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UNIVERSITY OF UTAH

INSTITUTE OF ENVIRONMENTAL BIOLOGICAL RESEARCH

ECOLOGY AND EPIZOOLOGY RESEARCH

A REVIEW OF THE

ECOLOGY OF ENIWETOK ATOLL, PACIFIC OCEAN

by

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James

No notes available.

Keith

This teardrop-shaped islet has the narrow end at the southeast dominated by scaevola which yields in the wider portion to a taller forest of coconut palms with an understory of messerschmidia trees, associated with a long strip of pisonia trees, 30 to 45 feet tall and scattering pandanus trees. The soil is loose and there is little grass.

Leroy

This islet showing much human activity is pitted with several large dry craters. Scaevola occurs generally around the edge of the island but also inland where it is generally dominated by messerschmidia, pisonia and palm trees. There are scattered morinda and guettarda trees among them; also considerable grass and triumfetta and morning glory vines.

The Fauna

The fauna of Eniwetok Atoll contains a sparse assortment of terrestrial and quasi-marine species. From a review of literature and judged from neighboring atolls, invertebrates include worms, mollusks, an assortment of nocturnal crabs, several species of centipeds, scorpions and spiders, and insects of considerable variety, including cockroaches, scale insects, termites, fruit beetles, fruit flies, ants and other kinds (Fosberg, et al. 1956:221-238). The vertebrates probably consist of a single species of native mammal (The Polynesian rat), about 25 or more species of birds, five or six lizards, and two turtles. Studies of a civilian crew from the University of Utah in the spring of 1962 have corroborated the presence of 22 species of birds.

Invertebrates

The invertebrates of Eniwetok Atoll include a much more heterogeneous assortment of kinds than the vertebrates. Both ecto and endoparasites doubtless came with their host vertebrates but other kinds must have arrived independently. Winged insects and small spiders sailing on silken webs blown by the wind might have come through the air. Other small invertebrates may have arrived on the feet of birds, on flotsam of ocean currents, on winds of tornadoes or as stowaways with human cargoes. Still others wander onto the land from their home in the sea. The presence of others is difficult to explain.

Mollusks

No evidence has been found to indicate that any marine mollusks like the crustaceans have emerged onto the land of this atoll and no freshwater mollusks have been found here but there are at least five species of small terrestrial snails found on the islets. Specimens of these taken in the litter under vegetation are of record in the Bishop Museum. These snails, listed below, appear to be widespread inhabitants of Pacific islands. Being of small size and of light weight, they could have been carried easily on the feet of birds, blown by tornadoes, or floated on driftwood or flotsam by ocean currents. They are probably of little consequence as carriers of disease and so far as known, these species are probably not involved in endoparasite transmission.

The list below gives the specimens from Eniwetok Atoll and their museum numbers of record at the Bishop Museum.

Pupillidae (family)
Gastrocopta sp. Bishop Mus. Nos. 193,184 and 193,185
Collected under trees May 15, 1946 by E. Y. Hosaka

Achatinellidae (family)
Lamellidea pusilla Moellendorff, No. 193,187
Collected under trees May 15, 1946 by E. Y. Hosaka

Subulinidae (family)
Lamellaxis oparanum Pfeiffer, No. 190,241
Collected on Runit (Yvonne) Islet, Aug. 28, 1945 by Lt. G. A. Estep

Opeas pumilum Pfeiffer, No. 193,188
Collected under trees, May 15, 1946 by E. Y. Hosaka

Truncatellidae (family)
Truncatella sp., No. 193,189
Collected under trees, May 15, 1946 by E. Y. Hosaka

Earthworms

Earthworms occur in the northern Marshall Islands where a reasonable amount of organic matter occurs in the soil. They are usually found more abundantly where there is considerable concentration of organic matter, such as in decaying logs or taro pits. They assist in hastening the process of decomposition and in aerating and loosening the soil (Fosberg, et al. 1956:230). They do not appear to be well studied and nothing has been found regarding their occurrence in this atoll. Much digging in the rich soils of Japtan (David) Islet has not uncovered any of these worms. All evidence so far indicates absence from this atoll.

Crustaceans

Crustaceans being primarily marine organisms as insects are primarily terrestrial, it is to be expected that few crustaceans will be found on the land as few insects are inhabitants of the ocean although many of both kinds are found in fresh water. Crustaceans with gills adapted for aquatic respiration have a difficult problem of keeping gills moist in air. Many species of the intertidal zone solve it by dipping the gills in sea water from time to time but others have attained more independence by developing protective coverings over their gills and behavior patterns that in the adult stage keep them in humid micro-habitats during the day and lead them into activity at night when humidity is high and danger of desiccation low. These marine crustaceans still reproduce in the ocean but not much is known of the early part of their life histories before they emerge onto the land in advanced stages.

At this atoll, there are many species that show stages of terrestrial adaptation intermediate between those that live entirely in the water, through those that live, at least in adult stages, in the intertidal zone to those that live as adults on the beach and those entirely on the land that hide among the vegetation.

It is understood that data on the semi-aquatic and terrestrial crustaceans of Eniwetok are now being assembled at the John Hancock Foundation in Los Angeles. Until such data are available, the following partial list is being used.

ISOPODA (order) . . . . . Sowbugs

Porcellionidae (family)
Metapornorthus pruinosus (Brandt) 1833
Specimen taken on Fred Island, Eniwetok Atoll, under edge of building, May 19, 1962 by John Bushman.

Talitridae (family)
Talorchestia spinipalma Dana . . . . . Sandhoppers or beach fleas
Reported taken at Eniwetok, July 7, 1946, Barnard, 1960, 4(2):24-27.

DECAPODA (order) . . . . . Shrimps, crabs and allies

Coenobitidae (family) . . . . . Hermit crabs
Typical hermit crabs with soft twisted wormlike abdomens are adapted to use empty snail shells, into which the abdomen is inserted for protection and which they carry around with them. They shift to larger and larger shells as they grow, if available; if not, they may use coconut shells or go naked. With projecting legs that can be withdrawn into the shell as needed, such crabs are well protected from desiccation and from some types of predation. The following records have been found.

Coenobita perlatus H. Milne-Edwards . . . . . Land hermit crab
Range: Bogombogo (Belle) Islet, Eniwetok (Held, 1960:18) over a two-year period, 1954-1956; widespread in the Marshalls (Fosberg, et al. 1956:230-231).
Habits: Usually hides in daytime under rocks, debris on the beach, shrubs, in crevices, or under bark of trees or litter on the ground; active at night on beaches and in vegetation.
Food: Primarily land plants and scavenger around detritus washed up on the beaches.

Birgus latro (L) . . . . . Coconut crab
A hermit crab adapted to living on land without snail shells; its life history is poorly known but has been known from early history as a conspicuous animal on many islands.
Range: Throughout Pacific islands, especially in association with coconut palms; occurs on Japtan (David) Islet (McQueen, Johnson).
Habitat: Chiefly coconut groves and associated vegetation.
Habits: It is known to climb coconut trees, Fig. 37; it hides in burros in daytime; young ones cover themselves with dirt in their burrows (Held).
Food: Chiefly coconuts on the ground which it husks with its large chelipeds and cracks the nuts to get at the meat inside; also known to catch young sea turtles on the beach.

Xanthidae (family)
Zoozymus aeneus (Linn.) . . . . . Reef crab
Range: From Red Sea to Hawaii, of record in Bishop Museum from Parry (Elmer) Islet. Occurs on reefs; collected at night.

Eriphia laevimana
Collected on Rigili (Leroy) Nov. 5, 1952 and on Runit (Yvonne) Nov. 6, 1952, Bonham (1959).

Eriphia scabricula Dana
Is recorded from the Marshall Islands (Bryan letter).

Grapsidae (family)
Grapsus grapsus (Linn.).
Reported from Gilbert and Marshall islands (Balss).

Metasesarma aubryi H. Milne-Edwards
Reported from Gilbert and Marshall groups (Balss).

Ocypodidae (family) . . . . . Ghost crabs
Pale fast running crabs, numerous along the beach.

Ocypoda ceratophthalma (Pallas) . . . . . Lower beach crab
Range: Widespread through Micronesia; occurs on Eniwetok islets (McQueen, Johnson, March 1962).

Ocypoda ceratophthalma (continued)
Habitat: Lower part of the beach where it burrows in the sand.
Habits: Ranges along lower part of beach at night; hides in burrows in daytime.

Ocypoda cordimana Desm. . . . . Upper beach crab
Range: Widespread in Micronesia; occurs on Eniwetok islets (McQueen, Johnson, March 1962).
Habitat: Upper part of beach and adjacent vegetation.
Habits: Hides in burrows in sand of upper beach in daytime; active at night mainly in vegetation.

Insects

At Eniwetok, insects are probably the most abundant of all animals but their small size and inconspicuous coloring of many of them reduce this impression of abundance. The insect fauna of this atoll is far from completely known and of those known, many of them are not yet reported in publications. From the mammoth work on the insects of Micronesia now in progress under the leadership of J. Linsley Gressitt of the Bishop Museum in Honolulu, Dr. Gressitt has extracted from published records and from manuscripts awaiting publication, a list of 42 insects known to occur at Bikini and Eniwetok atolls, 38 from the latter. These are given in the following list. Published records are followed by the author and reference in the insects of Micronesia; records from unpublished manuscripts by the author of the manuscript. These are followed by the collection records. If the atoll or islet name is not given, the record is presumed to refer to Eniwetok Atoll or to Eniwetok (Fred) Islet. Since names of the islets have been changed so much, not all of the names formerly used are included on the map of Eniwetok Atoll, Fig. 6.

MALLOPHAGA (order) . . . . . Chewing lice

Menoponidae (family)
Actornithophilus ceruleus (Timmermann) 1954
ex Anous minutus marcusi, noddy

Philopteridae (family)
Quadriceps sp. Novo
ex same noddy tern as in preceding
Ref: Ronald A. Ward (ms).

