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Preliminary Report on Land Animals at Onotoa Atoll, Gilbert Islands

by

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PRELIMINARY REPORT ON LAND ANIMALS AT ONOTOA ATOLL, GILBERT ISLANDS

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PRELIMINARY REPORT ON LAND ANIMALS AT ONOTOA ATOLL, GILBERT ISLANDS

This represents the first two parts of the preliminary report on the work of the General Naturalist on the Pacific Science Board's 1951 Expedition to Onotoa in the Gilbert Islands. The project was supported by funds granted to the National Academy of Sciences by Contract N7onr-291(04), NR 388-001 with the the Office of Naval Research. The generous cooperation of the U. S. Navy Department, the U. S. Coast Guard, and the Military Air Transport Service is acknowledged.

The author is grateful for the aid and assistance given by Mr. Harold J. Coolidge, Mrs. Lenore Smith and Miss Ernestine Akers. The cooperation and kindness of the British Colonial Government and its local representative, Mr. Richard Turpin and his wife added much to our comfort and success. The advice and assistance of my associates was a constant source of help and encouragement.

Part I. Land Vertebrates of Onotoa Atoll, Gilbert Islands

As general naturalist of the 1951 Pacific Science Board's expedition to Onotoa in the Gilbert Islands it was my duty to collect information about and specimens of all the land animals and plants on the island and to study the ecology of the fresh water and marine algae. In order to treat this material in a systematic manner I have divided my report into four sections. The first of these is the report on the land vertebrates collected and observed on the atoll of Onotoa from June 24 to August 30, 1951.

Due to my hurried preparation, I had very little time to search the literature for known facts about the flora and fauna of the Gilberts. Thus upon my return, I found that some information and specimens that should have been gathered were overlooked. Since very little has been published on the biota of this island group, the information and specimens gathered are of value in extending our knowledge of the distributional patterns of this life in the South Pacific.

In the following accounts of the individual species of vertebrates, I have included all the facts and observations recorded in my field notes. Because of my many other responsibilities, these accounts in many cases are correspondingly brief; most of the information was gathered "on the run."

The birds were identified by the author. Credit for other determinations are given with each group. The native names were supplied by Baru, our cook, and verified in most cases by James Redfern, our interpreter.

The author wishes to thank Dr. David H. Johnson of the United States National Museum staff for traps and other equipment used in collecting the rats; Dr. Joseph P. E. Morrison, also of the Museum staff, for providing the

fire-arms and ammunition for the collection of birds and for his excellent advice and encouragement while making preparations for the trip; and Dr. Waldo Schmitt, who has been extremely helpful on several of my visits to the museum and has assisted in securing the taxonomic information. The cooperation and kindness of the people of Onotoa in securing specimens is appreciated and acknowledged. Last and most important, due recognition should be given to the Office of Naval Research for making the expedition possible and for providing the opportunity to secure valuable basic scientific information on atolls and their ecology. All specimens have been deposited in the U. S. National Museum with provisions made for duplicates to be sent to the Bernice P. Bishop Museum in Honolulu.

MAMMALS

Rattus exulans exulans (Peale), Rat, "te gemoi."

Identification of this native rat was made by Dr. David H. Johnson of the United States National Museum. Four adults, three males and one female, and three young in various stages of growth were collected. The fact that these immature specimens were taken at intervals spanning our stay on the island is evidence that these animals bred from June through August. The specimens taken have been placed in the U. S. National Museum collection as numbers 294547 to 294553.

These rodents are not numerous and we hear no complaints from the natives about them. The number of cats, dogs and pigs around the village certainly keep these animals from becoming pests. I believe also that the construction of the native houses, with floors about two feet from the ground, the extreme cleanliness and order around the house sites, with no accumulation of rubbish, is also a factor in the control of these animals.

The first week of our stay on the island, pits were dug for garbage and latrines. These pits trapped great numbers of hermit crabs and a few rats. Spring traps placed in the kitchen caught several specimens, but on several occasions the activity of some local cat or dog left me only the tail.

At night there was a great amount of rustling noise in the dead leaves of the Scaevola thickets, which at first I attributed to rats, but most of which was later found to be caused by the nocturnal activity of the hermit crabs. Only a few times did I actually see these rodents running from thicket to thicket or scurrying under the rubbish in the thickets. When the camp was dismantled at the end of our stay, there was evidence of several nests under the packing cases in the supply tent. We suffered little damage to our supplies from these rodents. I feel certain from all the evidence I could find that the rat is not abundant enough on Onotoa to be a pest nor is it destructive to food.

Dogs.

The dogs are nondescript, short-haired and medium sized. They are very numerous around the villages and during the heat of the day were found sleeping or resting on loose sand in shady spots along the village street. They

rarely paid much attention to the "foreigners." Most of their food seemed to consist of scraps from the family table. Several nights I was awakened by noise from the kitchen and on investigating I found dogs foraging in the garbage can which had not been emptied.

Cats.

These animals were common in the villages. At the village of Aiaki our slumber was disturbed by the horrible crying made by cats congregating in the Maneaba, the community house, where visitors are housed and entertained.

Pigs.

Pigs were not common, but in each village there were a few stockades built of logs to confine one or two. These stockades were usually placed on the opposite side of the road away from the houses and the lagoon shore. An ordinance of the Magistrate made it necessary for pigs to be either confined in pens or tied to stakes to prevent their wandering about. On one of the field trips on the island of Tabuarorae, I saw one large specimen wandering about, rooting in the rubbish, dragging a long rope behind it which it had obviously broken.

We were told that pigs are used for food only on special feast days, when they are roasted in pits lined with pre-heated stones. I am sure the muck in the pig pens is one of the places where the common house fly breeds.

BIRDS

Fifteen species of birds were observed on Onotoa Atoll during our stay there. As one would expect of an oceanic coral island, these species were mainly oceanic birds or migratory shore birds. Only one species of land bird, other than the domestic chicken, was observed and this was a migratory species. The nomenclature is based on Baker (1951)*.

Phaethon rubicauda rothschildi (Mathews), Red Tailed Tropic Bird.

Only one specimen of this bird was seen. It was observed flying low over the camp area on August 10. The trailing red tail feathers and the rosy coloration on breast feathers were quite evident.

Fregata ariel ariel (Gray), Least Man-O-War Bird.

These birds were observed soaring only at rare intervals, and were usually seen at times of high wind velocities and overcast skies. The white patches on the ventral flanks of the males were visible. The fork of the tail was rarely visible, since it was held closed, it formed a straight line with the body. As many as five birds were seen at one time. They are reported to nest in the large Pisonia trees at the extreme south end of the atoll on Tabuarorae Island. During our stay none were observed on this island.

*Baker, R. H., 1951, Avifauna of Micronesia, its origin, evolution and distribution. U. of Kan. Pub. Mus. of Nat. Hist. 3:1-359.

Demigretta sacra sacra (Gmelin), Reef Heron, "te kai."

