 October 1980, 8 on 23 November 1981, and 11 on 1 November 1982.

Sharp-tailed Sandpipers begin arriving on Roi in late September or early October and peak in late October and early November. This is consistent with observations further to the east in the Phoenix Islands where fall populations also peak in October and November (Clapp and Sibley 1967).

Observations of from 1-7 birds in January and February (Table 13) are probably of late migrants rather than wintering birds. The absence of spring records from Roi may result from spring migrants first reaching Kwajalein Island, stopping briefly there, and then departing the atoll for the north. The buildup of numbers on Kwajalein Island during March 1988 doubtless consisted of migrants arriving from the south, but none was seen on Roi during this period.

Table 13. Numbers of Sharp-tailed Sandpipers seen by Schipper at Roi-Namur, October 1979-November 1988.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1)	2.8	1.0	---	---	---	---	---	---	2.3	5.7	5.9	2.8
2)	7	1	-	-	-	-	-	-	4	30	22	5

(1) Mean number seen per days observed.

(3) Peak number recorded.

During the March survey, Sharp-tailed Sandpipers were seen only on Kwajalein Island (Table 6). The first one was seen 13 March as it

fed with 12 Ruddy Turnstones. That I saw no more birds on three subsequent visits suggests that the larger numbers seen later were birds arriving on migration. Ten birds, the largest number seen together, were foraging on 29 March inside the wire fence surrounding the ammunition bunkers near the southwest end of the airstrip. Others were seen on the grassy golf course and at rain pools southwest and north of the runway. When more than one bird was present, the birds flew as a flock. They clearly preferred to associate with flocks of turnstones and seemed to avoid plovers.

After my departure, Schipper (in litt.) recorded Sharp-tailed Sandpipers on four days in 1988: 9 on 2 April, 12 and 7 on 8 and 13 October, respectively, and 6 on 5 November.

Elsewhere in the Marshalls, the Sharp-tailed Sandpiper has been reported from Enewetak (Woodbury 1962, Temme 1990), Jaluit (Amerson 1969) and Ujelang (Anderson 1981), Likiep, and Bikini Atolls and Mejit Island (Temme 1990); but it doubtless occurs more widely. A flock of 64 seen on Enewetak Island, Enewetak Atoll 17 November 1978 (Temme 1990) is by far the largest number seen in the more tropical parts of the Pacific Ocean. The earliest fall records of these sandpipers in the Marshalls are from Kwajalein but they have been seen in spring as late as 16 May at Enewetak Atoll (Amerson 1969).

#### CURLEW SANDPIPER (Calidris ferruginea)

A Curlew Sandpiper observed and collected on Kwajalein Island in March 1988 is the only record for the atoll or for the central tropical Pacific (Clapp and Schipper 1990). The sandpiper was discovered 23 March when it was heard calling as it flew with a flock of Ruddy Turnstones in the field by the battle monument. It was seen again on 25 March as it foraged with turnstones in a grassy area beyond the western end of the runway. I collected it (USNM 596229) on 29 March as it roosted with a flock of Lesser Golden-Plovers on the taxiway. The specimen is a male with unenlarged gonads and was extremely fat, weighing 82 g. The heavy layers of fat suggest that the bird was healthy and would have migrated north in due course.

Curlew Sandpipers breed primarily in northern Siberia (A.O.U. 1983) and winter south to Australia (Condon 1975). They are uncommon migrants in western Micronesia (Pratt et al. 1987). The prior records from the tropical Pacific are two sight records from Oahu, one bird seen and photographed 31 October 1979 (Pyle and Ralph 1980) and another seen 6-23 September 1987 (Pyle 1987).

#### RUFF (Philomachus pugnax)

The Ruff has been noted on Kwajalein Atoll six times. The first bird, presumably a male from its large size, was seen with Lesser Golden-Plovers on the Kwajalein golf course (Temme 1985). Schipper (in litt.) saw another on Kwajalein on 8 and 12 October 1988.

The other Ruffs observed were all seen on Roi-Namur: one from 23 September to 14 October 1979, another from 1 October to 23 November 1980 and on 11 January 1981, a third from 23 September to 1 December 1982, and the fourth, a juvenile, on 28 and 29 September 1988 (Schipper 1985, in litt.)

The Ruff, a species that breeds in the Palearctic, is an uncommon migrant to Hawaii and Micronesia (Pratt et al. 1987) that in recent years has been recorded with greater regularity. In the Marshall Islands it also has been recorded at Enewetak Atoll where a small bird, thought to be a Reeve, was seen on 21 November 1979 at Enewetak Island (Temme 1985). Temme also gives passing mention to a specimen from Enewetak in the USNM. This bird, a Reeve, was collected on Enewetak Island 15 October 1968 (Clapp ms.).

#### LATHAM'S SNIPE (Gallinago hardwickii)

The only unequivocal record of this Asian species in the Marshall Islands and the tropical Pacific is a male (USNM 494842) collected from a grassy area between the runway and taxiway on Kwajalein Island on 3 November 1964 (Amerson 1969). Temme (1990) reported birds he believed were this species on Aomon Islet, 25 March and 7 April 1979, as well as a less certain sighting of a snipe on Ananij Islet 27 March 1978.

#### ORIENTAL PRATINCOLE (Glareola maldivarum)

Schipper (1985) saw and photographed an Oriental Pratincole on Roi-Namur following ten days of heavy, southwestern winds. The bird was seen 16 October-11 November 1982 along the southwest lagoon side of the runway where it frequently hawked insects. This species breeds in eastern Asia and is an uncommon migrant in western Micronesia (Pratt et al. 1987). The bird on Kwajalein is the only record for the tropical Pacific east of western Micronesia.

#### FRANKLIN'S GULL (Larus pipixcan)

A Franklin's Gull was present on the Roi-Namur golf course from 24 June to 3 July 1988. It foraged for grasshoppers and frequented the water catchment basins (Clapp and Schipper 1990). This bird, in first summer plumage, is the second record for the Marshall Islands, the first being a bird in breeding plumage seen on Majuro Atoll on 10 June 1975 (Anderson 1978).

This North American species strays fairly regularly to Hawaii (Clapp, Morgan-Jacobs and Banks 1983, Pratt et al. 1987) and infrequently to Australia (Serventy and Whittell 1976, Eades and Debus 1982, Blakers et al. 1984) and there is one extraordinary sighting from Marion Island, Indian Ocean (Sinclair 1978).

## Terns, Sterninae

Tern flocks were seen feeding offshore fairly frequently (Table 14). A few contained only Black Noddies or Black-naped Terns, but most were mixed flocks of the two species. Most of these flocks, and all seen close to islands, contained a fairly small number of birds (4-42 birds, mean 15.3, n: 11). One large flock of about 500 birds was seen off the southern shore of Kwajalein Island on 28 March. This large flock was too far away to determine its composition, but it appeared to consist mainly of Black Noddies and a few white terns (probably Black-naped Terns) and an unknown proportion of larger dark birds, that may have been Brown Noddies (Anous stolidus).