HOMOPTERA (order) . . . . . Aphids, leafhoppers and allies

Aphididae (family) . . . . Aphids
Aphis gossypii Glover
Essig. 1956, 6(2):22-24.
On Hibiscus, Jan. 1945, R.Bohart; on Scaevola frutescens, May 1946, Oakley; Japtan (David), on Pandanus tectorius, May 1946, Townes; Engebi (Janet), on Scaevola, May 1946, Oakley.

Aphis medicagnis Koch
Essig. 1956, 6(2):24-27.
Japtan (David), on Portulaca samoensis and Triumfetta procumbens, May 1946, Townes, Oakley; Enjebi or Engebi (Janet), on Curcurbita May 1951, Fosberg.

Vertebrates

Other than birds, which came on their own power, all other vertebrates of the native fauna appear to have been accidental introductions, probably with the aboriginal inhabitants, or have been introduced with modern transportation ships and airplanes. Many of the inhabitants of other Marshall Islands have not reached this isolated atoll, hence the vertebrate fauna is much restricted.

Mammals

The Polynesian rat, Rattus exulans, appears to be the only native mammal at this atoll. Even the fruit bat appears to be absent. This small rat, called a mouse by some of the early German writers, is chiefly a forest or brush inhabitant and is much less of a human commensal or pest than other species of the genus. Its principal habitat appears to be heavy vegetation of forest, jungle, brushy tangles or grassy tangles where it can find suitable shelter and protection, especially during the day when it is relatively inactive. At night, it is active all through the vegetation and even out on the beaches.

Records of occurrence include: Biijira (Tilda) 11-9-52 (Bonham, 1959).

Its principal food appears to be fallen coconuts but also includes coconut blossoms. It is not known to damage coconuts on the tree, but on the ground, it gnaws a hole into the nut and eats out the inside. It takes a toll of drying copra where it is available. As supplements to this diet, it feeds on many other things and on islands where coconuts are absent, it survives on other diets. Other known foods include seeds of Triumfetta procumbens and young hatchling turtles. It probably obtains its chief water supply from the large fleshy calyces of the morning glory, Ipomoea tuba. Bird eggs may form a part of its diet but this may not be of great significance in economy of bird populations (Fosberg, et al., 1956:222-223).

The nest is uaually a globular mass about five inches in diameter of soft dead leaves from available plants or of coconut cloth. It is usually placed inside rotten logs, stumps, coconut husks, or among hanging dead leaves of Pandanus (Marshall, 1951:25).

Specimens taken by Marshall (1951:26) had mites and lice in the fur, flagellates in the caecum, whipworms threaded in the stomach lining, larger nematodes in the stomach, tapeworms in the intestines, and ova of both nematodes and tapeworms in the droppings. No biting bugs were found in their nests. So far as known, there are no predators that use these rats as a major source of food, hence Marshall suggests that their environment is filled to capacity within the parasite handicaps. Marshall (1955:261) reported occurrence of the true louse, Hoplopleura oenomydis, and the parasitic mites, Laelaps nutallii and L. echidninus, on this rat at Arno but found no fleas or biting bugs and no blood protozoans.

Feral mammals include domestic cats on Fred and Elmer islets and two dogs on David but these may be only temporary inhabitants since there is no evidence

of feral propagation. House mice of the genus Mus and one of the other species of rats of the genus Rattus have been observed on Runit (Yvonne) (McQueen, personal communication).

Birds

In his report of the avifauna of Micronesia, Baker (1951:5) states that there are no fewer than 206 kinds of birds belonging to 37 families and 91 genera found in Micronesia. A much smaller number than this is known from the Marshall Islands and only a fraction of this number from Eniwetok Atoll. A review of the literature to determine the ecological background of nine common birds of Eniwetok Atoll was made at the Bishop Museum under the direction of Edwin H. Bryan, Jr. The data from this review has been supplemented by data collected by the University of Utah field crew operating at the atoll during the spring of 1962. The information gathered from these two sources is presented in the species accounts to follow. A list of 23 species of birds encountered by the University crew at the atoll from February 24 to May 24 is given in the accompanying list.

Methods of Study

The University crew made studies of the birds on different islets of the lagoon with special reference to the habitats occupied, the nesting areas, feeding and breeding habits, social behavior patterns, and population numbers. When visiting an islet, the men usually made a census of the whole area of the smaller islets by counting and recording the number of birds observed along the routes selected. They usually made a circuit around the beach to count the birds feeding on the reef around the islet. These counts were usually timed to make the trip at low tide when birds were out feeding on the open reef where they were easily seen. This was supplemented by walking through the vegetation on lines selected to include sections of all types of habitat* and recording the birds observed.

On larger islets, all portions of the beach and adjacent reef were censused but only transects through the vegetation were made, from which total population estimates were determined. The same areas were usually traversed on repeated visits to the islets in order to get comparative data, but observations were not limited to these censusing routes. Other visits were made, especially to the nesting colonies to collect data on the breeding and social habits and for general observation purposes.

Species accounts

In gathering data of important birds of the region, information was extracted covering the following points:

1. Name: both scientific and common, including synonyms.
2. Range: overall area; if migrant, range at different seasons.
3. Habitat: ecological niche; feeding, breeding, summer, winter and migrant niches.

BIRDS OF ENIWETOK ATOLL

Observed from February 24 to May 24, 1962
by John Bushman and Crew

Procellariiformes . . . . . Tube-nosed swimmers
Procellariidae . . . . . Shearwaters
Puffinus pacificus cuneatus Salvin 1888 . . . . . Wedge-tailed shearwater

Pelecaniformes . . . . . Pelicans and allies
Phaethontidae . . . . . Tropic birds
Phaethon rubricauda rothschildi (Matthews) 1915 . . . . Red-tailed tropic bird
Phaethon lepturus dorotheae Matthews 1913 . . . . . White-tailed tropic bird

Sulidae. . . . . Boobies and gannets
Sula leucogaster plotus (Forster) 1844 . . . . . Brown booby

Fregatidae . . . . . Frigate-birds (Man-o-war)
Fregata minor minor (Gmelin) 1789 . . . . . Great frigate-bird

Ciconiiformes . . . . . Herons and allies
Ardeidae . . . . . Herons and allies
Demigretta sacra sacra (Gmelin) 1789 . . . . . Reef heron

Charadriiformes . . . . . Shorebirds and allies
Charadriidae . . . . . Plovers, etc.
Pluvialis dominica fulva (Gmelin) 1789 . . . . . Golden plover

Scolopacidae . . . . . Sandpipers and allies
Numenius phaeopus variegatus (Scopoli) 1786 . . . . . Whimbrel
Numenius tahitiensis (Gmelin) 1789 . . . . . Bristle-thigh curlew
Heteroscelus incanus (Gmelin) 1789 . . . . . American wandering tattler
Arenaria interpres interpres (Linnaeus) 1758 . . . . . Turnstone
Crocethia alba (Pallas) 1764 . . . . . Sanderling
Erolia acuminata (Horsefield) 1821 . . . . . Sharp-tailed sandpiper

Laridae . . . . . Terns, etc.
Sterna paradisaea Pontoppidan . . . . Arctic tern
Sterna sumatrana sumatrana Raffles 1822 . . . . . Black-naped tern
Sterna lunata Peale 1848 . . . . . Spectacled tern
Sterna fuscata oahuensis Bloxham 1826 . . . . . Sooty tern
Thalasseus bergii pelecanoides (King) 1829 . . . . . Crested tern
Procelsterna cerulea saxatilis W. E. Fisher . . . . . Blue-gray tern
Anous stolidus pileatus (Scopoli) 1786 . . . . . Common noddy
Anous tenuirostris marcusi (Bryan) 1903 . . . . . White-capped noddy
Gygis alba candida (Gmelin) 1789 . . . . . White (fairy) tern

Cuculiformes . . . . . Cuckoos, etc.
Cuculidae . . . . . Cuckoos
Eudynamis taitensis (Sparrman) 1787 . . . . . Shining (New Zealand) cuckoo

BIRD POPULATIONS

From the censuses of birds made on the islets between February 24 and May 24, Table 1 has been prepared. This table shows the number of each species of birds found on each of the islets each day a census was taken. It was not possible to census all of the islets simultaneously or even on the same day, consequently the census figures made on different dates or at different times of the same date cannot be considered as representing an accurate reflection of the total population of the atoll.

In general, the birds roost in their favorite haunts at night, go foraging in the daytime (exceptions), and return at night. Bushman watched three species of terns returning to Olive islet at dusk. They came in wave after wave over his head in the twilight. Visibility was poor but he counted 525 birds in 15 minutes. This sample seemed to indicate a general pattern of the nesting species.

Some of the birds fly out over the sea, inside or outside the lagoon and are missed in the censuses. Most of these do not rest on the water but come back to land for that purpose. Other birds forage along the reef and still others forage among the vegetation. The breeding terns go out over the water or onto other islets to hunt but continually rendezvous during the day at the nesting ground to tend the young. Some birds on the islets move from one place to another or to other islets. Many of the reef and beach-feeding shorebirds and herons spread out singly or in small flocks during low tide but usually come to land on the islets when the reef is covered with high tide water.

In censusing the birds of the reef, the counts were usually made at low tide, but the tide level made little difference to the seabirds either on the wing or resting on land. These difficulties interfered with accuracy in two ways: 1) some birds may have been missed in counting, and 2) others may have been counted twice. Despite these deficiencies, the censuses add a great deal to the understanding of bird populations at the atoll. A perusal of the numbers observed from day to day on different islets gives a quantitative estimate of numbers even though it is difficult to assign accurate statistical values to them.