A fairly common bird seen the whole length of the Atoll. White, blue and variegated individuals were present in the ratio of 3 to 2 to 1. A careful check on peculiarly marked, variegated individuals indicated that these birds are restricted to certain distinct territories along the reef and shore. Most of the birds fed at low tide along the seaward reefs and on the exposed reef flats between the various islands of the atoll. At high tide occasional individuals were observed foraging along the beach. They often capture food by standing motionless in the pools that remain on the dry reef at low tide. They wait for the organisms in these pools to move, then they capture the animal with a rapid jab of the beak. This species was less frequently seen on the lagoon side of the islands. On a number of occasions they were flushed from babai (taro) pits or the area surrounding these pits. They were also seen perched in coconut trees preening their feathers. On Aonteuma, the uninhabited northernmost island of the atoll, a structure resembling a nest was observed in a coconut palm. My attention was attracted to it by the circling and calling of a white specimen of this species. As long as I remained under the tree it continued circling and perching, uttering a loud gutteral call. The nest was placed in a coconut tree on the petioles of several leaves and was built of dead flower stalks of the coconut.

Two specimens were collected, #207, a blue individual, and #254, a white phase. This last bird was feeding along the beach at high tide and had fragments of crustacea in its stomach.

Gallus gallus (Linnaeus), Jungle fowl, "te moa."

I have used this name for the half wild, semi-domestic chicken observed around the villages. The adult males have the typical plumage of the Jungle Fowl, but the hens show a mixture of domestic strains. All are small and lay small eggs. Many of the hens were followed by flocks of chicks in various stages of growth.

The natives apparently do not eat the eggs and inquiry revealed they rarely use the mature birds for food. Both eggs and chickens were offered to us for our use. A whole roasted chicken was served to us on one occasion at a native feast. The feathers are utilized in decorating fans woven from pandanus.

Pluvialis dominica fulva (Gmelin), Pacific Golden Plover; "te kun."

A few birds of this species were observed feeding on the reef at low tide on July 12th. The number of these birds increased during August until small flocks were seen all along the seaward reef and on the lagoon shore. This was the only species of shore bird regularly flushed from sand and grass areas between the scattered coconut trees inside the beach rampart. A male was shot on the seaward reef on August 19 (#275).

Numenius phaeopus variegatus (Scopoli), Whimbrel.

These birds were exceedingly wary and none were collected. A few birds were noticed in late July, but the number increased in August. Individuals

were usually seen on the exposed reef flats at the south end of the northern Island. Abenekeneke, a small uninhabited island between the large North and South Islands, was the favorite gathering place for a small flock which was frequently encountered resting under the palms on the seaward side. This species was identified by the black line through the eye and the white back and rump, and barred tail.

Heteroscelus incanus (Gmelin), American Wandering Tattler, "te kiriri."

This was the noisiest of the shore birds and was always present on the reef and lagoon shore, becoming very common in late August. It was characterized by quick movements and frequent teetering of the body, particularly as it alighted. An immature specimen was collected on August 18 on the reef flat at the south end of the North Island (#277).

Arenaria interpres interpres (Linnaeus), Ruddy Turnstone, "te kitiba."

These shore birds were present on the island when we arrived in June. They associated with the Plovers and Tattlers, and flew with them, but fed in separate flocks. In June there were only three or four birds in a group. Late in August the size of the flocks had increased to 8 or 10 birds and every section of the reef seemed to have its own flock. They fed in close formation along the beach, turning over shells, algae, leaves and drift. At low tide they fed on the drying seaward reef. The Tattlers and Plovers were frequently seen on the lagoon shore, but the Turnstones preferred the rocky shore and reef of the seaward side of the atoll, also utilizing the cobble and shingle reef flats between the larger islands. One specimen was taken on the seaward reef, August 18 (#274).

Sterna sumatrana sumatrana Raffles, Black Naped Tern, "te ngutu."

Two colonies of these terns were found on each of the two small islands, Abanekeneke and Nanntabuariki. They seemed to prefer resting on the coarse coral gravel ramparts on the seaward side of these two islands. This species was observed habitually fishing in the shallow water at the northern end of the lagoon. Birds were seen returning to the colonies near the central part of the atoll, carrying fish crosswise in their beaks. When the Long Tailed New Zealand Cuckoo was flushed from shrubbery on Nanntabuariki, a group of these terns attacked and chased the Cuckoo into another thicket, in much the same manner that I have observed terns attacking gulls in eastern Massachusetts. One specimen, #262, was brought in by a native. The bird had a heavy deposit of orange colored fat between the skin and muscle layer.

Sterna fuscata oahuensis Bloxham, Sooty Tern.

The only specimen seen of this species was dead. It was washed up on the seaward beach on August 14, 1951. No living individuals were seen on the atoll.

Thalasseus bergii pelecanoides (King), Crested Tern; "te kabiniwa."

Only two individuals of this species were seen, both on August 19 on the seaward reef. Both birds were resting on large coral boulders facing the reef front. One bird, a male (#276), was collected. The second individual was an immature bird and flew out to sea when disturbed.

Anous stolidus pileatus (Scopoli), Common Noddy Tern; "te nan."

One specimen was collected (#49). This was the commonest bird of the Atoll. Colonies were scattered the whole length of the central area of the large North Island. They were present in large numbers on the two larger southern islands of Aiaki and Tabuarorae. During the middle of the day many birds were observed perched in palm and pandanus, resting and preening, but there always seemed to be some restless individuals moving out to sea and back again. The greatest movement of birds occurred in the early morning and late afternoon, when great numbers constantly moved back and forth between the roosting area and the sea, the reef or the lagoon.

This species and the smaller species of Noddy were frequently seen feeding on an ebbing tide, particularly if the sea beyond the coralline ridge was rough. On these occasions the birds could be observed up and down the shore as far as the eye could see. They hovered low over the reef, darting about, dropping to pick their food from the surface of the water or just below the surface, not diving and submerging like our common Atlantic Tern. Most dives were successful and they came up with small fish in their beaks. They could change the position of the fish in their bills as they flew away. Sometimes they would drop it and catch it in mid air. Other individuals would stand near tide pools and wait for a blennie or other small fish to move into the open water. On July 18 the birds were quite active over the reef in a rain storm. Occasionally they would drop, shaking the water from their wing and tail feathers and then recovering, gain altitude.

The period of our stay on the Atoll covered a long nesting season. The nests were placed in the tops of pandanus trees in the whorl of leaves. Young birds were numerous and advertised their presence by a constant squeaking sound somewhat reminiscent of the young of pigeons. One young bird was seen begging and squeaking about an adult and it was fed after grabbing the bill of the adult. Adults collected fragments of palm and pandanus leaves from the ground in the clear areas between palm groves during the whole period of our stay on the atoll. They appeared very awkward as they walked about looking for satisfactory nesting material. Some dived successfully for fragments of leaves floating in the surf as it washed up on the inner beach.