That Brown Noddies and White Terns did not participate in the smaller inshore flocks, even off islands where they breed and are moderately numerous (Illiginni, Legan), suggests that most feed well offshore. Engbring (in litt.) made similar observations in Palau.

Table 14. Size and composition of tern flocks feeding off Kwajalein Atoll in March 1988.

Date/Time	Island	Location	Number of			Total
			Black Noddies	Black-naped Terns	Crested Terns	
10th 0819	Ennylabagen	S of NE point	--	4	--	4
10th 1219	Ennylabagen	mid NE point	10	1	--	11
11th 0830	Legan	rocky N point	6	1	--	7
14th 1409	Illigini	off N shore	6	15	--	21
21st 1000	Meck	off SE shore	10	--	10	10
21st 1018	Meck	off S end	30	12	--	42
21st 1200	Meck	off W shore	--	2	3	5
24th 0949	Legan	off N shore	5	2	--	7
25th 1352	Gagan	off SW tip	15	10	--	25
25th 1506	Gagan	off SW tip	22	9	--	31
26th 0850	Roi-Namur	SW beach of Roi	2	1	2	5



The smaller tern flocks were seen from as close as just off the breakers to as far as perhaps 1.4 mi. for one flock feeding south of Meck. The structure of such flocks was tiered, with Black Noddies hovering low (3-10 ft) over the surface and dipping to seize prey while Black-naped Terns arced higher (6-20 ft) and dove into the upper layer of water to catch food.

Great Crested Terns (*Sterna bergii*) only occasionally fed with these birds. Most Great Crested Terns flew in ones or twos up and down the shores and usually dove from 15 ft or more. This species behaved quite differently in April 1988 at Christmas Island, Pacific Ocean, where it often fed in sizable flocks with Black Noddies. At that locality, where Black-naped Terns are absent, the Great Crested Terns formed the upper tier of the feeding flock, arcing and diving much as did the Black-naped Terns on Kwajalein.

#### GREAT CRESTED TERN (*Sterna bergii*)

Great Crested Terns occur throughout the atoll and are frequently seen fishing off the shores of most islands or roosting on sandy points or pilings. They have not been found breeding on Kwajalein, but it seems likely that some nest on isolated beaches on seldom visited islands. They have been reported on northern islands from Nell east through Roi-Namur and south to Gagan (Schipper 1985), and at Kwajalein (Fosberg 1966) and Ebeye (Anderson 1981) Islands.

Earlier data on abundance is largely lacking; the previously reported maxima are six birds at Kwajalein on 29 February 1952 (Fosberg 1966), six at Roi-Namur on 4 November 1964 (Amerson 1969), and five off Ebeye on several occasions in the mid to late 1970's (Anderson 1981).

Crested Terns occur widely in the Marshalls and have been recorded at 22 of the 34 atolls and reef islands comprising the group (Amerson 1969); they are recorded as breeding at eight (Amerson 1969 Anderson 1981). Breeding has been adequately documented for nine atolls. Amerson (1969) indicated Crested Terns breed at another site, Arno Atoll, but the source cited (Marshall 1957) makes no mention of breeding there. Sources cited by Amerson for Crested Terns on Enewetak Atoll also do not mention breeding. Subsequently, however, Anderson (1981) cited native informants who noted breeding at Enewetak. Breeding at Rongelap Atoll is documented by a very young chick (USNM 388733), not much more than a day old. Amerson listed this specimen but questioned whether Crested Terns bred there.

Observations for Kwajalein Atoll are given by island below.

Ennylabagen - None seen on any visit.

Legan - On 11 March, five adults, three in breeding plumage and two in non-breeding plumage, roosted on rubble off the central

eastern shore. This area could supply good nesting sites if it remains exposed at high tide, but no Crested Terns were seen there on 24 March.

Illeginni - A minimum of four birds was seen 14 March and probably at least six were present. One was seen flying along the eastern reef, two were roosting on the sandy beaches on the south side of the isolated island just north of Illeginni, and four more roosted with Black-naped Terns on the northern point of the isolated island. No Crested Terns were seen on 22 March.

Roi-Namur - Four were seen 12 March 1988. Two perched on a concrete piling on the southern side of the island, a third flew overhead, and another flew off the northeast end of the runway. All seen well were in non-breeding plumage. Five, two in juvenal plumage, were roosting on the sandy southwestern point on 26 March. Four others, probably some of the same birds, were on a concrete piling on the south shore the following day (Figure 38).

Schipper (in litt.) typically saw one to four birds off the island's shores (on 244 of 308 days these birds were recorded). Ten or more birds were seen on only 18 days (in over 600), all within the period from 17 March through 22 October. Peak numbers recorded were 41 on 11 September 1988, 35 on 26 May 1987, 23 on 11 May 1987, and 19 on and 15 April 1987. Mean numbers seen per days observed are lower in December and January (Table 15), perhaps reflecting a winter breeding season.



Figure 37. Great Crested and Black-naped Terns roosting on a piling at Roi-Namur, 27 March 1988.

Table 15. Numbers and frequency of occurrence of Great Crested Terns seen by Schipper at Roi-Namur, October 1979–November 1988.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1)	1.6	3.0	2.6	3.5	5.8	3.1	2.6	2.8	3.9	3.3	2.7	1.4
2)	2	7	16	19	35	15	9	12	41	12	7	2
3)	7	7	31	25	36	33	41	26	31	46	20	5
4)	.20	.22	.45	.52	.55	.54	.57	.51	.55	.64	.31	.23

- (1) Mean number seen per days in which observed.  
 (2) Peak number recorded during month  
 (3) Number of days observed  
 (4) Percentage of days of observation in which seen.

Gagan - On 15 March 16 Crested Terns were seen roosting together on rocks exposed by low tide off the northern point (Figure 39). Nine were seen there on 25 March. On 15 March eleven of the birds were in breeding plumage, three were in transitional or non-breeding plumage, and two were in juvenal plumage. On 23 March



Figure 39. Roosting Great Crested Terns and Black Noddies at the northern end of Gagan Island, 15 March 1988.

four were in breeding plumage, four in non-breeding plumage and one was in juvenal plumage. Thus, a total of at least 18 birds was present on the two visits.

Great Crested Terns also roosted on exposed rocks off the west shore as well as on a large concrete block well inshore. Birds foraged primarily along the western shore. One juvenile was seen pursuing another and begging for food, and one adult was seen making an unsuccessful kleptoparasitic attack on another adult.

At Gagan and Meck, large (6-8 ft) black-tipped sharks (Carcarhinus melanopterus) were driving schools of fish toward the shore, resulting in hundreds of small fish leaping into the air within a dozen feet of shore. Great Crested Terns foraging along these shores evidently waited for such events, and flew to such areas and dived repeatedly. Black-naped Terns also utilized shark-driven schools on Meck, but not as frequently as did Crested Terns.

Gellinam - A single bird was seen flying off the western shore in the mid-afternoon.

Omelek - None seen.