To obtain an estimate of the maximum numbers likely to occur on the islets, a summary has been prepared in Table 2. This shows the maximum number of each species found on each islet at any time. Whether this maximum represents birds mixxed on other censuses or whether it exaggerates the actual numbers is not known but it does show the actual maximum number of birds recorded on a census for each islet covered.

OTHER BIRD STUDIES

In addition to the census studies of birds, specimens of ten species were captured and brushed to obtain ectoparasites and nests of two species were processed through Berlesi funnels for nest-inhabiting parasites. The results of the parasite studies are shown below in Table 2. The figures in each box show the number of hosts infested (below) and total number of parasites or commensals found (above diagonal line).

Table 2. Parasites found on birds by brushing and in nests by processing through Berlesi funnels (Bushman).

	BIRD PARASITES									
	Numbers									
Birds brushed	Brushed	Infested	Mites	Ticks	Fleas	Flies	% Inf.			
Red-tailed tropic bird	1	1			2 / 1					
Golden plover	37	9	24 / 1	1 / 1	16 / 8		24			
Wandering tattler	4	3			9 / 3					
Ruddy turnstone	12	5		1 / 1	64 / 5		41			
Black-naped tern	2	2	2 / 1		49 / 2					
Spectacled tern	1	1			3 / 1					
Sooty tern	65	42		94 / 7	264 / 41		65			
Common noddy	68	66	38 / 5	25 / 11	1440 / 66	3 / 3	97			
White capped noddy	45	39	3 / 1	9 / 4	570 / 39		87			
White (fairy) tern	57	11	1 / 1		18 / 11	1 / 1	19			
Totals	292	179					61			
Nests processed						Isopods	Beetles	Lizards	Pseudoscorpions	
Common noddy	30	24	77 / 11	330 / 21	1 / 1	3 / 1		3 / 1	2 / 2	
White capped noddy	51	36	74 / 4	507 / 31	8 / 1		1 / 1			
Total	81									

Reptiles

In the northern Marshall Islands, the reptiles include at least four geckoes, a monitor lizard, three skinks, a blind snake, and two sea turtles. How many of these occur in Eniwetok Atoll is not certain but all will be considered as possible residents. The following will be treated:

SAURIA (suborder) . . . . . Lizards

Geckonidae (family) . . . . . Geckoes

Gehyra oceanica (Lesson) . . . . . Big tree gecko
Range: Arno Atoll (Marshall 1951); Onotoa Atoll, Gilbert Islands (Moul, 1954).
Habitat: Trees, common on coconut palms and pandanus trees; hides in crevices of bark and around trunks under sheltering limbs or leaves or on houses.
Habits: Nocturnal, tree trunk inhabitant, or on walls of house.
Food: Ants, crickets, crane flies, other insects.
Breeding: 14 eggs were found in a community nest at base of coconut stump.
Call: Kraaaaaaa, one of the few lizards that has a voice.
Parasites: Stomach nematode, large tapeworm, rectal flagellates.

Gymnodactylis pelagicus . . . . . Rock gecko
Habitat: Ground dweller, among rocks
Habits: Territorial on boulders, hides in daytime under logs or piles of coconut husks; active at night.
Food: Centipeds, weevils, spiders, sand fleas, beach crickets, other small insects.
Parasites: Nemstodes in stomach; rectal flagellates.

Hemiphyllodactylis typus . . . . . Four-finger gecko
Range: Arno atoll (Marshall 1950:6).
Habitat: Tree trunks, rare on Arno.
Habits: Nocturnal
Foods: Moths
Parasites: Rectal flagellates

Lepidodactylis lugubris (D & B) . . . . . Small house gecko
Range: Arno (Marshall, 1951); Onotoa Atoll, Gilbert Islands (Moul 1954:7).
Specimen: American Museum, Natural History, No. 66570, taken on Runit (Yvonne) islet by James Oliver, Sept. 2, 1945 (C.M.Bogert).
Habitat: Rotting palm logs; houses on screens, also in crowns of pandanus trees, especially on slender twigs and leaves, also in flower clusters of scaevola bushes.
Habits: Begins hunting in late afternoon and continues until early morning when it retires for the day; hides in shady places under leaves, fronds, walls of houses, driftwood, and the like; dark colored in daylight, pale at night, or agrees with substrate.
Call: Click, click

Lepidodactylis lugubris (continued)
Food: Small insects
Mating display: Male approaches with jerky progression and sinuous tail waving.
Predators: Was captured by a heteropodid spider in silk wrappings (Moul,1954:8).

Two specimens of an unidentified gecko taken on Bogombogo (Belle) on Dec. 30, 1950 by Yoshio Oshiro under loose canvas are listed in the Bishop Museum, catalog No. 899.

Lipinia noctua

Specimens of this lizard, taken on Runit (Yvonne) islet by James A. Oliver, September 2, 1941, are now in the American Museum, N. H. Nos. 66571-72 and four untagged (C. M. Bogert).

Varanidae (family) . . . . . Monitor lizards

Varanus indicus . . . . . Terrible monitor

This largest of all living lizards was said to have been introduced by the Japanese onto Japtan (David) islet and was collected there in 1946 by J. P. E. Morrison (Fosberg, 1956:225). It is said to occur there at the present time under planned protective measures. D. E. Johnson verbally reported seeing two of these lizards on that islet in March, 1962, Fig. 38. A specimen collected on Japtan (David) islet in 1955 by a GI is now No. 78994 in the AMNH (C.M.Bogert).

Scincidae (family) . . . . . Skinks

Dasia smaragdina . . . . . Arboreal skink
Range: Arno (Marshall, 1951); widespread, even on small islets.
Habitat: Tree trunks
Habits: Diurnal, active on sunny days from 7:30 a.m. to 5 p.m.; sleeps at night on tree trunks.
Food: Beetles, ants, maggots, sowbugs, cockroaches, moths; also plant material, including some flowers.
Predators: Land crab, Geograpsus crinipes
Parasites: Rectal flagellates; small nematodes in stomach, possibly derived from insect foods.
Color: Usually bright green but may be olive, yellow green, brownish, black, or dark with yellow edges on the scales.

Emoia cyanura (Lesson) . . . . . Little blue-tailed skink
Range: Arno (Marshall, 1951); abundant on nearly all islets.
Specimens: AMNH Nos. 66573-74 and three untagged, taken on Runit (Yvonne) islet by James A. Oliver, Sept. 2, 1945 (C.M.Bogert).
Habitat: Ground dweller, common everywhere among scaevola thickets, brush piles, litter of coconut groves.
Habits: Active in sunlight, 7:30 a.m. to 5 p.m.; agile, jerky fast progression; seldom climb trees; hide at night under rocks or other hiding places.
Food: Insects and fruit
Predators; Herons, land crab.
Parasites: Flagellates in cloaca and large intestine.

ECOLOGICAL RELATIONS WITH OTHER ISLANDS

Since the floras and faunas of Eniwetok are relatively typical of those found in other oceanic islands it is to be expected that there will be much interchange of biota between them. These exchanges include the movement of plants, vertebrate animals, invertebrates, and micro-organisms, inclusion of endo and ectoparasites and pathogenic organisms. The pathways by which such exchanges can be made include: 1) human transportation, 2) flying animals, a) birds, b) winged insects, 3) ocean currents, and 4) winds. These may act separately or in combination to disseminate the biota. Some pathways provide movement rapidly, others slowly. Some movements may be consciously directed, others accidental or carried by the forces of the environment.

HUMAN TRANSPORTATION

Travel by airplane and boat both offer potential transport of plants, animals, parasites, and pathogens, the latter in: 1) human hosts, 2) animal hosts, and 3) vectors. The problem of animal hosts and vectors in human transportation are largely questions of stowaways, in ships and airplanes. The essential aspects of these problems are covered in other sections of this report and need not be treated here.

BIRDS

Wandering or migrating birds are bound to carry their endoparasites and their feather-inhabiting ectoparasites with them. Nest-inhabiting parasites, while usually left behind, may also be carried with the birds occasionally under unusual circumstances. Birds may move to other islands where free-living pests such as mosquitoes, or other peiodic parasites may get blood meals from them. Parasites that obtain blood meals must be considered potential vectors of blood parasites until proved otherwise. Obligate host-specific parasites are not likely to be interspecific transmitters of parasites or disease although they may transmit intraspecifically.

In assessing the correlation between bird movements and the distribution of arthropod-borne virus disease, McIntosh (1961:419) indicated that there is a positive correlation in the distribution of western equine encephalitis, Eastern equine encephalitis and St. louis encephalitis with the migration of birds between temperate and tropical America, and also in the distribution of Western equine encephalitis in temperate North and temperate South America, but he could find no such correlation of Eastern equine encephalitis with bird movements in Czechoslovakia and in the Philippines.

He found a positive correlation in distribution of West Nile Virus with intra-African migration and in African-Indian migration but not between African-European migration. He suggested that recurrent epidemics in Israel may be bird-borne from Egypt or Sudan.

WINGED INSECTS

Although mosquitoes are not known at Eniwetok but occur on many of the islands of the Pacific and Seabird flyways, it is certain that many of the migrant birds will encounter mosquitoes on islands they visit. Mosquitoes, tabanid flies and other invertebrates that obtain blood meals from birds, other animals or man are likely to ingest blood parasites and diseases and are suspect as vectors unless proved otherwise. Any invertebrate known to obtain blood meals from both man and other susceptible hosts is not above suspicion as a vector of disease until experimentally tested. It is suspected that there may be many potential vectors between mammalian, avian and reptilian hosts and man.

neighboring islands where the migrants would probably overlap those from Siberia using the Western Pacific Flyway through Japan and the Mariana Islands. There might be further mixing as long-distance migrants move on south toward Australia or New Zealand. These far-flung migrants would doubtless enter areas used by birds of the Southern Hemisphere during the southern summer.