The raucous call notes of these terns, plus those of the smaller species, were never absent, day or night. The noise seemed greater at night, and moon or no moon they were constantly moving about at all hours,

Anous tenuirostris marcusi (Bryan), White-capped Noddy. Also called "te nan."

There were not as common as the larger species, and were easily recognized by the smaller size, blacker plumage and more rapid wing beat. They were seen more frequently fishing over the lagoon than on the seaward side. Otherwise their habits were very similar to those of the larger species.

The first nests definitely belonging to this species were found on Tabuarorae on July 26 in a grove of Pisonia trees. The nests were small for the size of the birds and straddled the larger horizontal branches of the trees about 30 feet from the ground. At least 20 nests were observed there. Where a nest was occupied the bird's beak was visible over one edge and the tail over the other. The area under the trees had a strong ammonia odor and droppings were visible. These trees are also reputed to be the roosting place for the Man-of-War birds. On August 27, another nesting colony of

small Noddies was found, near the center of the North Island, adjacent to the Government Reservation. Here the nests were straddling the petioles of the coconut leaves. There were six to eight nests in a single tree with a maximum of 3 nests on a single petiole. The nests appeared to be much the same as those seen in the Pisonia trees. Birds were on some nests or standing beside them.

Gygis alba, White or Fairy Tern.

This was not a common bird, but occurred widely scattered throughout the atoll, even on the small islets such as Nanntabuariki. We were asked by the Colonial Government to protect this species. The birds moved about in pairs, perched on pandanus or coconut trees, and were most numerous in the central part of the islands. As I approached a pair, they greeted me with loud raucous cries and flew low over my head. No eggs were seen, but a young bird with plumage still tipped with down was brought in by native boys. This is #56 of the collection sent to the U. S. National Museum.

These birds were observed flying in pairs and generally much higher in the air than the other terns.

Eudynamis taitensis (Sparrman), Long-tailed New Zealand Cuckoo.

This bird was seen only on August 22 on the small islet, Nanntabuariki, just north of the large South Island. This islet is covered chiefly with coral gravel. The Scaevola and Guettarda trees are low and scrubby and scattered singly or in small thickets. I flushed this long tailed bird from the base of a Guettarda tree. As it flew away it was attacked by a group of Black Naped Terns who kept diving at it. The Cuckoo paid no attention to the attacking force and flew to the southern tip of the islet and dodged into a thicket. I was successful in finding the bird twice after that. Each time it flew low and swiftly to the opposite end of the island and hid in a thicket. On each flight it was chased by the terns. The bird remained silent. I did not locate the bird on a return trip. This species migrates into this area during the winter of the southern hemisphere.

REPTILES

Lizards and Geckos were common on all the islands of the atoll. Specimens of the species present were collected and have been deposited in the U. S. National Museum in Washington. Dr. Doris Cochran has kindly supplied me with the specific names.

Lepidodactylus lugubris (Dumeril and Bibron), Gecko, "te beru."

This gecko was nocturnal in its habits and was rarely seen during the day. Specimens were found in rotting palm logs in the daytime. They frequently became active in the late afternoon. Once I watched one of these animals on a palm frond, at eye level. The frond was waving gently in the wind and occasionally came close to the frond below it. The Gecko crawled out near the tip of a leaflet and as this leaflet came close to the frond below, the animal jumped to it and then hurried to the mid-rib and out of sight at the base of the leaf.

At dinner time or later in the evening these geckos were seen crawling up the screening on the mess shack, taking advantage of the few insects attracted by the lights. They also crept over the walls of the Residency at night, searching for insects. I assume they were also to be found in the native houses.

On several night collecting trips to Scaevola and Guettarda thickets for insects, I found this Gecko in almost every flower cluster waiting for the night flying insects. On one occasion a Gecko rose on his short legs and stretched out toward a visiting crane-fly, catching it so rapidly that only the subsequent settling back and the "apparent serious business" of swallowing indicated that the prey had been caught. The number of Geckos present at night in a single Scaevola shrub was amazing, considering the apparent scarcity of night-flying insects.

The large Hunstmans spider (Heteropodidae) is one of their natural enemies. A Gecko was caught on the vertical wall of the wash house by one of these spiders and completely covered with silk. When first found the Gecko was still struggling, but became quiet in a very short time. The spider remained with its catch for about a day and a half.

Gehyra oceanica (Lesson), Big tree Gecko

This is the largest lizard on the atoll and one brought in by native boys was about 6 inches long. This specimen was dark brown above and bright yellow on the ventral side except where rough handling had apparently torn off some of the skin.

Only two specimens were secured. I do not know if the animals were rare or overlooked since this species is an inhabitant of trees. Both specimens were brought in by boys.

Emoia cyanurum (Lesson), Skink; "te tikunei."

This was the commonest reptile on the atoll. They were found everywhere, in Scaevola thickets, piles of rubbish, and the litter of the coconut groves. The sparse vegetation of the beach rampart and the smaller islets were favorite places for great numbers of these Skinks. These lizards are very agile and move with a rapid, jerky run. One of the constant sounds heard as you walked over the islands was that made by their scurrying over and through the rubbish to avoid capture or hunting for food. This is a ground inhabiting species but occasionally I saw them dart up the trunk of a coconut or other tree and slip off before they were more than 2 or 3 feet above the soil surface. When alive, their color was bronzy-brown with two longitudinal dorsal stripes, yellow-brown or tan in color. Fifteen specimens were collected.

Part II. Land Invertebrates and Animal Ecology of Onotoa Atoll, Gilbert Islands.

The majority of the Invertebrates collected on Onotoa Atoll belonged to the phylum Arthropoda, principally the class Insecta. Since Onotoa is situated two degrees south of the equator, out of the trade wind belt, rain is not a regular daily occurrence. It is considered a "dry" atoll. The scattered vegetation on the soil surface and areas where the coconut and bread fruit trees are dead, attest to the drought conditions that prevail at intervals.

In contrast to the land Arthropods collected on Arno in the Marshall Islands, where an estimated 500 species were found*, Onotoa at present can boast of no more than approximately 80 species. This number is in agreement with the 96 species reported for Canton Island, another dry island.

In the first part of this paper the invertebrates are reported in their taxonomic groupings. Under the heading of animal ecology, are shown the ecological relationships observed during the short time on the island. Lists of associated species are given at the end grouped under two headings: Habitats and Individual Plants.

PROTOZOA

Protozoans belonging to the genera Paramecium, Frontonia and Difflugia have been recovered in algal material collected in the fresh waters of the babai pits and in the slightly brackish water of pools at the north end of the North Island.

ROTIFERA

In the algal material mentioned above rotifers of two genera were found. One belonging to the order Bdelloidea and the other probably belonging to the genus Monostyla.

NEMATODA

Numbers of Nematode worms were also preserved in algal material taken from babai pits and brackish pools.