Eniwetak - Several Great Crested Terns were flying off the northwestern shore as we arrived, and an adult and a juvenile were seen off the eastern end shortly thereafter. Later in the morning, an adult was seen returning to feed a juvenile as another adult stood by. All three were on exposed reef rock south of the helipad. When flushed, the juvenile could only fly weakly. No good nesting habitat for these terns is found on Eniwetak; the young bird probably fledged on some nearby island.

Meck - Three, two adults in breeding plumage and a juvenile, constantly patrolled along the sandy beach and breakwater on the southwestern shore.

Kwajalein - One Great Crested Tern flew off the southwestern end of the island on 19 March. These terns may be more common off the ocean side of the island than a single observation suggests because I spent relatively little time on the ocean side. Their absence from the lagoon side where I saw both Black Noddies and Black-naped Terns probably does indicate that the species is a less frequent visitor to Kwajalein than the other terns.

Only a few scattered records document breeding by Great Crested Terns in the Marshall Islands (Table 16), but they are well scattered and suggest either irregular breeding, different breeding seasons in different areas, or perhaps other than an annual breeding regime.

Table 16. Stages of breeding reported for Great Crested Terns in the Marshall Islands (1)

Atoll	Date	Breeding stages observed	Based on observations	
			Earliest Eggs	Latest Young
Rongelap	31 Jul 1946	small chick collected	24 June	2 Sep
Bikini	19 Aug 1946	small - near-fledging chicks	20 June	21 Aug
	8 Nov 1978	18 eggs, 2 young, ca 2 day & 2 weeks old	12 Aug.	19 Dec
Wotho	11 Sep 1976	6 nestlings	4 July	13 Oct
Taongi	10 Oct 1964	7 eggs	12 Sep.	20 Dec
Bikar	15 Oct 1964	20 eggs, 2 small chicks	2 Sep.	25 Dec
Taka	20-22 Oct 1964	10 eggs	7 Sep.	25 Dec
Jaluit	11 Nov 1964	2 3/4 grown young	16 Sep.	26 Nov
Taongi	29 Apr 1967	49 eggs, two small young	22 Mar.	11 June
Ailinginae	1 May 1967	9 near-fledging young	1 Mar.	11 May
Taka	5 May 1967	1 small young	29 Mar.	7 June
Bikar	7 May 1967	7 eggs	10 Apr.	17 July

(1) Data from Amerson (1969), Anderson (1981), Temme (1990), and USNM specimens. Calculations are conservative estimates; presence of small young suggests at least moderate incubation of other eggs seen. A 28-day incubation period and 43-day fledging period, the latter a maximum (Langham and Hulsman 1986), were used to arrive at the dates given in columns to the right. "Small young" are assumed to be 10 days old, 3/4 grown young 28 days, and near-fledging young 33 days. Eggs are regarded as fresh or incubated, whichever will make the span of possible breeding dates greater.

COMMON TERN (*Sterna hirundo*) or  
ARCTIC TERN (*S. paradisaea*)

Anderson (1981) reported a bird he believed was one of these near Ebeye and Kwajalein on 2-4 January 1976. No descriptive details were given, and the bird could have been a winter-plumaged tern of the genus *Chlidonias*. Anderson cites one record each for the Common Tern (Amerson 1969) and Arctic Tern (Woodbury 1962) in the Marshall Islands. The former is a specimen of the nominate race; the latter is a sight record without details that was rejected by both Clapp, Laybourne and Pyle (1983) and by Pyle and Engbring (1985).

BLACK-NAPED TERN (*Sterna sumatrana*)

Previous reports give specific records of Black-naped Terns only on Ebeye (Fosberg 1966), Enebuoj (Amerson 1969), and Gagan (Schipper 1985) despite this species' widespread occurrence on Kwajalein. Black-naped Terns are now known to breed on three islands at Kwajalein. Nests of this ground-nesting bird are not conspicuous and

it is highly likely that the species nests on other islands, particularly those lacking ground predators (dogs, cats, pigs) and that are free from human disturbance.

Judged from available observations it is likely that the total population is at least several hundred birds, but too little of the atoll has been surveyed to allow a conjecture as to the maximum population level. Observations obtained on this survey are given by island below.

Ennylabagen - These terns were seen on visits to this island on 9, 10, and 23 March; but the total number seen was likely no more than half a dozen. On 9 March three birds fed in the lee of the large wrecked ship on the mid-eastern shore. Two were adults and one a juvenile, the latter evidently the offspring of the former as the young bird followed the adults calling continuously. Later, one adult perched with the calling young on the boat itself. Guano on the edge of the ship indicated its regular use as a roost and possibly as a nest-site.

On the following day four were fishing along a Tournefortia edged cove east from the north village. Four birds, presumably these, later flushed from the sandy spit that runs more or less northwest off the north end of the island. The habitat here, at least the more raised, lightly vegetated portion, provides the most likely nesting habitat, but dog and pig tracks on nearby beaches make it highly unlikely that these birds nest here with any success.

Only one was seen on 23 March, a calling juvenile flying along the lagoon side of the south end.

Legan - Two to three Black-naped Terns foraged offshore on both visits. The shores of Legan provide very little potential nesting habitat and I doubt that this tern ever breeds here.

Illeginni - A maximum of 29 birds, all apparently adults, and largely without black carpal bars, roosted on the offshore rocks and sandspit of the island north of Illeginni on 14 March. A flock of about 15-20 birds flew from the raised area of this separated northern island; about 30 birds were also here on 22 March. Although one bird was seen carrying a fish over the island, intensive searching of the areas from which the birds flushed revealed no nests. A male and a female, largely in breeding plumage, that were collected 22 March were molting in the primaries but showed no enlargement of the gonads. Although none were found nesting during this visit, the birds' behaviour, and the nature of the habitat, make it very likely that Black-naped Terns nest on this island.

Roi-Namur - Two were seen on 12 March as they perched with Great Crested Terns on a concrete block near the westernmost of the two piers on the island's south side. An adult and a juvenile perched on a pier railing on 27 March, and another adult was seen on a concrete block on the southern shore.

The presence of Black-naped Terns at Roi-Namur was suggested by Schipper (1985) but he provided no details. His daily tallies indicate that the species occurs there as a visitor throughout the year and is somewhat more abundant in the northern hemisphere winter (Table 17).

Table 17. Numbers of Black-naped Terns seen by Schipper at Roi-Namur, October 1979–November 1988.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1)	9.4	4.6	3.8	3.6	3.1	2.4	2.6	1.4	4.0	4.4	3.2	3.8
2)	26	10	17	7	8	6	7	3	12	8	15	9
3)	7	7	18	15	16	13	16	5	11	27	23	5
4)	.20	.17	.26	.31	.24	.21	.22	.10	.19	.38	.36	.23

(1) Mean number seen per days in which observed.

(2) Peak number recorded.

(3) Number of days observed.

(4) Percentage of days of observation in which seen.

Gagan - No Black-naped Terns were found breeding on Gagan during my visits, but Schipper (1985) found six nests with eggs or downy young on 26 August 1979. The nests were on the ground among low vegetation 5 m from the east side of the helipad.