From my own background in studying migration of birds (Woodbury 1941; Woodbury, Behle and Sugden, 1946; Woodbury and Knight, 1951), it is my conclusion that many of the migrants crossing Eniwetok going south will come back over the same route in reverse direction and that nearly all other returning birds will use other parts of the Central Pacific Flyway and go back to the same general summer nesting area, if not to the specific location where they were reared. Stragglers might do otherwise and even get lost. Some of these stragglers may even go back along the Japanese Flyway and vice versa, some stragglers using that flyway going south might use the Central Flyway going north, especially if they are flocking birds that get mixed on the winter range in the tropics.

It was shown in the case of California gulls banded in Great Salt Lake and Utah Lake that most of the young banded gulls moved westward toward the Pacific Coast in late summer and early fall without companionship of the adults who came later in the season (Woodbury and Knight, 1951). This wandering phenomonen is well known in many other birds, e.g. the short-tailed shearwater whose young circle the Pacific unguided by adults, the black-crowned night heron in which the young "explode" in all directions, and the wood ibis, which wanders northward over the United States in late summer after breeding.

In the case of California gulls banded at Great Salt Lake, (Woodbury, et al., 1946), it was shown that the young birds soon after they are on the wing, move toward the Pacific Coast and remain there until two or three years of age when they return to the nesting grounds to breed. In the case of migratory shorebirds from the Arctic, it is probable that immature birds similarly might linger in the tropics for two or three years until ready to return to their homeland for breeding.

Most of the birds using the Central Pacific Flyway are shorebirds of the order Charadriiformes. The common migrants that regularly stop at Eniwetok are likely to pass on to other islands and carry their parasites and diseases with them. They will be moving south from their Arctic breeding grounds mainly from August to November going south in the fall, although stragglers might pass earlier or later, and mainly from March to May going north in the spring.

Seabird Flyway

Migrants

Eniwetok Atoll is occasionally visited by seabirds that do not nest there. Some species are known and others are suspected of visiting these islands. These are migrants with flight patterns entirely different from those of the shorebird.

They belong mainly to two orders, the Procellariiformes (albatrosses, shearwaters, and petrels, wimmers that have the nostrils open through tubes that extend onto the bill, and the Pelecaniformes (Pelican allies), the totipalmate swimmers that have all of the four toes connected by webs. The latter include tropic birds, boobies, frigate birds and allies. In addition, stragglers or accidentals of other orders may reach the islands.

Seabird nesters

The seabird nesters on Eniwetok present a radically different pattern of movement from the seabird migrants. Most of them nest at any time of the year whenever the ovarian cycle brings the females into egg production. While they are nesting and rearing the young, the parents are bound to the nesting and feeding area. As the young reach maturity, the increase in numbers develops a population pressure that usually affects the behavior pattern in at least two important ways.

First, it emphasizes competition in the food supply and forces either longer hours of searching or longer distances of travel to find an adequate food supply. Second it increases the number of social contacts which produce more nervous reactions that may trigger less social or anti-social behavior. Either one or both of these may trigger the well known widespread dispersal drive in either adults freed from parental duties, or in young birds on the wing that have become independent of parental care. Both are then free to wander at will; in many cases the young go without companionship of older birds to guide them in their movements.

When the wandering drive lures the young seabirds away from their home grounds, they may wander in unknown directions. There appears to be little in the literature from which prognostications can be made, but it is possible that extensive banding operations on these birds might reveal flight patterns that are now not known. Since many of them inhabit islands, it is likely that the movements will be guided by some hereditary traits not presently understood that will enable them to navigate the air in suitable directions to find other islands. Perhaps the young birds may be influenced by wind patterns since many species seem to follow the clockwise circulation of wind around the northern Pacific.

WINGED INSECTS

Some of the winged insects of Eniwetok doubtless reached the atoll from other places on their own power. In other parts of the world, some insects have regular migration routes and patterns much like some of the birds. Whether such routes exist in the Pacific has not been established. If not, insect exchanges between islands may be haphazard or accidental. The distribution of mosquitoes has been better studied than most other insects but these studies have not revealed any special migration pattern even though they are well distributed through many of the tropical islands. It is more likely that they are blown by winds than that they are driven by a migration behavior pattern.

Other correlations were indicated for Japanese B encephalitis in temperate and tropical far eastern Asia; Murray Valley encephalitis in Australia and New Guinea; but the cases for Russian spring-summer viruses and louping ill are not so clear.

He concludes that since bird migrations probably do disseminate these viruses, yet this does not answer all the questions, and other factors must be involved in any satisfactory explanation of virus distribution. It is entirely possible that there might be a correlation in the Pacific between encephalitides and bird movements.

In considering the problems of global bird migration with particular reference to the Pacific area, Kuroda (1961:417) recognized five major Pacific flyways, namely: 1) North American coastal flyways, from Alaska southward along the coast, 2) Central Pacific flyways, mainly from Alaska and Aleutians southward via the Hawaiian and Leeward islands to the islands of Oceania as far as New Zealand. These are mainly waders and shorebirds that are experts in island hopping across the broad waters of the Pacific, 3) Western Pacific Japanese flyways, mainly from Siberia, either along the Pacific Coast or along the Kamchatka Peninsula and the Kurile Islands to the Japanese islands, from whence one path leads toward the East Indies, New Guinea, Australia and even New Zealand while another veers slightly eastward through the Volcanoes and Marianas toward the Caroline Islands, 4) Southern Hemisphere flyways which are directed northward, especially from the south temperate to tropical areas, and 5) Seabird flyways, represented principally by the albatrosses, shearwaters, petrels, and pelican allies. These include trans-equatoral north-south movements, subcircular east-west travels and round-the-Pacific components, generally clockwise following the winds.

The Central Pacific and the Seabird flyways are obviously of prime concern in this report because birds on other flyways have high probabilities of missing the area of this study. For practical limitations, these will receive principal emphasis. For the Central Pacific flyway, there is a definite seasonal correlation of bird movements with time of year, and predictions of migration times and directions can be made with reasonable accuracy. Seabird movements are less well understood and there may be little, if any correlation with seasons. Such movements are more likely to be timed with internal physiological than with external environmental stimuli.

Central Pacific Flyway

Migrating shorebirds from the Alaskan region using the Central Pacific Flyway might stop at Eniwetok in both southward flight in the fall and northward flight in the spring. Details of bird migrations across this atoll are not well understood but since Eniwetok is at the westernmost edge of the Marshall Islands, there is greater probability that it would be on the fringe of the main flow of migrants in both directions. Going south, this fringe could well miss the main group of the Marshalls and push southward toward Ponapé, Kusae and

OCEAN CURRENTS

The ocean maintains a marine flora of bacteria, fungi and other microorganisms, but this is little studied and poorly known in comparison with the terrestrial flora. There is doubtless some interchange of such organisms between sea and air, but the extent of such exchanges is also poorly understood. The question of whether terrestrial pathogens will live in the ocean is stated by ZoBell (1946:182) thus: "It is the consensus of opinion that there are no autochthonous marine bacteria which affect man, but the literature is replete with contradictory accounts of the viability of adventitious pathogens in sea water. Some workers hold that sea water is highly lethal for bacteria from land-dwelling animals while other workers present data which indicate that such bacteria can live almost indefinitely in the sea." Recent work has indicated that lethality of sea water may be due to heavy metal ions (Jones, 1962:20). As ZoBell envisions it, the differences have arisen largely through differences in methods of study. The use of seawater separated from the sea gives rise to different results if the seawater samples are subjected to different treatments.

Sea water in the ocean is being continually agitated by waves that hasten gaseous exchanges with the air at the surface. Currents are continually mixing the surface water with that below. However, fresh water entering the ocean may overlay the denser sea water below and produce a layering effect in dynamic balance between inflow of fresh water and its diffusion with sea water. Plankton production at any place varies considerably with changes in the microhabitat, including chemical and physical composition of the water; the amount, duration, and portion of the sunlight spectrum available; and the biotic competition present.

Samples taken from the ocean upset this dynamic balance of the microhabitat in various ways. Straining removes large organisms; filtering removes the plankton and reduces chemical exchanges; autoclaving kills the living organisms and leaves the decomposing remains in the water; bottling the water reduces gaseous exchange; removing samples from the sea exposes them to different temperature and light conditions as well as removing them from mass action and reducing the biotic competition. There is no certainty that experiments performed with samples separated from the sea will reveal the role of the sea itself.

Professor Penso of the Institute Superiora di Sanita, Rome, Italy told me (personal conference) that the problem of pathogen transmission in the ocean was poorly studied because it was difficult to culture the organisms in sea water but he stated that certain organisms such as Salmonella could be obtained in the Mediterranean Sea at many places along the Italian coast, especially near the mouths of streams even though they could not be cultured in vitro studies.

Dr. John Liston, Marine bacteriologists, Associate Professor, College of Fisheries, University of Washington, stated (personal communication) that Coliform bacteria had been found in fishes taken around Eniwetok Atoll and in other inshore areas but he th ught they did not persist beyond about three miles from shore. Colwell (1961), a student of Liston, studied the commensal bacteria of marine

animals in the Pacific ocean and established the existence of a distinct commensal flora of bacteria on both vertebrates and invertebrates. It was Liston's impression that there was little likelihood that ordinary terrestrial pathogens would survive immersion in sea water and be transported to other lands by ocean currents. If so, the ocean could be considered as an aquatic desert that would act as a barrier to dissemination of such organisms.

Marine Animal Transmission

This hypothesis that the ocean itself may act as a barrier would not necessarily apply to marine animals, some of which are known to be potential hosts of pathogens that may be disseminated through marine faunas. It is well known that certain pathogens, e.g. Pasteurella tularense, produce epizootics among fresh water faunas, such as muskrats and beavers (Banfield, 1954; Fenstermacher, et al., 1949; Green, et al., 1929; Green, 1937; Jellison, et al., 1951; Labzoffsky, et al., 1952, Larson, et al., 1955; Parker, et al., 1951; Schwartz, 1929; Scott, 1940).