MOLLUSCA

The layer of humus and sand under the thickets and under stands of coconut, Pandanus and Messerschmidia trees was sifted for land Gastropods. The large fragments of litter consisting of leaves, old coconut shells and Pandanus seed pods were scraped away and the finer material below was sifted t through a series of nested screens. The material of medium size retained in the screen was bagged and sent to the United States National Museum. The

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*Usinger and LaRivers. Insect Life of Arno. Atoll Research Bulletin 15. April 30, 1953.

following species of snails have been tentatively identified from these soil samples by Dr. Joseph P. E. Morrison:

Opeas gracilis junceus (Gould)

Lamellidea peponum (Gould)

Gastrocopta pedicula (Shuttleworth)

Gastrocopta pedicula nacca (Gould)?

Gastrocopta lyonsiana (Ancey)

One fresh water snail, Melanoides cf naiufouana Mousson was found in a mass of green algae, Rhizoclonium hieroglyphicum Kuetz., collected in a well on the North Island. Dr. Morrison has expressed the belief that this snail was carried with water supplies to Onotoa from some other island. According to his personal communication, this snail closely resembles the large population living on Niaofcu Island.

ARTHROPODA

Crustacea

The coconut crab, a large species adapted to life on land, was brought to us on two occasions. Individuals of this species are rare on the island, probably because the natives utilize them for food. Those brought to us had been captured on the extreme northern end of the atoll.

Hermit crabs, "te makuro", were common and active at night, when their presence was conspicuously evident from the noisy rustling of litter as they moved about in great numbers. These crabs were most frequently found living in turbo shells.

Sow bugs were fairly common throughout the atoll and were collected in rotting logs, under coconut husks, and in the thick humus under old Messerschmidia trees. These animals were most abundant on the area of silty loam soil where a caliche-like hardpan is formed.

A large species of Ostracod was fairly common on algae taken from the babai pits.

Chilopoda

One species of centipede was collected from rotten palm logs and under coconut husks in the area of silty loam soil (caliche). Centipedes constituted a part of a community which included sow bugs and Collembola.

Arachnida

Spiders, called "te nareau" by the natives, were the most abundant terrestrial Arachnids on the island. A large black and yellow species of orb weaver

was ubiquitous; its webs stretched between branches of low shrubs or across the paths in Scaevola, Guettarda and Pandanus thickets. Most of the webs examined were empty, but the great numbers of spiders present suggested that food was probably abundant. One web had the remains of a dragon fly and a moth in it. A smaller, rarer species of orb weaver was also found.

Large crab spiders (Huntsman spider) provisionally identified as belonging to the family Heteropodidae (Sparassidae) occurred quite commonly. They were frequently seen around Pandanus and retreated noisily into the funnel formed by the leaf bases. A specimen was observed feeding on a small gecko on the thatched wall of the shower room. The gecko was completely covered with silk and the spider spent the better part of two days feeding. The longest legs (second pair) on the largest specimen captured had a length of two and one half inches.

Other species of spiders, including a "jumping spider", were collected by sweeping the sparse vegetation, in packing cases, in the litter under trees and on the leaves of trees.

A species of scorpion, Hormurus, was collected in the Residency building in boxes of food and clothing. These were not considered common, for had they been, certainly more specimens would have been brought in by the natives.

Gorged ticks were found on native dogs and were collected from the region back of the ears and around the head.

Insecta

The abundance and variety of insect life usually evident to an entomologist was lacking on this dry atoll. The house fly, one species of dragon fly, and three species of Lepidoptera (two butterflies and one moth) were common. Other insects were generally uncommon and it was necessary to search for them. The clouds of insects so typical of any grass field in eastern United States were never seen.

Odonata and Lepidoptera were collected with an insect net. Diptera, Hymenoptera and some Lepidoptera could be taken from the blossoms of Scaevola and Guettarda. Sweeping the isolated culms of grass produced Cicadellidae, Lygaeidae and a few other small forms belonging to the orders Homoptera, Hemiptera and Diptera. Similarly small spiders were collected. Beating the foliage of trees and shrubs was not very productive although some Diptera and the long horned grasshopper were taken in this manner. Searching under the litter in the coconut groves produced a few sow bugs, centipedes and Collembola. The cocoons of the large ant Odontomachus haematoda (L.) and some adults were found in the same type of habitat. No animals were obtained by means of the Berlese technique.

Fungus beetles and ants were collected in large decaying fungi on dead coconut trees. Termites were found once in an old Pandanus log on the beach rampart. Nymphs of Odonata were found in the water of the babai pits, retting pools and the brackish pools on the north end of the North Island. Dolichopod flies were caught frequently on the leaves of many plants.

Several species of Coleoptera, including the species of Oedemeridae (blister beetle), were taken near lights at night. These, and a lace-wing fly, crane flies and some Noctuid moths were the principal insects so attracted. The absence of large swarms of insects usually found around lights in the temperate zone also indicated a small insect population on the atoll.

The Arachnids, sow bugs, centipedes and insects which were collected on the expedition have been turned over to Dr. J. L. Gressitt of the Bishop Museum for identification and final distribution. All identifications given in this paper are tentative and many were supplied by Dr. Gressitt.

Collembola

Large rafts or colonies of these insects were discovered by Dr. A. H. Banner at low tide in a hollow of an intertidal rock in the lagoon where the tidal amplitude averages two feet. This rocky outcrop is located 300 feet from shore.

A large species of this Order was collected under dead coconut husks in the area of the caliche. Collembolans, sow bugs and centipedes formed an association under this type of litter on the atoll.

Thysanura

Several specimens of Thysanura were taken in a moist area under the bark of a rotting stump of *Messerschmidia*.

Orthoptera

Cockroaches, "te babatuannanu", were the most common species of this order. The species *Cutilia soror* (Brunner) were present in abundance under the rubbish that covered the camp site and were exposed as the site was cleared. Individuals continued to appear in luggage and stores throughout the summer, although the majority of them moved away when the area was disturbed. This species is common from Hawaii to the Ellice Islands (Zimmerman, 1948*). At night a number of specimens were taken on the under surface of young palm fronds at one to two feet above the surface of the soil. *Evania appendigaster* (L.), a Hymenopteran, is parasitic on the eggs of this cockroach. An Evanid fly was fairly common; identification has not yet been made but the great abundance of both insects may be significant. Two other species of cockroaches were collected. One of these, tentatively identified as *Pycnoscelis surinamensis* (L.), was winged and collected under litter in a coconut grove. These last mentioned species were not common.

A medium sized green Tettigonid grasshopper tentatively identified as the genus *Phisis* was brought in frequently by the children. The tibia of the first and second pairs of legs were covered with long spines on both the outer and inner surfaces. Since the children were paid for these specimens with candy, they could not be coaxed to divulge the habitat of the species. Search by the author revealed two specimens, resting, with legs stretched out at full length, on the under surface of leaves of *Ficus tinctoria*. It cannot be said with

*Zimmerman, E. C. 1948. Insects of Hawaii. V. 2. Univ. of Hawaii Press.

certainty whether this was their specific habitat or just one of many places they occurred. Sweeping the grass Lepturus did not produce any specimens of this species.