I saw a maximum of six at once on 15 March, and 18 on 25 March. The largest numbers roosted on small rocks off the northern point, but the southwestern sandspit was also used frequently. Its shallow slope led these birds to use it as a bathing area. Bathing birds walked to the water's edge and then out into it, eventually to be carried off their feet by the waves.

None of the birds seen was a juvenile. Approximately 80% of the birds showed dark carpal bars, possibly a sign of non-breeding status. No nests were found, nor did any of the birds behave aggressively. The island provides adequate nesting habitat, however, and nesting there at other times of year seems likely.

Gellinam - Birds were initially seen around the island perimeter, roosting on rubble and usually in twos. Later, nine were seen together on the western beach, and a maximum of 13 was flushed from the northwestern area. Most were adults, with and without black carpal bars, but one begging juvenile accompanied by a bird with a black carpal bar was seen. I found no nests, nor did the birds' behavior strongly suggest breeding. Ken Jourdan (pers. comm.) told me that a total of about 18 pairs nested on Gellinam around January - March 1986. Undated photographs provided by Jourdan show numerous

eggs and small chicks as well as a few near-fledging young.

Omelek - At least six Black-naped Terns were present, all adults lacking dark carpal bars. Three roosted on the southwestern point and two more on the northern point. Black-naped Terns were much more demonstrative on Gagan than any other island except Meck (where a nest was found). Calling, they flew above me to investigate my presence. I found none of their rather cryptic nests but think it likely that the species nests here.

Eniwetak - Two were seen on the southeastern reef flat, one in pronounced juvenal plumage.

Meck - Ten Black-naped Terns roosted in medium rubble at the southeastern corner of the runway when we arrived. They showed no particular attachment to the island when flushed, but others seen farther north were more aggressive than birds anywhere else. After much searching, I found a nest with an egg and a newly hatched young on a flat rock on the beach crest a little more than one-third the way up the island's east side (Figures 40, 41). I was struck in the head three times by an adult at this point, presumably one of the parents. A very careful search of this area revealed no more nests.



Figure 40. Black-necked Tern chick and egg, Meck Island, 21 March 1988.





Figure 41. Nesting habitat of Black-naped Terns on Meck Island, 21 March 1988.

Kwajalein - Five were seen along the lagoon side of the northeastern portion of the island on 19 March: an adult followed by a calling juvenile, another adult flying alone, another seen foraging, and one perched on a buoy not far from shore.

#### LITTLE TERN (*Sterna albifrons*)

The only report of this Old World species on Kwajalein was of a bird seen on southeastern Roi-Namur on 26 July 1981 (Schipper 1985) where it foraged over the reef. This white-tailed species was only recently (A.O.U. 1983) separated from the similar New World Least Tern (*Sterna antillarum*) which has a gray tail and distinctive vocalizations (Pratt et al. 1987).

Earlier sight records of both species usually failed to provide enough descriptive detail to allow their subsequent identification. Some of the records for albifrons accepted by Pratt et al. (1987) such as those for Upolu, western Samoa, and Ocean Island (Banaba), are equivocal as are virtually all of the records of antillarum from Hawaii (Clapp 1989b). Schipper's record for Kwajalein is one of the very few where the observer provided details that allow the species to be determined.

#### SOOTY TERN (Sterna fuscata)

Few reports document the occurrence of this abundant tropical seabird at Kwajalein Atoll. A report of "2 Sooty Terns... or Gray-backed Terns (Sterna lunata) along the beach at Kwajalein" in late July 1960 (Yocum 1964) was accepted by Amerson (1969) as a record for both species; but it should have been discarded. Fosberg (1966) reported that one was seen at Eniwetak on 23 January 1952, but no details are available and the record is equivocal. All other records for Kwajalein are provided by Schipper (1985), who saw five adults, one in the lagoon to the east of Gehh Island and the others in different years off the shores of Roi-Namur. He also found a dead juvenile on the western side of Roi-Namur. Dates were provided for none of these observations.

More recently, Schipper (in litt.) has recorded Sooty Terns off Roi-Namur on four occasions: two on 15 March 1983, 23 on 24 May 1987 and one the following day, and one on 13 March 1988.

#### BROWN NODDY (Anous stolidus)

Brown Noddies are common on Kwajalein but are by no means as abundant as the smaller Black Noddy. They seldom forage inshore and are seen regularly only on islands where they breed. They have been sighted previously at Kwajalein (Baker 1951, Temme 1990), Lojjairok, Enubuj, Eniwetak, Ennylabagen (Fosberg 1966), and Loi islands (Fosberg 1966, Amerson 1969). Schipper (1985) reported that the species breeds at Obella, Edgigen, Debuu, Edjell, and Gagan; but he provided no details and Fosberg (1966) reported evidence of breeding at Loi and/or Lojjairok. Observations of this species at other islands are summarized below.

Ennylabagen - The only previous record of Brown Noddies at Ennylabagen was a bird seen flying just offshore on 3 August 1952 (Fosberg 1966). I saw 3-5 Brown Noddies flying over the southern end of the island on 10 March and two flying over the island on 23 March. One of the birds seen 10 March was flying low among Pandanus on the southwest part of the island. Although I found no nests, a few pairs may breed here. The forested parts of the island provide such an abundance of nest sites that Brown Noddies could probably nest successfully despite the presence of native Marshallese.

Legan - Perhaps 30 pairs of Brown Noddies breed on Legan and the total population is probably on the order of 80 birds. I first found nests there on 23 March. Five of the six nests found were at the base of Cocos fronds, and the remaining nest was on a Pandanus leaf (Figure 42). Nests were about 17-25 feet up. An eggshell was found on the ground near one of the nests in Cocos. The nest in Pandanus was discovered when the medium to large downy chick it contained was heard calling to its parents. This nest was on the northeastern part of the island; the others were all in the east-central portion north of the open observation shed. Behavior of other Brown Noddies suggested that additional nests were present, some in Cocos and some in Pandanus, at sites that could not be seen from the ground.

Illeginni - At least five active nests were present, four in Cocos in the central portion of the island and west of the road. The other nest was in the top of a 45-foot Pandanus on the southeastern part of the island, just south of the southeastern corner of the artificially raised area. Most nests were high in the trees with none lower than 20 feet. Examination of smaller Cocos near the pier revealed no evidence of nests. A medium-sized downy young was seen in the nest in Pandanus, and several of the birds perched on palm fronds were immatures. A few other nests probably were present in the taller Cocos and Pandanus. The breeding population is probably not less than 10 pairs.



Figure 42. Brown Noddy nest in Pandanus, Legan Island, 24 March 1988.

Roi-Namur - One Brown Noddy flying over the east end of Namur on 26 March was the only bird seen during the March survey. No other reports put this species at Roi-Namur, but Schipper (in litt.) has seen it offshore in all months of the year. Flocks of 100 birds or more have been seen on 11 occasion, more than half in May and June.

Gagan - None seen.

Gellinam - None seen.

Omelek - One Brown Noddy flew over the west side of Gagan on 17 March. I have no reason to believe that any breed there.