In our conversation, Professor Penso called attention to the potential mechanism for transmission of diseases from fresh water to sea water among eel fishes that come from both American and European rivers on both sides of the Atlantic to breed in the sargasso seas off the Bermuda Islands. After hatching, the young eels return to their ancestral fresh waters on both sides of the Atlantic where they remain for several years until they reach maturity and return to breed at the place of their birth. This appears to provide a potential mechanism for transmission of diseases from fresh water into sea water and across the Atlantic Ocean, but I have found nothing in the literature to indicate that it is known to be a significant factor of disease transmission.

In a conversation with Dr. Anita Brinkmann at the Stazione Zoologica, Villa Communale, Naples, Italy, she stated that the problem of terrestrial-marine transmission of disease was not well studied there, but it was a well known custom at Naples to refrain from eating raw oysters, mussels and other mollusks taken from the Bay of Naples during the summer months because of the danger of contracting typhoid, typhus, or other digestive disturbances (probably hepatitis or salmonella) during the summer months. These diseases occurred at other times of the year, especially after rains, presumably being derived from the water supplies. The mode of transmission had not been studied, but they were aware of the problem.

It has recently been reported in a mimeographed statement on Viral Hepatitis prepared by the Communicable Disease Center, Atlanta, Georgia, without date, that "recent outbreaks of hepatitis have occurred in this country (United States) and Sweden among persons consuming raw shellfish which were taken from fecally infected waters. . . . . Shellfish that come from waters known to be contaminated with sewage should neither be consumed nor sold for consumption."

An epizootic among marine faunas of seals was reported by Laws and Taylor (1957:315) but the cause was not accurately determined. In this case, about 3,000 crabeater seals, Lobodon carcinophagus; 300 Weddell seals, Leptonychotes weddelli; and 10 Leopard seals, Hydrurga leptonyx were wintering below South America in the Crown Prince Gustav Channel between the east coast of Graham Land (north tip of Antarctica) and adjacent islands during the southern hemisphere winter of 1955 (May to November). A mass die-off occurred among the crabeaters but did not affect the other two species.

The crabeaters were concentrated in about six areas usually close to open water. Dead seals were first observed on September 4 and by mid-October, there was a very high mortality, ranging from an estimated 0 to 97 per cent of the populations as follows, beginning at the north end of the channel: At Duse Bay, 400 seals alive; from View Point to Egg Island, 50 seals, 50 percent dead; at Red Island, 500 seals, 90 per cent dead; in Sydney Herbert Sound, less than 50 seals, some dying; near Carlson Island and Cape Lagrelius, 1000 seals, 97 per cent dead.

Investigation of pathology in 10 of these seals showed white flecks on kidneys and livers of two specimens; some kidneys enlarged; acute congestion of all lungs with areas of collapse, consolidation and emphysema; spleens engorged with blood had indications of extensive hemolysis; kidneys showed evidence of acute nephritis; and other minor pathological changes. In the opinion of Mr. A. R. Jennings, who examined the specimens, "death was certainly due to disease and probably to a virus infection."

Another example of marine animal disease, perhaps of worldwide significance, is reported by Candolin (1953). This is the disease known as seal finger (spekk-finger) which has been transmitted to man in many parts of the world where seals occur. In man, the disease usually occurs as an infection in a finger of seal hunters or handlers, probably introduced from infected seals or seal carcasses through abrasions in the skin. Candolin states that the disease is well known in the Baltic, in the North Atlantic around Spitzbergen, Greenland, Newfoundland, and Laborador; is less well known in the north Pacific around Kamchataka and the Pribilof islands; and is almost unknown in Japan and the Canadian Pacific coast. It is poorly known in the Antarctic and in Australia, southern Africa and South America.

Although poorly known among medical people and inadequately studied, Candolin indicates that it is an important disease that may incapacitate a seal worker for half of the sealing season. In his investigations in the north gulfs of the Baltic Sea, that author found 244 cases in 193 patients, some of them having been infected more than once (2 to 7 times). The disease is unknown among the freshwater seals of Lake Ladoga in Russia.

Infections come mainly from the true seal group, Phocinae, but other seals and walruses also carry the infection; only monk seals and sea lions have not been implicated so far. The disease occurs principally in the spring. The infection usually manifests itself as a swelling of the finger that usually affects a joint

and is accompanied by insufferable pain. This is accompanied by extensive oedema in the fatty tissue, infiltration of plasma cells and lymphocytes and by circulatory disturbances. The swelling may last for months. Aureomycin is indicated as the best known treatment (250 mg. every 6 hours, 12 to 16 doses total). The causative agent is still unknown.

I have been informed by Dr. Donald D. Bode that fishes from the Pacific Ocean showing radioactivity appeared on the Japanese market after the Atomic detonations in the Pacific atolls. Presumably, the fish were taken from waters of ocean currents that had passed sources of radioactivity. The episode poses the question whether fishes of ocean currents passing atolls where terrestrial parasites and diseases are present might carry these deleterious organisms with them.

In discussing the breeding colonies of terns on Cape Cod, Massachusetts, Austin (1961:135) comments "diseases, caused by epizootics of which we know little, sometimes wipe out the young before they are two or three days old."

Winds

Ever since Pasteur demonstrated the transmission of microorganisms through the air, there has been much speculation about what organisms are so transmitted. There has been little difficulty in establishing the fact that bacteria, fungi, pollen grains, moss spores, protozoans, insects and other organisms are airborne (Pady and Kelly, 1954:202). These authors reviewing the literature, call attention to the revolution in thinking on the subject. Early investigators in the 1880s (Certes, 1884 and Fischer, 1886) reported that ocean air was practically sterile, the numbers depending upon survival of land organisms. By 1936, ZoBell and Matthews had cultured separately sea and land organisms found in the air. These and later studies led to the conclusion (Pady & Kelly, 1954:203) that "while some bacteria are carried into the air from sea water by spray, very few, if any, fungi come from such a source."

Seasonally, it was found by Pady & Kelly (1953) that air over the Arctic Ocean was practically sterile in winter but summer air had highly variable numbers; southerly winds brought large numbers of bacteria and fungi, northerly winds few. Quantitative studies by the same authors (1954:209-210) over the Atlantic Ocean tended to corroborate the conclusion that air masses from the tropics carried 2 to 3 times more viable fungi and bacteria than air masses from the arctic. In these studies, it was found that Cladosporium, a well known saprophyte on decomposing plant materials, was the commonest and most persistent (highest viability) of the fungi and that Micrococci led the bacteria with 41.4%. Other bacteria included Sarcina (13.2%), Gram negative rods, gram positive pleomorphic rods, and aerobic spore formers.

Food Relationships

The energy-transfer food-chains that have their origins in sea or soil have many points along the way which offer possibilities of parasite or disease transmission. Those chains originating in the sea (lagoon) usually begin with

the phytoplankton and pass through zooplankton, echinoderms, mollusks, segmented worms, crustaceans, or other invertebrates to reach the fishes. The plankton feeders of each group are usually used as food by predators or carnivores of the same or of other groups. The fishes and other marine animals fall prey to birds that roost or nest upon the land. Microorganisms, round worms, and tape worms are noteworthy as being transmitted with their hosts that fall prey to predators.

Those chains arising in the soil begin with green plants and pass through a large series of terrestrial organisms to reach the predators at the top. The green plants offer a great variety of food. The wood of certain plants is infested with long-horned wood-boring beetles and the bark is underlain with bark beetles. The leaves are attacked by aphids, scale insects and leaf hoppers and by several species of true bugs, such as the mirids, coreids, and chinch bugs that suck out the sap. The leaves are eaten by many animals. Leaf miner flies excavate tunnels in the spongy tissue between the veins of Scaevola; caterpillars chew the leaves, and leaf-cutter bees cut sections out and carry them away. No doubt other insects not yet included in the list play a part in foliage consumption.

Flowers, fruit and seeds offer further variation in proffered diets. Flower beetles, butterflies, moths and other unlisted insects inhabit or visit the flowers in search of pollen, nectar or prey. The large fleshy calyces of the morning glory supply both food and water to the polynesian rat, which also eats seeds of some of the plants. On islets with Cocos palms, the coconuts provide food for both the polynesian rat and the coconut crab as well as having some left over for insects. Drosphila flies infest ripe fruits.

Microorganisms falling on leaves, flowers, fruit, or seeds might be ingested by vegetarians feeding on these plant products. It is less likely that they would get into the digestive systems of bark and woodboring beetles, sapsucking bugs, or other sucking insects. Among the scavengers that feed upon decaying decomposing or waste material are a number of animals that might ingest microorganisms found among such effete substance. They include such forms as sandfleas on the beach, earthworms in moist soil, sowbugs, pseudoscorpions and millipeds in moist litter, termites in moist logs, ants on the surface or in subsurface galleries, house flies, blow flies, and dermestid beetles in almost any filth, and boubtless others not included in the lists.

The main source of potential parasite and disease transmission occurs among the insectivorous and predatory vertebrates that feed mainly upon other animals. Prey infested with parasites or diseases may pass them onto the predator. This is a very complex set of relationships even in a simple atoll biota. Among the insects are incheumons and sarcophagid flies that parasitize other insects, robber flies that catch other insects and suck out their juices, lacewings and ladybird beetles that prey on aphids and other soft bodied insects, ceratopogonids and chironomids that may be potential bloodsuckers, and many other similar relationships. Nearly all the spiders catch insects for food and some of them even catch small lizards in their webs. A typical food-chain in the Marshall Islands, as adapted for Eniwetok is given in Table 3.