A small pale yellow cricket was collected near lights around the camp. Their thin weak songs were heard all about at night. The song consists of a short ascending note and a longer descending one, usually repeated about ten times between intervals.

Isoptera

Decaying logs and branches of trees were examined for termites but were located only once in a Pandanus log at the top of the beach rampart on the sea side of the North Island. Judging from its position, it is possible that this log had floated here from some neighboring atoll.

Neuroptera

A single species belonging to the family Chrysopidae was collected near lights. The general body color is yellow green, and the eyes are a distinct black. Specimens were taken in June, July and August.

Odonata

One of the most thrilling sights particularly on calm mornings was the occurrence of huge swarms of dragon flies hawking low over the grass tops or higher up around the tree tops. At such times the house flies were particularly numerous and annoying. It is assumed that the dragon flies were preying upon them. This same swarming of dragon flies was noticed at Majuro in the Marshall Islands and at Bikati in the northern Gilbert Islands. The common species of dragon fly was distributed generally over the atoll, except on the small island of Nanntabuariki. There are no pools or wells present on this island, but it is possible that dragon flies would reach it in passing back and forth from the larger islands. Large swarms were found around the brackish fish ponds on the north end of the large North Island as well as in the region of the brackish pools on the North Island and the South Island of Aiaki. They were also present in the region where babai pits were located. Nymphs were found in the fresh water of babai pits and in the brackish water pools mentioned above. At least three species were collected. A large green and blue species resembling Anax junius of North America, a medium sized reddish brown species (the most common), and a small species of which the males are bright red. This last was the least common.

A single species of damsel fly was found in the babai pit areas and in the area of the brackish pools. These did not venture far from the water.

Hemiptera

True bugs were rare. A species of Lygaeidae of the genus Nyseus was taken by sweeping the isolated clumps of the grass Lepturus growing in the coconut groves. A single reddish brown Pentatomidae was found on the foliage of Guettarda. In the tide pools left in the beach rock on the seaward side of the

islands after the exceptionally high spring tides of August, water striders of the family Gerridae, genus Halobates were collected.

Homoptera

Cicadellidae were captured by sweeping the isolated clumps of the grass Lepturus growing in the coconut groves. A Fulgorid related to the sugar cane leaf hopper was collected in the camp area. Plant lice were present on Sida fallax, but were not common. Other plants seemed to be quite free of aphids. Scale insects were common on many of the older Messerschmidia trees.

Coleoptera

Nine families of beetles were represented in the collections from the atoll, with the possibility of a tenth family after the material is properly identified.

Staphylinidae, which were attracted to lights, were also collected on rotting Pandanus fruit left on the ground.

The most abundant beetle was an Oedemeridae of the genus Sessinia. When this beetle was crushed on the skin it caused a blister. These insects were rather abundant and a pest to the human population. The Islanders gathered "toddy" from the coconut trees by allowing the sap from the cut end of a flower bud to drip into an empty coconut shell or bottle. This dripping sap was attractive to these beetles and they frequently drowned in it. A native drinking "toddy", which contains one of these insects will experience violent pain, accompanied by hemorrhage in the urinary tract. One affected by this ailment was known to treat himself by drinking immense quantities of water. These beetles commonly came to lights.

Cleridae was represented by the "copra bug" of the genus Necrobia. These small metallic green beetles were fairly common and were attracted to lights.

A few specimens of the Elateridae, Conoderus pallipes, were collected. One specimen was taken at Scaevola flowers at night.

Beetles of the family Dermestidae were collected on drying skins of rats and birds. Nitidulidae beetles were present on rotting Pandanus fruit and larvae and adults were collected from chocolate bars stored with provisions.

Large old bracket fungus growths on dead coconut palms provide a home for Erotylidae beetles, in company with ants.

Lady-bird beetles, Coccinellidae were taken on Scaevola Morinda citrifolia and Messerschmidia. A large tan colored beetle taken in the mission house on Tabuarorae Island was tentatively identified as a Cerambycidae.

A small species of weevil was taken twice, once on rotting Pandanus fruit and another time near a light.

Lepidoptera

Three species of butterflies were collected, two Nymphalidae and one Hesperidae. The large Nymphalid, Hypolimnas bolina, was the most common and was found all over the atoll. Its food plant Sida fallax was common in the clearings of the palm groves, along the beach ramparts and on coral gravel areas. All stages in the life cycle were found. The eggs were deposited on the underside of Sida leaves. Black hairy larvae were so common in some cases as to defoliate the plants. Chrysalids kept in cages completed their dormancy in 7 to 10 days. Adults were observed at night with wings folded on the underside of Scaevola, coconut and Pandanus leaves. Children caught these large butterflies and tied a string of coconut leaf fiber around their thorax and played with them in much the manner of an American child playing with a pinwheel.

The smaller brown Nymphalid, probably a Precis villida (Fabr.), was also widespread and very common. Its food plant was probably Messerschmidia as smooth caterpillars typical of the genus, with longitudinal black and white stripes, were abundant on this tree.

A single specimen of Hesperidae was collected on Callophyllum inophyllum. If this tree were the food plant of the species, its rarity could be accounted for by the few trees on the island.

The moth fauna of the atoll is more varied, with a greater number of species, representing at this writing the following families: Arctiidae, Noctuidae, Sphingidae and Pyralididae.

The most common moth was a day flying Arctiidae of the genus Utetheisa. This moth was first seen on Kwadak, an island of the Kwajalein Atoll. It was subsequently found on Majuro Atoll, the island of Bikati on Makin Atoll and the island of Betio at Tarawa, all stopping places made on the trip to Onotoa. In most cases it was captured and observed wherever Messerschmidia or Scaevola grew. The black hairy caterpillars, the apparent larvae, were abundant on Scaevola. The moth was common on the North Island, but rare on the southern islands of the atoll.

At least 5 species of moths of the family Noctuidae were collected. The largest and most common species was tentatively identified as Achaea janata. The under wings are banded with black and white stripes superficially resembling a small Catocala. It occurred in swarms on Pemphis wherever that shrub grew. This moth was also taken near lights. At least four other species typical of the family were collected around lights and await identification.

A day flying, clear winged moth of the family Sphingidae was collected from blossoms of Scaevola and Guettarda. It was never abundant, but usually one or two were seen each day. Sphingid caterpillars were taken on Morinda citrifolia, which is evidently the food plant of this species. A Sphingid pupa case was brought in by a native, but unfortunately was destroyed by ants before it matured. A copulating pair of these moths was captured near a light at the Residency on August 2. These moths were also tied with strings and used as living toys by the native children.

A small green winged moth, with pure white body and legs, of the family Pyralididae, was taken on and around Guettarda on the North Island and Aonteuma. It was among the insects drawn to lights.

Several other small moths, almost micro-lepidoptera were captured. One with wings the color of gun metal was on Sida fallax. The other species came to lights.