Eniwetak - Perhaps 10-15 Brown Noddies were on Eniwetak, one of them a fledged juvenile perched high in a Pisonia tree that also supported a large Black Noddy colony. The others were seen occasionally in the upper canopy and flying along the outer reef. I found no nests but think a few pairs likely nest on Eniwetak.

Meck - None seen.

Loi - About 20 Brown Noddies were flying over the island and roosting in Pisonia when I visited the island in November 1964 (Amerson 1969). The species probably nests there in at least small numbers.

Kwajalein - The only birds I saw were about 100 flying southwest, singly and in pairs, off the western end in the late afternoon of 29 March. The birds streaming past were both Black and Brown Noddies and I estimate an aggregate total of 250 birds.

#### BLACK NODDY (Anous minutus)

Black Noddies are one of the most familiar sights of Kwajalein Atoll and are its most abundant breeding bird. Despite its abundance, the species has been recorded breeding on only Eniwetak (Fosberg 1966), Obella, Edgigen, Debuu, Edjell, and Gagan (Schipper 1985) islands. The occurrence of Black Noddies has also been reported from Lojjaiong, Kwajalein, Loi, Ebeye, and Roi-Namur islands (Fosberg 1966, Amerson 1969). Previous data on numbers are few and inexact, but hundreds were said to be nesting on Eniwetak on 23 January 1952 (Fosberg 1966). Data from the present survey are given by island below.

Ennylabagen - Black Noddies only visit Ennylabagen; about 15 were present on 10 March. Three noddies roosted in an open Pisonia tree in the central portion of the island on 23 March. A dead bird found 10 March had evidently collided with one of the antennae wires. It had a well developed brood patch suggesting that it was nesting somewhere nearby.

Legan - Fourteen nests were found during the two days I spent on Legan, but at least one nest was inactive. Almost all nests found had sitting birds, and I estimate that there were 12 breeding pairs. Nine of the nests were 60 ft up in two adjacent Pisonia trees on the northern portion of the island. Two others were about 15 ft up in Pemphis, two were about 12 ft up in Tournefortia near the north beach crest, and one was 5 ft up on a low branch of Pisonia. The latter nest, the only one low enough to be examined, contained an incubated egg. The consistency with which adults sat on other nests suggests that most had eggs or very small young.

Illeginni - Forty-seven nests were found in Pisonia, Tournefortia, and Coccoloba north of the trailers on the southern and western portion of the island. Allowing for inactive nests, I estimate the breeding population at about 40 pairs and at least 100 birds. All nests were 20 ft or more above the ground; the majority were at heights of 30 to 40 ft. The behavior of the nesting birds suggested that either eggs or small young were present.

Roi-Namur - A few were flying offshore on both visits, but the Black Noddy does not breed on Roi-Namur. Two were using the understory of the western pier at a perch from which to fish on 26 March. Large flocks of 100-300 birds were seen off Roi-Namur on 19 different days during 1979-83 and 1987-88 (Schipper, in litt.). Seven of these flocks were seen in May 1987 and four in July 1987.

Gagan - Three Black Noddies flew over the grove at the southern end on 14 March, and three roosted on the southwest triangle of sand with Black-naped Terns on the 25th. Schipper (1985) found Black Noddies nesting on Gagan but provided no details. The open Pisonia forest of the northern end that formerly held their nests (Schipper, pers. comm.) now has no nesting birds nor were there any old nests.

Gellinam - A substantial colony of Black Noddies nests in Pisonia forest at the northern end of Gellinam (Figure 43). I counted 266 nests; and allowing for inactive nests, I place the breeding population at about 225 pairs.

Gellinam is the only island visited during this survey where Black Noddies nest low enough so I could examine the contents of a reasonable sample of nests. They were placed from as low as 4 ft to as high as about 40 ft with the majority from 15 to 30 ft.

Of nests with contents that could be seen, 8 were empty, 12 contained eggs, and 18 held young. These figures overestimate the proportion of young present because young could be seen in higher nests where eggs could not. Probably not less than 60%, perhaps more, of the active nests contained eggs. Five eggs candled were uniformly heavily incubated, and most of the young were quite small and less than a month old. Two to three large young were seen, one of which was capable of weak flight.



Figure 43. Gellinam Black Noddy colony from east end of grove, 16 March 1988.

Omelek - An estimated four pairs and a total of 15 birds was present. Four active nests and three inactive nests were found in the mid-eastern portion of the island. Nests were too high (ca. 25 ft) to check the contents, but the birds sat tight as on Legan and Illeginni so it seems reasonable to suppose that most contained eggs or small young.

Eniwetak - This island contains a burgeoning population of nesting Black Noddies - one that contains well over twice as many nesting pairs as all other islands visited combined. I counted 1,163 nests on 18 March but estimate the number of active nests at 750, the population at about 2,000 birds. These noddies nest throughout the Pisonia forest which is the oldest and largest such forest encountered during our survey.

Nests were at heights from 20 to 80 ft with most 60 ft or more (Figure 44). A few young were seen, and many adults were sitting on nests suggesting that the stage of breeding, not much different from that found on Gellinam, was fairly evenly divided between eggs and chicks.



Figure 44. Colony of Black Noddies on north end of Eniwetak Island, 18 March 1988.

In two areas the Pisonia were fruiting and their small sticky seeds formed a carpet several inches deep beneath the trees. These seeds were a hazard to both Black Noddies and White Terns because they gummed the feathers when the birds flew into the trees, often causing the terns to fall to the forest floor (Figure 45) where they died of slow starvation. I found a total of 13 Black Noddies and seven White Terns on the forest floor. Five of the Black Noddies and one of the White Terns were still alive; the others had succumbed.



Figure 45. Black Noddy entangled in Pisonia fruit, Eniwetak Island.

Meck - The Black Noddy visits this nearly denuded island in small numbers. One roosted on a piling along the southwestern shore, and others were feeding offshore. No nests were found, and the species probably does not nest here.

Kwajalein - These terns only visit Kwajalein but were regularly seen along the perimeter of the lagoon at the northeastern portion of the island. Here, Black Noddies either foraged along the shores or perched on buoys. Only one to three were seen at any time.

#### WHITE TERN (Gygis alba)

This tern occurs in small to moderate numbers on most of the islands, but very little has been said of its numbers or its breeding status. It has been recorded previously at Kwajalein, Loi (Fosberg 1966, Amerson 1969) and Enubuj Islands (Fosberg 1966); and it has been found breeding on Eniwetak (Fosberg 1966), Roi-Namur, Ennumennett, Obella, Edigen, Debuu, Edjell, and Gagan Islands (Schippner 1985). During the March 1988 survey, it also was found nesting on Kwajalein and Legan Islands; and it probably breeds on other islands visited (e.g. Ennylabagen, Gellinam, Omelek). Observations are given by island below.



Ennylabagen - A total of 15-20 White Terns was seen during our visits to Ennylabagen. No nests were found but this species probably nests there in small numbers. Breeding was strongly suggested by one tern with a fish in its bill that landed near another in Pemphis along the island's southeastern perimeter. White Terns occur primarily in the southern third of Ennylabagen where a maximum of seven were seen in flight at once. Others perched in Pisonia in the south-central portion. Only five were seen in the northern part of the island: three flying over a small antenna field along the northeastern perimeter and two, presumably a pair, showing interest in a Coccoloba in shrubby forest at the north end.