Table 3. A general pattern of the food chains in atoll islets of the Marshalls, adapted from Usinger and LaRivers (1953:22-27) is given below. Much of it applies to Eniwetok Atoll.

Stratum	Herbivores	Scavengers (Saprophagous)	Predators
		MARINE ENVIRONMENT	
Surface	Plankters		Water striders
		STRAND	
Open beach	Sand crickets	Sand fleas house flies	Robber flies crab spider ghost crab rock gecko plover, tattler
		VEGETATED BEACH	
Foliage	Leaf-miner fly in Scaevola caterpillars on Messerschmidia leaf cutting bees	Ants	Lady bird beetles syrphid fly green lacewing spiders geckoes, skinks
Bark and deadwood Woodbores	Bark beetles cerambycid beetles		Staphylinid beetles predaceous bugs, spiders geckoes, skinks
Ground	Sand crickets		Crab spiders, ghost crabs rock geckoes plovers, herons
		WOODLAND	
Tall trees	Coconut scale leafhoppers	Bark lice ants	Earwigs, spiders reduviid bugs geckoes, skinks
Ground cover	Red spider mites green grassbug hopping plant bug sedge bugs, false chinch bugs, leafhoppers thrips, bees, aphids, mealybugs, caterpillars	Ants	Damsel bugs, thrips, ladybird beetles, spiders, stink bugs, green katydids, geckoes, skinks
Fallen coconuts	Rats, coconut crabs		
Fallen logs	Fungus beetles fungus flies	Weevils, wireworms termites stag beetles	
Soil		Earthworms, sowbugs millipeds, ants	Hermit crabs geckoes, skinks

Among the crabs, there are vegetarians, scavengers and predators. Among the reptiles, the blind snake is a burrower and gets its food underground, the small lizards are mainly insectivorous, the large monitor lizard preys on other vertebrates and the green sea turtle is a marine feeder. The polynesian rat is omnivorous and feeds on many things.

Birds are the most likely source of parasite and disease transmission. In the case of these Arctic breeding shorebirds that regularly use the Central Pacific Flyway and stop at Eniwetok Atoll, there is a potential hazard of their bringing parasites and diseases to the atoll or of carrying them away, if either the birds or their parasites are carriers. Such transmission may take both south in the late summer or fall (usually July to November) or bring them north in late winter, spring or early summer (usually February to June). Young birds that do not return to the breeding ground for two or more years may remain at this atoll or other Pacific islands until they approach sexual maturity. They would then fit into their species pattern of migration.

If the birds themselves were infected, it seems probable that the energy drain on their physiology might either delay their departure or prevent them from reaching their next island destination. In either case, there would be little hazard of spreading either parasites or diseases to other islands. Infected parasites which reach the host destinations with their hosts may be transmitted to other hosts of the same or other species.

The regular seabird nesters at the atoll present a different ecological hazard. These birds usually maintain a continuing population at the atoll. Infected birds would be potential transmitters to other birds or to parasites at any time of the year. A focus of infection established at the atoll might be permanently reservoired either in the vertebrates or their parasites. Any spreading of disease to other islands by these birds would depend upon migrants or wanderers that leave their home range and go elsewhere. Since their migrant and wandering patterns are not known, the transmission potential of the hosts cannot be satisfactorily predicted.

RELATION TO ISLAND POPULATIONS

If infected hosts move from one island to another, there is a probability of spreading the infestation and infection of parasites and diseases on the new island by 1) exchange of parasites to other hosts, or 2) transmission to other hosts by free-living periodic parasites such as mosquitoes or biting midges. By the first route, infection might reach human populations indirectly by first establishing a focus on the island; by the second route, it might be transmitted directly to human hosts from free-living vectors that obtain blood meals from infected birds.

I have been informed by Captain Wallace Murdock, who has made a world-wide study of tabanid flies, that he has found no record of any of those flies biting birds. If it is true that tabanids do not bite birds, they could be ignored as possible vectors from birds but not from mammals to human hosts. The relations with reptiles are not well understood.

Table 4. Native human populations of Marshall Islands, 1860-1958, compiled from published figures by Edwin H. Bryan, Jr. Published figures for 1948 do not agree with published total.

Atoll or Island	1860	1880	1906	1920	1930	1935	1945	1948	1954	1956	1958	June 30 1961
Ailinglaplap	200	220			734	682	913	706	893	1386	1256	
Ailuk atoll					305	293		319	432	400	411	
Arno atoll		1000	1600		1062	942	1017	1014	1219	1191	1005	
Aur atoll	1000	1000	300		253	279	388	399	539	395	238	
Bikini atoll					127							
Ebon atoll	1000		2000	850	605	648	801	784	875	745	873	
Eniwetok atoll					121	81						
Jaluit atoll	500	1400	955	995	1630	1989	1194	862	1241	1172	1112	
Jabwot Island					48							
Kili Island					32	26			187	205	255	
Kwajalein atoll	100	200		500	973	1079	747	832	1233	1371	1240	
Lae atoll	500	200	200	250	79	88	101	138	164	109	163	
Lib Island	50	50	20		73	68	64	84	57	76	43	
Likiep atoll	300	1000			472	495	505	503	610	712	602	
Majuro atoll	1000	1000	1604	1400	755	782	1236	1537	1522	2706	3336	
Maloelap atoll	1000	1000		900	400	460	298	451	502	390	452	
Mejit Island	50	50	100	500	318	324	323	302	354	421	334	
Mili atoll	700	700	700		550	515	294	272	215	393	405	
Namorik atoll	400	400		750	405	368	327	429	482	735	509	
Namu atoll	50	150		190	257	276	288	341	420	420	471	
Rongelap atoll	120	18	100	110	92	98	100	95	118	174	262	
Rongerik atoll	80	120	20	80	11	6		198				
Ujae atoll	500	300	200	130	143	160	122	243	185	185	161	
Ujelang atoll		20			11	40		136	167	193	171	
Utirik atoll		40	25	90	145	126	166	164	136	197	194	
Wotho atoll	40	25	30		25	47	40	31	37	52	66	
Wotje atoll		300	350+	260	544	590	329	320	290	356	369	
TOTAL	7590	9193	8204	7005	10170	10462	9253	10160	11878	13984	13928	15399
Total men								5066	6123	7089	7175	
Total women								5018	5755	6895	6753	
Eastern Caroline Islands				21426	23401	24082						
Ponape district				6638	8201			7763	12137	12654	14335	16434
Truk district				14788	15200			14608	16946	17477	19807	21309
Western Caroline Island												
Yap district				8177	6329	5801		4745	5071	5251	5459	5797
Palau district				5605	5794	6022		6169	7726	7999	8845	9674
Mariana Islands (excluding Guam)				3398	3829	4297		5565	7380	7674	8220	9300
												77913

Since the opportunity for exchanges of parasites and diseases increases with greater contacts between hosts, vectors, and human populations, we had Table prepared by Edwin H. Bryan of the Bishop Museum to show the native human populations of the atolls and islands of the Marshall group and comparative totals for the Caroline and Mariana groups. This shows the trends in population shifts over a century from 1860 to 1961. No population records have been found for Jemo Island and Ailinginae, Bikar, Erikub, Pokak (Taongi), and Taka atolls. They are presumed to be uninhabited.

MEDICALLY IMPORTANT ARTHROPODS

Arthropods of potential medical and veterinary importance at Ponape have been listed by Hurlbut (1918, Pacific Science, 3(3):278 as follows. How much of this list applies to Eniwetok is unknown.

Mites: Trouessartia rosterii Berlese; host-starling (Aplonis opaca ponapensis). Myocoptes musculinus (Koch); host-mouse. Radfordia affinis (Poppe);host-mouse. Echinolaelaps echidninus (Berlese); host-rat. Laelaps nuttalli Hirst;host-rat. Ticks: Boophilus sp., probably B. annulatus australis (Fuller) previously reported by Alicata (1948, Pacific Sci.) host-dairy cow. Amblyomma sp.; host-domestic pig.

Sucking Lice: Pediculus humanus capitus Degeer. Haematopinus Newm.; host-domestic pig. Biting Lice: Lipeurus caponis (L), Menopon gallinae (L), and Oxylipeurus dentatus (Sugimoto) host-wild chicken (Gallus gallus). Actornithophilus incincisus(Piaget 1880); host-tern (Anous stolidus pileatus). Myrsidea sp.; host-starling (Aplonis opaca ponapenis). Fleas: Ctenocephalides canis (Bouche); hosts-dog, pig, goat.

Biting midge: Culicoides esakii Tokunaga. Annoying in hte forests of the interior. Mosquitoes: Aedes aegypti (L); Aedes sp.; Aedes sp.; Culex quinquefasciatus Say; Culex annulirostris Skuse; Culex sp.

Filth-frequenting flies: Chrysomya megacephala (F.); Chrysomya rufifacies (Macq.); Chrysoma (Microcalliphora) nigripes Aub.; Hemipyrellia tagaliana (Big.); Musca domestica L; Musca sorbens Wd.; Ophyranigra (Wd.); Ophyra chalcogaster (Wd.): Sarcophaga peregrina (R.D.): Sarcophaga knabi Hk. Biting flies: Stomoxys calcitrans (L): Siphona irritans (L).

Parasitic flies: Ornithoctona plicata (Olfers); host-pigeon (Ducula oceanica townsendi). Ornithoica pusilla(Schin.); hosts-wild chicken (Gallus gallus) and starling (Aplonis opaca ponapensis). Cyclopodia sp.; host-fruit bat.