Diptera

The first Dipteran seen and the one always present was the ubiquitous house fly. Great swarms were present and were especially annoying on calm days. They infested the open sores on the natives and it was quite evident that cuts and abrasions on our own limbs were soon infected by these flies, making it necessary to keep all sores and cuts covered until they were completely healed. The native population was extremely careful about refuse, but the open pits for garbage, the pens in which hogs were kept, and the habit of defecating on the reef and beaches, afford ample breeding areas for these flies.

Flies tentatively identified as Sarcophagids were observed and caught on bags containing decaying mollusk shells set aside for cleaning. These flies also swarmed in our own garbage pit, in spite of the fact that refuse was covered as quickly as possible with soil. At least two species were collected. A blue bodied fly, a Calliphoridae of the genus Chrysomyia, was taken on the flowers of Messerschmidia.

Dolichopod flies were quite common and were seen frequently on the foliage of Scaevola and on other plants. They were collected on most of the islands of the atoll.

Anthomyiidae were collected on unripe Pandanus fruits. These flies were quite sluggish but difficult to capture around the fruits.

A Syrphid fly was taken around Messerschmidia along the beach rampart of the North Island. The markings are typical of this group.

Mosquitoes were never very abundant. They were noticed on several occasions at night in the Maneabas (Community meeting houses) and were extremely abundant in the village of Aiaki on the South Island. At other times they were found personally annoying only when collecting on the babai pits where they breed. Wigglers were found several times in old coconut shells that had become filled with water. The extreme drought conditions on the atoll for the last year and a half may explain the reason for relative freedom from the pests.

A medium sized black crane fly, probably a Tipulidae was taken by sweeping the grass. It was also the chief pest around the lights at night, many of them, dead or drying, were constantly falling on the table where we worked.

Chironomid larvae were found in abundance on algae collected in the babai pits and brackish pools.

A large flat black fly with a buzzing flight was captured near a light. Later another specimen was taken on litter on the beach rampart and a third on the drying skin of a Great Crested Tern. These were members of the family Hippoboscidiae.

A single specimen of an orange bodied fly of questionable identity was taken near a light.

Hymenoptera

The most conspicuous Hymenopteran on the island was the large jawed black ant identified as Odontomachus haematoda. It was seen on all the islands of the atoll in sandy areas, including the beach rampart. Colonies of a few individuals, protecting a few brown cocoons, were found under old Pandanus and coconut logs.

At least two other species of ants were collected, but these were not common. A minute red species lives in fungus growing on dead coconut trees. A nest of the other species containing eggs, larva, pupa and winged adults was uncovered below the hard surface of the "caliche", near the northern end of the North Island. A procession of this species was also attracted by spilled sugar in the storage tent where a few individuals were collected. Pandanus fruit rotting on the ground attracted ants, as well as other insects.

A large tan colored species of Ichneumon fly was found frequently flying around the Scaevola thickets, but its prey was not located. It is recorded on all the islands of the atoll.

An evaniid wasp, probably Evania appendigaster (L.), was common. It is recorded from all of the islands of the atoll. Reference was previously made in this report to the fact that this insect is probably parasitic on the eggs of the abundant cockroach, Cutilia soror.

A small black vespid wasp identified provisionally as belonging to the Odynerinae is common around the flowers of Scaevola and Guettarda. Two of these insects were taken in the hollow twigs of Scaevola, although no nests were found when other dead hollow twigs were examined. These wasps are common throughout the atoll.

A large bronze green Sphecid wasp, Ampulex sp., was observed making nexts and depositing eggs in the holes of the reed furniture of the Residency and in the holes and crevices left in the native lime stone walls of the Residency and mission houses. Mud was employed in the construction of the cells.

A single species of bee, Megachilidae, was found on the north end of the North Island and on Aonteuma. The work of these leaf cutting bees was first noticed on leaves of Pisonia grandis, while trying to secure specimens of the latter for the herbarium collection. The leaves were so badly cut, that entire ones were not available. Small semicircular portions about 3/4 of an inch in diameter had been cut from the margins of the leaves. Damage of this kind was later seen on Morinda citrifolia. Specimens of the bees were collected around Pisonia, Morinda and Pemphis.

ANIMAL ECOLOGY

Coconut Groves

The major portion of the land area on the atoll is covered with an overstory of coconut groves and an understory of Pandanus, Scaevola and Guettarda. The ground in the groves is strewn with fallen leaves and other litter, with scattered forbs and grass growing through this litter. These groves were usually silent and devoid of animal life. Noddy Terns were sometimes present in the palms and a few Fairy Terns on Pandanus, but both birds seemed to prefer the open areas. Near the villages, flocks of chickens were encountered wandering about in search of food. The ground skink (Emoia)was the most conspicuous animal throughout these groves and was frequently heard scuttling away over the litter.

Removal of the litter disclosed a large population of the cockroach Cutilia soror and colonies of the large ant Odontomachus haematoda . Sifting the fine litter and top layer of soil revealed sow bugs and the minute Gastropod snails belonging to the genera Opeas, Lamellidea and Gastrocopta.

Clearings

Along the center of the two large islands and scattered irregularly at other places sunny clearing occurred containing only scattered palm, Pandanus and Messerschmidia trees, and a more dense shrub and herbaceous cover. These areas supported a large population of both species of Noddy Terns and the Fairy Tern. In these clearings the calls of the adult birds and the food call of the young were heard day and night. Here also adult Noddies frequently swooped down to earth and waddling awkwardly gathered pieces of shredded coconut leaves for nesting material. The Golden Plover was flushed from these clearings several times. Clouds of dragon flies were usually cruising at tree level, particularly on calm days when the house flies seemed to be most annoying. The two common butterflies, Hypolimnas and Precis flew above the herbs. Sida fallax, frequently the dominant herb in these areas was the host plant for Hypolimnas and carried a large population of eggs and larvae.

Skinks were as common in the litter here as in the groves. Ants and cockroaches were present under the litter and the large Huntsman Spider was captured around the clumps of Pandanus.

Area of Brackish Pools (Caliche-like hardpan)

On the North Island east of the village of Taneang and on the South Island east of Aiaki village are two rather similar areas, differing from the typical coconut groves. The trees were far apart and Pemphis formed the understory around a series of small brackish water ponds. The soil is the consistency of nearly dry putty and Dr. Preston E. Cloud, Jr. has designated it as a "caliche-like hardpan". Dragon flies were abundant and nymphs were numerous in the algae filled pools. The fauna of the brackish pools is dealt with in another portion of this report. A few damsel flies were observed resting on the foliage of Pemphis bordering some of the pools. Butterflies, the Achaea moth and leaf cutting bees were present in addition to the dragon flies. Orb weaving spiders had constructed webs between shrubs.

Skinks ran through the rubbish piles. During the day geckos were found hiding in rotting logs. Under decaying coconut shells and leaves was found an association of sow bugs, Collembola and centipedes. Colonies of a small species of ant seemed to find the soil of the right consistency for their nests. A large species of land crab was seen to occupy burrows in these areas.