Legan - Legan holds the largest nesting concentration of any island visited. Five nests, two with eggs and one each with small downy young, large downy young, and a near-fledging immature, were found. I estimate that not less than 25 breeding pairs and perhaps 75 birds were present. I base this on the difficulty of finding nests and on maximum counts of 15 birds seen at once in the air along the northeastern perimeter on 11 March and 18 over the central lake on 24 March.

Eggs were found in the hollow top of a small Pisonia stub four ft tall (Figure 46) and 12 ft up on a horizontal branch of Pemphis



Figure 46. White Tern nest site on Pisonia stub in open Pisonia forest at the north end of Legan, 11 March 1988. Arrow points to egg.

(Figure 47). The downy chicks were found at heights of 6-7 feet in live and dead Pemphis and the near-fledging chick was on a Pisonia branch 10 ft above the ground. Four nests were on the island's northern end, and one was between the shed on the eastern side and the central lake. Legan's White Terns occur primarily east of the lake and in the northern part of the island in Pisonia forest and in fringing Pemphis. Only two to three White Terns were seen in the southeastern fringe of forest, and they were absent from the understory along the western perimeter and in the open coconut forest north of the lake.

Eller - Although flyovers of largely unidentified islands along the atoll perimeter revealed that White Terns are widespread, the number seen over Eller (at least 30 on 12 and 14 March) suggests that this island holds one of the largest concentrations on the atoll.

Illeginni - Small numbers flew along the perimeter on 14 and 22 March. A maximum of three was seen over a Black Noddy colony at the southern end. White Terns were less common on Illeginni than I would have thought from the habitat available, and I doubt if more than two or three pairs were nesting there in March.

Gae - Small numbers (10 birds or so) were seen from the air during our survey. A local informant stated that White Terns nest there in some numbers.



Figure 47. White Tern nest site on horizontal limb of Pemphis, Legan, 11 March 1988. Arrow points to egg.

Roi-Namur - White Terns are uncommon on Roi-Namur where they occur almost exclusively in the heavily vegetated northern portion of the island and in trees near the airport. About eight were present in March 1988 which compares favorably with an estimate of 10 made during my visit to the island on 2 November 1964 (Amerson 1969). A chick less than a week old was at about 25 ft on the branch of an Artocarpus on 13 March. Schipper (1985) stated that other nests on Roi-Namur have been found in Artocarpus, Pandanus, and Pisonia.

Gagan - A maximum of six birds flew over the southern forest on 25 March. Others, or perhaps the same birds later, flew over the northern forest. I found no nests and all White Terns left the island at midday, which suggests that active nests were not present. A photograph taken by Schipper on 26 August 1979 shows chicks less than a week old.

Gellinam - Four White Terns were consistently present in the Black Noddy colony at island's northern end. No nests were found, but a few pairs likely breed on Gellinam.

Omelek - A maximum of seven birds was seen on 17 March. Six were adults and one was a late juvenile that could fly well but that retained traces of the flecking characteristic of the juvenal plumage. Birds flew over the forest at the north end and along the southeastern shore.

Eniwetak - Fosberg (1966) reported that large numbers were present on 19 January 1952 and noted the presence of several young. White Terns were not numerous on 18 March 1988, when perhaps 20 flew about the upper story of the Pisonia forest. Others were found dead and alive entangled in the carpet of fruit beneath some of these trees. I saw no evidence of nesting but have no doubt that White Terns breed on Eniwetak and that some were breeding during our visit.

Meck - I saw no White Terns on Meck, and they probably occur there only as a casual visitor.

Loi - I estimated that 30 were present on Loi on 8 November 1964 (Amerson 1969). At that time birds were roosting in Pisonia and probably nested there.

Kwajalein - Kwajalein has a population of about 10 White Terns, all associated with trees north of the ball fields north through the residential sections to about the high school. One bird was seen on a nest 40 ft up a Casuarina, and several other terns acted as if they were mated pairs.

#### FORK-TAILED SWIFT (Apus pacificus)

Schipper (1985) found one to three of these birds on the southwestern end of Roi-Namur from 31 October to 7 November 1982. The only other reports from the tropical Pacific of this vagrant from

the western Palearctic are two fall sight records from Saipan in the Northern Marianas (T. K. Pratt in Pratt et al. 1987) and a specimen collected at sea in the northern Marshall Islands (Clapp 1989a).

#### SACRED KINGFISHER (Halcyon sancta)

One of these birds was seen irregularly from 5 April to 22 August 1981 on the chicken farm on western Roi Island (Schipper 1985, in litt.). A second bird was seen there 11 July. Both birds usually perched well within a Beach Heliotrope (Tournefortia argentea) tree. Sacred Kingfishers are common in the southwest Pacific and breed in Australia, New Zealand, and New Caledonia. They migrate north after breeding (Pratt et al. 1987). Schipper (1985) concluded that the birds on Roi-Namur were migrants that overshot their wintering range.

#### COMMON MYNA (Acridotheres tristis)

The Common Myna is an abundant resident in the main Hawaiian Islands and also has been introduced successfully to the Fiji, Cook, Society, and Marquesas islands (Pratt et al. 1987). They were briefly present on Kwajalein Island during the early 1950's. Marshall (1957) reported one on the main airport building 11 June 1950. At least several pairs were present from mid January to mid March 1952 (Fosberg 1966). About a half-dozen were seen eating papayas (Carica papaya) in July 1956 (Marshall 1957). Fosberg (1966) saw none in February 1956, however, and failed to find any during visits in 1958 and 1960.

#### HOUSE SPARROW (Passer domesticus)

A maximum of three House Sparrows was seen on Kwajalein Island during a survey in October and November 1964. Sparrows were seen flying in and around the fuel depot-docking and nursery areas, but no details were provided by Amerson (1969). The lack of details may have led Pratt et al. (1987) to suggest that these birds were misidentified Eurasian Tree Sparrows. I did not take part in the attempts to mist net the birds mentioned by Amerson, but I did see one female-plumaged bird and heard the distinctive call. I have no doubt that they were House Sparrows that soon died out.

#### EURASIAN TREE SPARROW (Passer montanus)

This introduced passerine is a common resident of Kwajalein Island that appears to be becoming gradually more abundant. The first observation of what was presumably this species occurred when Anderson (1981) reported 20 unidentified Passer on Kwajalein on 1 March 1977. Several birds were identified as Eurasian Tree Sparrows during October 1978 (K. Guthrie in Engbring and Owen 1981, Temme

1985). Schipper (1985, in litt.) recorded this species from the Pacific Bachelor's Quarters and the Pacific Ding Room (about a third of the way up the east side of the island) south to the nursery during visits from October 1979 to February 1983. He regarded them as particularly abundant near the Chapel and Richardson Theatre. The largest numbers of sparrows recorded by Schipper (in litt.) were 34 on 20 August 1980 and 40 on 24 October 1981 and 21 August 1982.