SUMMARY AND CONCLUSIONS

Eniwetok Atoll, consisting of about 40 islets on a coral reef enclosing a lagoon about 20x25 miles in size, is located in the path of the northeast trade winds at the northwest extremity of the chain of Marshall Islands, approximately latitude 11°30′ N and longitude 162°15′ E in the western Pacific Ocean. It rests on volcanic olivine basalt about 4500 feet below the surface. Nuclear detonations at the atoll during the past several years have severely disturbed some of the flora and fauna and left considerable radioactivity behind that still affects the welfare of many of the plants and animals through biotic concentrations of the radioactive substances in living organisms.

The islets have typical atoll vegetation consisting mainly of scaevola shrubs, messerschmidia trees, grasses, sedges, and vines on small islets and denser forests on larger islets. The latter have better soils and more extensive vegetation, including coconut palms, pandanus, morinda, pisonia, guettarda, cordia, terminalia, and ochrosia trees and other vines and shrubs. Much of the vegetation devastated during the last war and during the nuclear detonations is recovering but has not yet reached maturity.

A sparse fauna of invertebrates, mostly common forms of widespread occurrence in Micronesia, is associated with the vegetation. This fauna includes at least six species of terrestrial mollusks, about a dozen species of amphibious crustaceans, four species of pseudoscorpions, two species of spiders, and an unknown number of insects, of which 38 are listed. All, except the crustaceans appear to be terrestrial forms that have reached the atoll across the ocean waters. The crustaceans have been derived from the sea.

A limited fauna of vertebrates, dominated by birds, also occurs on the islets. The Polynesian rat, Rattus exulans, is the only known mammal, except for feral dogs, cats and rats, on one or two of the islets. The herpetological fauna is limited to reptiles; there are no amphibians. The reptiles include about nine lizards, a blind snake, and two marine turtles. The lizards are terrestrial inhabitants of the vegetation, the blind snake is a burrower in the soil, and the marine turtles return to land (seashore) to deposit their eggs. The hatchlings return to the sea. There are no freshwater fish.

The bird fauna includes 23 species observed during the spring of 1962. Others are of record or suspected of occurrence. Of these 23, seven are migratory shorebirds nesting in the Arctic and migrating through the atoll. Four of these seven species are common in winter and in migration; the other three are sparse or accidental migrants. Of the 23 species, nine are terns known to occur at the atoll. Of these nine, four are found only in small numbers, one is common but has not been found breeding, and four are common colonial nesters. A population, approximating 45 to 50 thousand of the breeding terns, forages in the lagoon and surrounding areas.

Endoparasites and microorganisms are not well studied. More is known about the ectoparasites of birds. A list of the ectoparasites known from nine species of the most common birds has been prepared and these have been rearranged in a

separate list to show known hosts for each parasite. Human pathogens that might be reservoired in the native fauna have not been determined.

Exchanges of biota with other oceanic islands may occur over pathways that include: 1) human transportation, 2) flying animals (birds, winged insects), 3) ocean currents, and 4) winds. Human transportation systems offer potential transpost of plants, animals, parasites and microorganisms. Birds may carry plant seeds, algae, microorganisms, or small animals in mud on their feet, endoparasites or microorganisms in their bodies and ectoparasites in their feathers, as they move from island to island. Winged insects fly and young spiders baloon in the air and both may be carried by winds to other islands. Some insects may carry either external or internal parasites. Ecto-parasites and free-living blood-sucking dipterans may transmit microorganisms including pathogens from host to host.

In addition to carrying small animals, heavy winds such as tornadoes may carry salt spray, dust, and microorganisms unknown distances. It is well known that wind currents carry many kinds of microorganisms derived from both land and sea sources and spread them around the world. It is probable that all of the Pacific islands are being bombarded continually with such organisms. The effect of this bombardment is not known.

It is a general concensus of opinion that ocean currents circulating around the Pacific may carry certain plant seeds and small animals resistant to immersion in sea water to distant shores but is a barrier to the dispersal of the great majority of terrestrial plants and animals. The effect on the dispersal of terrestrial microorganisms in seawater is poorly understood, but it is known that marine shellfish exposed to contaminated sewage can transmit such human diseases as typhoid, typhus, hepatitus, salmonella, and possibly other types, even though they cannot be cultured in vitro studies. The mechanism by which the contamination spreads is not well understood but the evidence points toward an hypothesis that the disease microorganisms may become associated with marine plankton that are concentrated by the shellfish in a manner suggestive of the biotic concentration of radioactive substances.

It is well known that freshwater animals are subject to epizootics such as duck sickness in waterfowl and tularemia in muskrats and beavers, but epizootics in marine animals is not so well known. A case of die-off of crabeater seals in Antarctica is known and a disease of seals transmitted to man (spekkfinger) has been reported from the Baltic and many other parts of the world. Nothing is available concerning diseases of marine mammals at Eniwetok.

Food chains offer many pathways by which energy, parasites and micro-organisms may flow along the pathways of food transfer, particularly from plants to vegetarians, prey to predators, hosts to parasites and parasites to new hosts. Most of the aquatic birds of the atoll feed on marine organisms gathered from the sea and roost upon the islets where their excreta fertilizes the soil with phosphorous, potassium and other minerals.

Some of the birds at the atoll feed on insects, crabs, lizards, young turtles, or other terrestrial animals and open the way for speculation about the potential transmission of disease through some of these pathways.

The cycles of parasite and disease transmission through bird-fish-bird or bird-crustacean-fish-bird sequences suggested by cycles occurring elsewhere have not been studied at Eniwetok. The ectoparasites of birds include groups that have been incriminated in some types of disease transmission and there is good reason to believe it is feasible to transmit pathogens by ectoparasites from host to host both intra and interspecifically among the birds. Although no mosquitoes are known from Eniwetok, yet when birds move to other islands where they occur the birds may become involved in disease transmission cycles involving mosquitoes or other free-living vectors.

Social contacts such as those involved in family rearing or flocking aggregations enhance the possibilities of food, parasite, or disease exchange. The expert island-hopping shorebirds from Arctic breeding grounds that pass Eniwetok, associate with local birds and often leave contingents behind to spend the winter. The seabird nesters at Eniwetok breed in large colonies. When not breeding, these birds may move around the Pacific region but the migration patterns are not well known. Non-breeding birds are common at the Atoll and must come from some other source.

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Emoia sp. . . . . Brown emoia
Range: Arno (Marshall, 1951)
Habitat: Mainly a ground dweller; occasionally climbs trees; on rocks, gravel beaches, around base of trees; avoids dense shrubbery and thickets.
Habits: Poke heads under things, roost at night in special places under rocks or other protection such as under large leaves, from 6:15 p.m. to 7 a.m.; sleep with eyes shut.
Food: Earthworms, ants, maggots, other insects.
Color: Black or brown
Parasites: Rectal flagellates; stomach nematodes; nematode encysted in mesentery.

The blind snake, verbally reported to me from Eniwetok Atoll by E. E. Held, has not yet been identified.

CHELONIA (order) . . . . . Turtles

Chelonidae (family) . . . . . Sea turtles

Chelonia mydas agassizii Bocourt 1868 . . . . . Pacific green turtle
Range: Warm seas of the Pacific Ocean.
Habitat: Shoal waters with submarine vegetation.
Food: Adults mainly herbivorous on marine algae; captives eat fish.
Breeding: Female leaves the ocean and walks up the sandy beach and lays 75 to 200 round soft eggs in holes dug for the purpose. After a pit is excavated, she digs holes for the eggs with her hind legs. They are buried by covering with sand pushed into hole by front legs and plastron, then smoothed and left without guarding. Eggs hatch in 45 to 60 days. Hatchlings dig out of sand and go down beach to ocean. On the way, many of them fall prey to predators such as rats, coconut crabs, birds, and possibly others and in the sea to sharks.
Movements: Almost nothing is known of its travel in the Pacific Ocean. Its counterpart in the Atlantic sometimes follows the warm Gulf Current along the Atlantic seaboard and reaches New England, Laborador, and even European coasts, chilled by the cooler waters.

Chelonia sp. (probably imbricata) . . . . . Hawkbill turtle
Range: Warm seas of the Pacific Ocean.
Habitat: Shoal waters.
Specimen: A live specimen was captured in the lagoon off Rojoa (Ursula) islet, May 20, 1962 by Larry McIntyre and kept in a pond on Eniwetok (Fred) islet.

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An Annotated List of Marine Algae from Eniwetok Atoll, Marshall Islands[1]

E. YALE DAWSON[2]

THE FOLLOWING ACCOUNT is based largely upon collections made by the writer at Eniwetok during the late summer of 1955 and upon collections made on several occasions prior to that time by Dr. Ralph F. Palumbo of the Applied Fisheries Laboratory, University of Washington. The object of the work has been the preparation of a reference collection of algae of the atoll for deposition at the Eniwetok Marine Biological Laboratory (EMBL), where it may be consulted by future biological investigators interested in identifying algal research materials.

There exist only three previous accounts of Eniwetok marine algae, namely, Taylor's *Plants of Bikini . . .* (1950) which treats of 67 species, Palumbo's (1950) brief listing of a few entities, most identified only to genus, and Odum and Odum's (1955) mention of four species by name. The most comprehensive list of Marshall Islands algae to date has just been published by the writer (1956) in *Pacific Science*. It treats of 149 species (exclusive of Myxophyta) for the southern Marshall Islands. All but 43 of these are again listed in the present account, which includes 228 species and varieties. Of these, 36 are Myxophyta, 79 Chlorophyta, 20 Phaeophyta, and 91 Rhodophyta.

Inasmuch as this paper can be of greatest service as an aid to the identification of the algae occurring at Eniwetok, a key to all of the genera is included as well as an illustration for each species of Green, Brown, and Red Algae for which a figure is not to be found among the following accounts of tropical Pacific marine algae: Taylor, 1950; Dawson, 1954; Dawson, 1956. If these three papers are employed in conjunction with the present list, one should find it relatively easy to identify a great majority of the species encountered.