Scaevola Thickets

Throughout the atoll, in neglected coconut groves, in clearings and along the sea side beach rampart there were thickets of Scaevola. Since these shrubs were in continuous bloom during our stay on the island, many species of insects were found visiting the blossoms. The list of insect visitors is given in a following section. Many leaves of the plants were attached by leaf miners. Dolichopod flies were frequently seen walking over the leaf surfaces.

The ground skink was observed climbing clumsily into the flower clusters during the day. The orb webs constructed by two species of spiders were numerous and were suspended in gaps between branches. The population of spiders, geckos and skinks present appeared too great for the quantity of insects observed at any one time. However, food must be sufficient to support the population. On only a few occasions were insect remains observed in the spider webs.

Observations of these flowering thickets at night revealed considerable activity. Geckos were present in almost every flower cluster feeding on crane flies and other night flying insects. Crickets were heard all through these thickets. The two common butterflies, Precis and Hypolimnas, were found sleeping on the underside of the leaves. The large Huntsman spider was also active here at night. The constant rustling of the litter under the shrubs indicated the great nocturnal activity of the numerous hermit crabs. On rare occasions rats were observed running from thicket to thicket.

Shrub Growth on Sand Flats

A shrub cover of scattered Scaevola, Guettarda, Pemphis, Sophora, Terminalia and Suriana maritima was growing on sand flats at points where the islands narrowed and were separated by the shallow inlets. These areas were bright from the reflection of the sunlight on the white sand and very hot on calm days. The southern tip of the North Island, the southern end of Aiaki or South Island and the adjoining point of Tabuarorae were the largest of these areas. Noddy Terns were observed with young in this area on Tabuarorae. Reef Herons were flushed from the openings between shrubs. Dragon flies, Precis butterflies and Sphingid moths were the common insects here. The Noctuid moth Achaea was very common on Pemphis.

Coral Gravel Areas

On extremely exposed shores on the seaward side of the atoll were large areas of coral gravel. The few scattered plants offered little cover, explaining the near absence of animal life on these gravel fields. An occasional skink was seen. The butterfly Hypolimnas was present where the scattered Sida plants grew. At the north end of the North Island where the gravel fields bordered the large enclosed fish pond, swarms of dragon flies filled the air above the Pemphis growing along the shore of the pond. However, the dragon flies did not wander far out over the barren gravel.

The Black Naped Terns and Whimbrels seemed to prefer this gravel area on the seaward side of Abanekeneke as headquarters. On every trip to this island we found and disturbed these birds on the gravel flats.

Pisonia Grove

One small grove of Pisonia trees was growing on the edge of a coral gravel area on Aonteuma. The leaves of these trees had been so badly damaged by the leaf cutting bees, that it was impossible to find perfect specimens of the foliage for a herbarium specimen.

A large grove of tall mature Pisonia trees on Tabuarorae Isle supported a large nesting population of the small species of Noddy Tern. Native tradition named the community house or Maneaba of this southernmost village the "Maneaba of the large trees where the birds roost". The Man-of-War birds were reported using these trees frequently as roosting spots. The accumulation of droppings and the odor under the trees indicated a large concentration of birds.

ANIMALS ASSOCIATED WITH HABITATS

Land Communities

A. Coconut Groves

Noddy terns-two species
Fairy terns
Chickens

Skink (Emoia)

Orb weaving spiders

Sow bugs-under the litter

Cockroaches-under the litter
Ant-Odontomachus haemotoda -soil surface and litter

Gastropod snails-three genera in litter

B. Clearings (Widely scattered trees)

Noddy terns-large population of both species
Fairy terns
Golden Plover-rare

Skink (Emoia)

Orb weaving spider
Huntsman spider

B. Clearings, cont'd.:

Cockroaches-in litter
Dragon flies
House flies
Butterflies (*Hypolimnas* and *Precis*)
Ants-*Odontomachus haematoda*

C. Area of Brackish Pools (Caliche-like hardpan)

Gecko
Skink (*Emoia*)

Sow bugs-under the litter
Land crabs-burrows

Centipedes-under litter

Collembola-under litter
Dragon flies-common Nymphs in pools
Damsel flies
Butterflies (*Hypolimnas* and *Precis*)-common
Achaea moth-on *Pemphis*
Mosquitoes-South Island
Leaf cutting bees-around *Pemphis*
Ants-small species-nest in soil

D. *Scaevola* Thickets

Rats-rare

Gecko-feeding at night
Skink (*Emoia*)

Hermit crabs-in litter beneath shrubs

Orb weaving spider-two species

Crickets-heard at night
Butterflies-*Hypolimnas* at flowers
Precis adult at flowers, larva on foliage
Moths-*Utetheisa*-flowers and foliage
Sphingid-flowers
Noctuids-resting on leaves
Click beetles
Lady Bird beetles
Crane flies-flowers at night
Ichneumon fly
Wasp-Odynerinae

E. Shrub Growth on Sand Flats

Noddy terns
Reef herons

E. Shrub Growth on Sand Flats, cont'd.:

Precis butterfly
Sphingid moth
Achaea moth-on *Pemphis*
Dragon flies

F. Coral Gravel Area

Black Naped tern
Whimbrel
Long tailed New Zealand cuckoo-in thickets

Skink (*Emoia*)

Orb weaving spider

Dragon flies
Sphingid moth
Butterflies (*Hypolimnas* and *Precis*)
House flies
Syrphid flies
Dolichopod flies-on foliage
Leaf cutting bees

G. Litter, Rubbish, Rotting Logs (In groves and under isolated trees)

Rats-rare

Noddy terns-for nesting material

Gecko
Skink (*Emoia*)

Sow bugs
Hermit crabs

Huntsman spider

Centipede-under coconut husk

Collembola-under coconut husk
Thysanura-under bark of dead *Messerschmidia* tree
Cockroaches-three species
Termites-rare, log on rampart
Beetle larvae-in log on rampart
Ants-two species
Mosquitoes-larva in water filled coconut shells

Gastropods
Opeas gracilis junceus (Gould)
Lamellidea peponum (Gould)
Gastrocopta pedicula (Shuttleworth)
Gastrocopta pedicula nacca (Gould)?
Gastrocopta lyonsiana (Ancey)

H. Buildings and Huts

Rats-nest with young

Gecko

Spiders-in packing cases and crannies
Huntsman spider
Scorpion-rare

Cockroach-Cutilia soror
House flies-by day
Mosquitoes-at night
Crane flies-near light
Moths-various species to light
Long horned beetle-identification uncertain
Coconut blister beetles (Oedemeridae)
Wasps-two species

I. Insects Taken at Light

Cricket
Lace winged fly (Chrysopidae)
Large dragon fly-Anax sp.
Blister beetles-Oedemeridae
Long Horned beetle (Ceresium)
Rove beetle-Staphylinidae
Copra bug-Cleridae
Click beetles-Elateridae
Noctuid moths-several species including Achaea
Small moths-almost micro-lepidoptera
Pyralididae moth
Sphingid moth
Crane flies
Mosquitoes
Orange bodied fly-family unknown
Hippoboscidiae