In March 1988 I found this sparrow locally common not only in the areas recorded by Schipper but also north to Sand's bachelor's quarters and south throughout the eastern portion of the island to the terminal and aircraft repair shop, in the area with buildings along the lagoon side of the island, and west to the northwestern end of the runway. Flocks of birds also frequently foraged on the raised area west of the runway and in grassy areas along the runway and in the golf course from the southwestern end of the runway to about two-thirds of the way from the runway's northeastern end. The only areas in which these birds were not seen were the northern portion of the residential area on the northeastern part of the island and at the eastern end of the runway.

The largest number of birds that I saw on any one day was about 50 on 2 March, but on that day I covered less than half the area the birds are known to inhabit. I can estimate the population with no great certainty; but incidental observations, made for the most part during shorebird surveys, suggest that the population cannot be less than 200 individuals and may be as high as 500.

These birds feed largely on weed seeds, judged from the frequency with which flocks were found in the grassy areas. Birds also came to the terminal to feed on pet food put out for the turnstones (Figure 48). Sparrows were present near stores but did not display the avid tendency to scavenge characteristic of the closely related House Sparrow. They were also much warier than that species and seldom allowed an approach as close as 15 ft. They were also drawn to air-conditioners, the condensation from which appears to be their primary source of fresh water.



Figure 48. Eurasian Tree Sparrows feeding on pet food, Kwajalein, 29 March 1988.

I found no nests, but observed two birds copulating near warehouses at the runway's western end. The preference of these birds for both open sheds and for coconut palms leads me to believe that these may be breeding sites. The palms seem particularly attractive to the sparrows as they were frequently seen spiraling upwards 60 ft or more to reach the fronds.

The source of these birds is unknown, but the species was known from the tropical Pacific only from the Mariana Islands prior to its occurrence on Kwajalein (Pratt et al. 1987). They may have arrived at Kwajalein on a flight from Guam where these birds are common around the terminal.

#### Other vertebrates

Despite carefully surveying the shores of the eight outer islands, I found no evidence of previous nesting by Green Turtles (Chelonia japonica). A Green Turtle with a 15 inch carapace that was captured offshore Gagan Island was the only turtle seen during this survey, but I was told by Schipper that two Hawksbill Turtles (Eretmochelys imbricata) with carapaces about 18 inches long were currently being seen off the old Jackaroo Club building on Roi-Namur.

He also stated that both species were formerly much more abundant off Roi-Namur. In 1978 as many as nine Green and Hawksbill turtles could be seen at once. Populations are said to have been depleted by an increase in the rate of capture for barbecue parties. Breeding by the Green Turtle has been alleged but no substantive information is available. Of the islands visited Ennylabagen had what I regarded as the best nesting beaches, but the numbers of inhabitants and burgeoning populations of introduced animals make it very unlikely that any breed there now.

The only reptile previously reported to occur at Kwajalein is the House Gecko, Hemidactylus frenatus (Crombie, ms.); but at least several other species of lizard occur there. I noted lizards only on Ennylabagen, Illeginni, and Gegan Islands; but Herbst reported seeing a small lizard on Eniwetak Island, and Fosberg (field notes) saw them there in 1952. I found old gecko eggs in trees on Meck and Kwajalein. I am not sure what species they represented, but they looked much like those of the Mourning Gecko (Lepidodactylus lugubris), that I have seen elsewhere in the Pacific and that is likely to occur on Kwajalein.

Most of the lizards seen appeared to be Azure-tailed Skinks (Emoia cyanura), but a large Green Tree Skink (Lamprolepis smaragdina) was seen in a tree along the southeast shore of Ennylabagen. Schipper (pers. comm.) informed me that a few of these lizards also occur on the northeastern portion of Kwajalein Island, but I found none there during my visit.

Small lizards were most abundant on Ennylabagen where they were moderately abundant in palm fronds on the forest floor. I only saw

one or two lizards along the eastern shore of Illeginni and on the forest floor of southern Gagan.

I saw Polynesian Rats (Rattus exulans) only on Illeginni (one near the helipad) and on Namur (several in forested areas), but I have no doubt that they are more widespread. Rats of one species or another have also been seen on Eniwetak (Fosberg, field notes) and it seems likely that the Norway Rat (R. norvegicus) or the Black Rat (R. rattus) occurs on more developed islands such as Kwajalein, Meck, and Illeginni.

Introduced domestic animals inhabit several islands, with cats especially numerous on Roi. Cats and dogs are common on Roi-Namur, Kwajalein, and Ennylabagen. A cat was seen near the security trailer on Gagan, and a pair was present on Illeginni. I was informed that litters of the latter are destroyed to reduce the probability of establishing a feral population. Ennylabagen also has numerous chickens and pigs; as many as 10 of the latter were seen at once.

#### Discussion

Previous environmental disturbance of most islands visited was so extreme that I believe breeding populations of seabirds are no more than a small fraction of their former numbers. Loss of nesting habitat for indigenous terns and boobies on Kwajalein, Roi-Namur, Ennylabagen, and Meck islands has resulted from clearing for buildings, runways, helipads, antennae fields, and other structures and has surely much reduced bird populations. Shorebird populations, on the other hand, may have benefited from the increased area available for foraging and resting.

During the March survey, I found evidence of human predation on seabirds on two occasions. A pair of Black Noddy primaries was found tied together by their tips near the security trailer on Omelek, and several pairs of White Tern primaries were found in similar condition near the open shed on western Legan. The effect of such depredations is probably minimized by the presence of security personnel on the various islands.

Two islands are of particular importance to breeding bird populations on Kwajalein and would best be left undisturbed. Legan, with its central lake unique among the islands visited, provides a valuable resource for shorebirds; and the vigorous Pisonia forest at the island's northern end has most of the nesting White Terns found on the March survey. Legan also has a small Black Noddy population and the largest nesting Brown Noddy population of any island visited. Eniwetak Island has the largest and best developed Pisonia forest, and its large Black Noddy colony dwarfs those elsewhere. Eniwetak has been an important nesting area for these noddies for over 30 years and may be the primary breeding area on the entire atoll.

The Black Noddy colony on Gellinam is also worth preserving. Illeginni, despite considerable environmental manipulation, has shorebird and tern nesting habitat worth preserving.

Even though Ennylabagen has more remaining forest than any island but Legan and Eniwetak, tern populations there are far less than I would have expected from the amount of habitat available. Presumably, native populations and burgeoning populations of introduced animals have already much reduced bird populations.

The other islands visited -- Omelek, Meck, Kwajalein, Roi-Namur, and Gagan -- have so little remaining habitat of value to resident seabirds that further development will have no significant effect.

#### Summary

Fifty-four species of birds are now known from Kwajalein Atoll, This is due largely to intensive observations by William L. Schipper during the 1980's. This is the largest faunal list for any of the oceanic atolls in the central Pacific except for Laysan Island, in the Northwestern Hawaiian Islands. Most of the avifauna (42 species) consists of vagrants, migrants and transients. A small resident component includes eight native seabirds, one heron, and an introduced sparrow. Two other introduced passerines no longer occur.