J. Rotting fruit on ground

Beetles-Nitidulidae
Staphylinidae
Cleridae
Tan colored beetle?
Weevil
Ants-small species

ANIMALS ASSOCIATED WITH SPECIFIC PLANTS

A. Coconut palm

Noddy terns-two nesting species
Reef heron-nesting

A. Coconut palm, cont'd.:

Gecko-on foliage

Cockroaches-on underside of leaves of small plants at night
Butterflies-on underside of leaves at night
Flies-on underside of leaves at night
Blister beetles-around toddy
Fungus beetles-in fungus on living and dead trees
Ants-in fungus on dead trees

B. Messerschmidia

Sow bugs-in litter beneath

Moths-Utetheisa-adults and larvae
Noctuids at flowers
Syrphid flies
Calliphorid flies-Chrysomyia at flowers
Scale insects on bark of twigs
Lady bird beetles

C. Pandanus

Noddy terns-young and adults of both species
Fairy terns-young and adults

Gecko

Huntsman spider
Orb weaving spiders

Cockroaches-on underside of leaves at night
Butterflies-on underside of leaves at night
Flies-Anthomyiidae-around green fruit
-other species on underside of leaves at night
Rove beetles-Staphylinidae on rotting fruit
Nitidulidae beetles-rotting fruit
Weevil-rotting fruit

D. Sida fallax

Butterfly-Hypolimnas-eggs, larvae, chrysalids and adults
Small tan colored moth
Pyralididae moth
Plant lice

E. Morinda citrifolia

Sphingid moth-larvae on foliage
Lady bird beetles
Ichneumon flies
Leaf cutting bees-attacking foliage

F. Guettarda speciosa

Pentatomid-stink bug
Pyralididae moth
Sphingid moth-at flowers
Odynerinae wasp-at flowers

G. Pisonia grandis

Noddy tern-small species nesting
Man-of-war bird-reported roosting

Leaf cutting bees-leaves badly damaged

H. Pemphis acidula

Moth-Achaea janata-very common
Damsel flies-resting on foliage
Leaf cutting bees

Note: Usinger and LaRivers report Pemphis on Arno as seemingly a barren tree as far as insect life is concerned. They report the Achaea moth, so common on Pemphis at Onotoa, as associated with Cordia, a plant not present on this atoll.*

FRESH WATER HABITAT

Surface water on the atoll was found in the babai pits used to grow the native "taro", in brackish ponds scattered at several places on the atoll and in wells. Algae samples were taken from these situations and preserved. During preliminary examination of these samples a number of invertebrates have been observed. While they have not been positively identified, mention should be made of them since they are obviously part of the food chain ending in the Odonata or the Reef herons.

Protozoa

Paramecium sp.
Frontonia sp.
Difflugia sp.

Rotifera

Monostyla sp.
Species of Order: Bdelloidea

Nematodes

Mollusca

Melanoides cf. niaforiana Mousson (With algae in well)
(Ident. by J. P. E. Morrison)

Crustacea

Ostracods
Crabs

*Usinger and LaRivers. Insect Life of Arno. Atoll Research Bulletin No. 15. April 30, 1953.

Insecta

Chironomid larvae
Mosquito larvae
Nymphs of dragon flies-3 species
Nymphs of damsel fly-one species

Aves

Reef heron

MARINE HABITATS

Seaward Reef

When the reef was covered by the tide on stormy days the Noddy Terns could be seen flying back and forth over the reef, capturing food. At other times they fished beyond the algal ridge. The Fairy Terns even on stormy days, generally fed beyond the ridge and only occasionally were noticed over the reef itself.

As the tide ebbed, the shore birds and reef herons advanced out over the exposed reef, investigating tide pools and the drying turf of algae.

The water strider, Halobates was found in the tide pools on the reef after the high tides of August.

Seaward Beach and Beach Rampart

The stretch of beach from the Scaevola thickets along the rampart to the high tide line was bare of vegetation. The shore birds were active along this beach at high tide. The Turnstones were most active just at the water's edge, rapidly flicking over pebbles, bits of rubbish, dried sea weed and bits of shells looking for prey. Each section of the beach and reef had its small flock of shore birds. The number of flocks and the number of individuals in the flocks increased during August.

The Reef Herons seemed to have rather definite territories along the beach and reef. By keeping certain peculiarly mottled individuals under observation the approximate size of their beach and reef territories could be roughly estimated. A beach and reef front territory at the cemetery on the south end of the North Island measuring approximately 1000 yards was occupied by a white heron having a slate gray head and a gray stripe down the middle of its back. Another mottled individual occupied a similar territory north of the camp site. Individual herons trespassing into these territories were attacked and forced out by the original occupant.

The skink (Emoia) was observed in the thickets on the rampart and made short journeys down the slope of the upper beach.

Gray rock crabs (Grapsus grapsus L.) were very common on the outcroppings of rock along the beach. At night the ghost crabs (Ocypode sp.) were common. One was observed feeding on a dead jellyfish, stuffing the jelly into its mouth as fast as it could, oblivious to the light from a flashlight. The beach and

rampart was also alive at night with large and small species of hermit crabs. The large species living in old turbo shells seemed to come down to the beach at this time from the thickets along the ramparts.

Since Scaevola was the dominant plant along the rampart, the insects here were those native to the thickets of this shrub as was previously mentioned. Dragon flies frequently swarmed above the beaches. Similar swarms were seen on the islands of Bikati, northern Gilberts, during the trip to Onotoa.

Lagoon

Tattlers, Golden Plovers and Reef Herons were the common birds along the lagoon shore. The small species of Noddy Tern seemed to prefer fishing in the lagoon to the seaward reef and was more frequent here than was the larger species. The Black Naped Terns were also lagoon feeders and were rarely absent from the shallow northern end.

Swarms of dragon flies were frequently seen along the lagoon shore. Collembola were collected from the water in a hollow of the rock outcropping, 300 feet from shore, near the village of Taneang by Dr. A. H. Banner. The tidal fluctuations of this spot were about two feet.

MARINE COMMUNITIES

A. Seaward Reef

Wandering tattler
Ruddy turnstone
Golden plover
Whimbrel
Noddy tern-larger species more frequently
Fairy tern-rarely
Crested tern
Reef heron

Water Strider-Halobates

B. Beach and Beach Rampart

Wandering tattler
Ruddy turnstone
Golden plover
Reef heron

Skink (Emoia)-rampart and upper beach

Rock crab-Grapsus grapsus
Ghost crab-Ocypode sp.
Hermit crabs-several species

Dragon flies-swarming over beach
Ant-Odontomachus haematoda -upper beach and rampart

C. Lagoon

Wandering tattler-along shore
Golden plover-along shore
Reef heron-along shore and shallows
Black naped tern-over lagoon, fishing
Noddy tern-small species usually, fishing over lagoon

Dragon flies-swarming along shore
Collembola-tide pools in rock

Fiddler crabs-sand flats