Native bird populations on Kwajalein have probably been much reduced as a result of habitat modification, but this change has apparently allowed a substantial increase in wintering shorebird populations. Of the islands examined during the March survey, only four -- Gellinam, Illeginni, Legan, and Enewetak -- possess substantial nesting seabird populations.

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Appendix Table 1. Bird populations on islands of Kwajalein Atoll in March 1988.

Species/Island:	1										
	ENN	LEG	ILL	R-N	GAG	GEL	OME	ENI	MEC	KWA	Totals
Red-tailed Tropicbird	-	-	-	-	-	-	1	-	-	-	1
Red-footed Booby	-	-	-	1	-	-	-	-	-	-	1
Great Frigatebird	1	2	-	2	-	-	-	2	-	1	8
Pacific Reef Heron	5	4	6	4	2	-	1	-	-	3	24
Lesser Golden Plover	100	20	25	230	5	4	1	3	60	270	718
Wandering Tattler	20	10	10	30	1	1	2	1	1	25	101
Gray-tailed Tattler	-	-	1	-	-	-	-	-	-	-	1
Whimbrel	10	-	4	15	1	-	1	-	7	8	46
Bristle-thighed Curlew	-	2	1	-	-	-	-	-	-	1	4
Hudsonian Godwit	-	-	-	-	-	-	-	-	-	1	1
Bar-tailed Godwit	-	-	-	-	-	-	-	-	1	1	2
Ruddy Turnstone	75	25	20	400	2	9	10	-	20	450	1011
Sharp-tailed Sandpiper	-	-	-	-	-	-	-	-	-	-	13
Curlew Sandpiper	-	-	-	-	-	-	-	-	-	1	1
Shorebird subtotals	205	57	61	675	9	14	14	4	89	770	1898
Great Crested Tern	1	5	6	4	18	1	-	5	3	1	43
Black-naped Tern	6	3	30	2	10	15	6	2	12	5	91
Brown Noddy	5	80	30	1	-	-	1	15	-	-	132
Black Noddy	15	30	100	5	3	500	15	2000	5	5	2678
White Tern	20	75	10	8	6	4	7	20	-	10	160
Eurasian Tree Sparrow	-	-	-	-	-	-	-	-	-	200	200
Totals	257	256	243	702	48	534	45	2048	109	995	5237
Island:	2										
Birds/acre	2.07	14.22	7.84	1.76	8.00	106.80	5.62	136.53	1.98	1.32	
Shore-birds/acre	1.65	3.17	1.97	1.70	1.50	2.80	1.75	0.22	1.62	1.03	
Terns/acre	.37	10.72	5.68	.03	6.17	104.20	3.62	136.44	0.54	.03	

1) Estimates are maxima. ENN: Ennylabagen, LEG: Legan, ILL: Illeginni, R-N: Roi-Namur, GAG: Gagen, GEL: Gellinam, OME: Omelek, ENI: Eniwetak, MEC: Meck, KWA: Kwajalein.

2) These figures are not rigorous density estimates, but hopefully will provide a rough index of the relative wildlife values of each island. Figures for terns and shorebirds suggest varying values as wintering grounds for migrants and as nesting areas for seabirds, respectively.

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Appendix Table 2. Number of days on which William Schipper listed observations on Roi-Namur\*.

<u>Year:</u>	<u>Month</u>												<u>TOTAL</u>
	<u>JAN</u>	<u>FEB</u>	<u>MAR</u>	<u>APR</u>	<u>MAY</u>	<u>JUN</u>	<u>JUL</u>	<u>AUG</u>	<u>SEP</u>	<u>OCT</u>	<u>NOV</u>	<u>DEC</u>	
1979										10	2	7	19
1980	15	11	11	7	14	7	15	5	7	14	10	-	116
1981	2	-	4	6	7	8	15	6	-	11	13	2	74
1982	5	8	4	2	4	1	-	4	11	16	9	3	67
1983	6	11	19	6									42
1987	-	2	7	17	18	17	15	9	12	-	18	10	125
1988	7	7	24	10	23	28	27	27	26	21	11		211
Totals	35	39	69	48	66	61	72	51	56	72	63	22	654

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\*Data sheets for September 1981 and July 1982 are unavailable. Schipper was in Australia in October 1987.

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Appendix Table 3. Approximate times that shorebirds were censused on different parts of Kwajalein Island.

<u>Area/Date</u>	Times of observation on March: <sup>1</sup>							
	<u>17</u>	<u>20</u>	<u>23</u>	<u>24</u>	<u>25</u>	<u>28</u>	<u>28</u>	<u>29</u>
Golf course (2)			1710	1712	1748	0822	1615	0930
Runway margin (3)			1710	1712	1748	0822	1615	0930
Stop sign to Mt. Olympus (4)		0920	1740	1735	1730	0810	1555	0915
Plateau (5)	0910					0755	1548	0905
Battle memorial field (6)	1740	0900	1750	1745	1720	1740	1540	0855
Fields N of Mt. Olympus (7)	1740	0900	1750	1745	1720	1740	1540	0855
"Dump road" field (8)	1730	0850	1755	1750	1715	0735	1540	0850
N to Coral Sands (9)			1800	1755	1710	0730	1535	0845
Coral sands to helipad (10)	1715		1810	1805	1700	0725	1530	0840
"O" field (11)	1715		1815	1815	1650	0725	1530	0840
Helipad field (13)			1820	1825	1645	0720	1525	0835
Helipad to aircraft shop (14)			1825	1830	1640	0715	1520	0825

1) For larger areas censused over longer periods of time (20 minutes or more for the golf course) the midpoint of the observation time is given.

(2) Grassy area along the south side of the runway.

(3) Area south of the runway from its eastern to western ends.

(4) Both sides of the road from the easternmost stop sign at the west end of the runway to the access road to the western corner of the northwestern extension of the runway and to the base of the elevated area southwest of this extension.

(5) The elevated area beyond the west end of the runway and southwest of the northwestern extension of the runway.

(6) East of Olympus Drive and west of the northwest runway extension to a point where a road runs south to warehouses on the northeastern edge of the runway extension.

(7) Includes the area west of the road from the point where Zeus Boulevard turns sharply north to become Olympus Drive to the point where a wide dirt road runs northeast.

(8) Includes the eastern portion of the grassy area north of the wide dirt road and northwest of Olympus Drive to the point where this drive joins with Lagoon Road.

(9) Both sides of the road from the end of the previous area to the point where a dirt road turns north to the Coral Sands beach pavillion.

(10) Both sides of the road from the Coral Sands turnoff to the entrance to the helipad but excluding areas in footnotes 11 and 13 below.

(11) The area north of the road and outside the Zar Transmitter shielding fence from a point southwest of Camp Hamilton and bounded on the southeast by the road to administrative building 1012.

(12) Grassy area across the road and northwest of the helipad bounded by the road mentioned in 11 and by water storage facilities to the northeast.

(13) Only very limited habitat occurs on both sides of the road in this strongly developed area. All shorebirds seen were in the road or near its edges.