It should be noted that the key to the genera is intended to apply specifically to those algae recorded here from Eniwetok Atoll. It does not necessarily apply to species of those genera from other regions.

The short glossary of certain special phycological terms is intended to aid those of other disciplines in the use of the key.

ACKNOWLEDGMENTS

Nearly all of the algal collections cited here other than the writer's were made by Dr. Ralph F. Palumbo, who kindly contributed much time in preparing them for study in Honolulu. The list is considerably more comprehensive as the result of the availability of his specimens, which provide an excellent supplement to mine.

Dr. Francis Drouet provided identifications for all of the Blue-green Algae, so that this

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part of the list may be considered entirely his own contribution.

Dr. Harold St. John kindly prepared the Latin diagnoses of new taxa.

Special thanks are due to Dr. Robert W. Hiatt for making all the arrangements for carrying out this study, and to Dr. Maxwell S. Doty for the use of his library and other facilities in Honolulu. Several others contributed help in various ways, especially Mr. Malvern Gilmartin, Mr. A. Dexter Hinckley, Mr. Robert T. B. Iversen, Mr. James Stewart, Dr. Donald W. Strasburg, and Dr. A. J. Bernatowicz.

Photographs are by Mr. George Edelman.

COLLECTING LOCALITIES

Inasmuch as a number of variations occur in the spelling and application of the names of islands in Eniwetok Atoll, a list is presented here to show the equivalents. The list follows the succession of islands in a clockwise manner, beginning with Bogallua in the northwest part of the Atoll. The first name given in each case is that used in the text and in the labeling of specimens, followed by some common variations which may be encountered on United States maps and in geographical publications.

Bogallua
Bogombogo
Eneroul = Eybbiye = Ruchi (often treated as a single island with the next)
Runo = Eybbiye = Ruchi = Cochiti
Bokanjoio = Sanildefenso
Elagelab
Lidilibut = Teiteiripucchi
Bogairik = Bogeirik
Bokaniuar
Bogon
Engebi
Muzin = Mujinkarikku
Kirinian = Biilee
Bokonaarappu
Yeiri
Aitsu
Rujoru = Lujor = Pujiyoru = Rujiyoru
Eberiru
Aomon = Aranit
Biijiri = Biiziri
Rojoa
Aaraanbiru = Arambiru
Piiraai
Runit
Enedrol
Chinieero
Aniyaanii = Japtan
Chinimi
Japtan = Muti
Bogen = Boken = Jieroru
Parry
Eniwetok
Igurin
Mui = Buganegan
Pokon = Bogan
Ribaion = Libiron = Ribairon
Giriinien = Grinem
Rigili

The following is a complete list of the writer's collections made during August and September 1955. The inclusive field collection numbers precede the locality data in each case. It should be noted that where these numbers are cited in the text they are prefixed by "D." Collection numbers by Palumbo are prefixed by "P.," and, because of their smaller number and scattering in time and space, are provided with locality data in the text. Those collections by Taylor which represent species not again collected are cited by his field number prefixed by "T."

A specimen of each of the Dawson and Palumbo collections cited here is deposited in the Eniwetok Marine Biological Laboratory, with the exception of the type specimens of new species and varieties, which are deposited in the Bernice P. Bishop Museum in Honolulu.

13607–13654. Parry Island, outer seaward reef opposite EMBL, Aug. 19.

13655–13679. Parry Island, seaward reef flat between EMBL and south end of island, Aug. 20.

13680–13692. Parry Island, seaward reef flat at extreme south end of island, Aug. 21.
13693. Parry Island, drift in front of EMBL, Aug. 21.
13694–13712. Parry Island, among coral heads in the lagoon near south end of island in 6 to 10 feet of water, Aug. 21.
13713–13716. Aniyaanii Island, inshore lagoon near landing, Aug. 22.
13717–13745. Aniyaanii Island, seaward reef just on or inside of coralline ridge, Aug. 22.
13746–13781. Aniyaanii Island, under coral and rocks in tidal washes at north side of island, Aug. 22.
13782–13798. Aniyaanii Island, lagoon side among coral heads in 3 to 8 feet of water, Aug. 22.
13799–13824; 13855–13858a. Engebi Island, ocean side reef, Aug. 23.
13825–13827. Engebi Island, on a boulder in middle of ocean side reef, Aug. 23.
13828. Engebi Island, lagoon side drift, Aug. 23.
13829–13854. Engebi Island, algal mat area on dead coral and sand bottom of lagoon side, Aug. 23.
13859–13874. Igurin Island, seaward reef, Aug. 24.
13875–13877. Igurin Island, at depth of 20 feet off edge of seaward reef, Aug. 24.
13878. Igurin Island, sand flat on sea side, Aug. 24.
13879–13880. Igurin Island, seaward reef drift, Aug. 24.
13881–13885. Igurin Island, lagoon side drift near north end, Aug. 24.
13888–13897. Igurin Island, mid-island lagoon in 3 to 6 feet of water, Aug. 24.
13898–13899. Runit Island, lagoon side bottom at about 8-foot depth, Aug. 25.
13900–13908. Runit Island, scraped from a *Tridacna* shell from 20-foot depth in the lagoon, Aug. 25.
13909–13910. Runit Island, lagoon side drift, Aug. 25.
13911–13916. Runit Island, from vertical sides of pier piles in the lagoon, Aug. 25.
13917–13925. Runit Island, on a floating bumper log fastened to the pier, Aug. 25.
13926–13936; 13940–13946. Runit Island, ocean reef flat, Aug. 25.
13937–13939. Runit Island, in the lagoon in 10 feet of water, Aug. 25.
13947–13954. Parry Island, in the lagoon among coral heads in 10 to 12 feet of water, Aug. 28.
13955–13956. ¾ mile off Aniyaanii Island, on lagoon bottom in 90 feet (drift), Aug. 29.
13957–13961. Parry Island, lagoon beach in 6- to 8-foot depths, Aug. 29.
13962–13970. ½ mile off Aniyaanii Island, around and on a dead coral head in the lagoon at 35- to 65-foot depths, Aug. 30.
13971. Parry Island, off lagoon swimming beach in 10 feet of water, Aug. 30.
13972–13983. Parry Island, in end of pipe and beneath outfall of salt water from generating plant opposite EMBL, Aug. 30.
13984–13995. Japtan Island, reef along passage opposite Parry Island, Aug. 30.
13996–14000. 1½ miles off Aniyaanii Island, lagoon bottom at a depth of 135 feet, Aug. 31.
14001–14020. Rigili Island, seaward reef near edge at north end of island, Sept. 2.
14021–14032. Rigili Island, sand bottom in lagoon in 3 to 6 feet of water, Sept. 2.
14033–14039. Rigili Island, at small island on lagoon side subject to prevailing winds, Sept. 2.
14040–14041. Rigili Island, seaward reef, Sept. 2.
14042–14043. Parry Island, lagoon swimming area, Sept. 3.
14044–14053. Parry Island, on and around tanker wreckage adjacent to passage, Sept. 3.

GLOSSARY

chromatophore: a pigment-bearing structure within the cell.
corticated: provided with a complete or incomplete layer of superficial cells over the primary axis of the thallus.

distichous: disposed in two vertical rows; two ranked.
endophytic: growing within another plant.
epiphytic: growing on another plant.
heterocysts: cells which are uniformly dissimilar in shape and (or) size from their neighbors.
intercalary: inserted between, as opposed to terminal or basal.
medulla: the central or inner tissue of a thallus as opposed to the cortex.
midrib: a vein-like or rib-like thickened axis of a blade.
monosporangium: an asexual reproductive organ in the red algae which produces a single spore.
multifarious: disposed in many ranks about an axis.
multiseriate: of more than a single row of cells.
rhizoidal filaments: thick-walled, very long cells of exceedingly small diameter running vertically between the larger cortical cells as in *Gelidium*.
rhizoids: small root-hair-like unicellular or multicellular outgrowths for attachment.
saxicolous: growing on rocks.
stichidium: a club-shaped reproductive branch in the red algae producing tetrasporangia.
tetrasporangium: an asexual reproductive organ in the red algae which produces spores in groups of four.
trabeculae: bars or strands running from one side of a coenocytic thallus to the other, as in *Caulerpa*.
trichoblast: a branched, colorless, hair-like outgrowth produced around the apex of certain red algae, usually soon falling away.
trichome: the individual cellular filament of a multicellular blue-green alga, not including the sheath.
tristichous: disposed in three vertical rows; three ranked.
uniseriate: of a single row of cells.
utricles: the enlarged, bladder-like ends of the filaments of *Codium* which are arranged to make up the surface layer of the thallus.

KEY TO THE GENERA OF MARINE ALGAE OF ENIWETOK

1. Plants unicellular, or apparently so, macroscopic or microscopic, spheroidal, ellipsoidal or club-shaped 2
1. Plants multicellular, or, if noncellular the thalli macroscopic and not solid spheroidal, ellipsoidal or club-shaped . 8
2. Plants microscopic, less than 40 μ in diameter, in pairs or colonies within a gelatinous matrix or sheath, sometimes (in *Entophysalis*) arranged in short filaments 3
2. Plants macroscopic, bladder-like 7
3. Colonies showing no particular orientation into basal and apical regions 4
3. Colonies showing orientation of cells into basal and apical regions . . . . . **Entophysalis (deusta)**
4. Colonies without definite shape; cells symmetrically ellipsoidal 5
4. Colonies with a definite shape; cells pear-shaped . . . . . **Gomphosphaeria**
5. Cells spheroidal, or hemispheroidal when divided 6
5. Cells elongate ellipsoidal . . . . . **Coccochloris**
6. Cells usually single or paired, enclosed in a thick, gelatinous sheath. **Anacystis**
6. Cells forming colonies within a gelatinous matrix. **Entophysalis (conferta)**
7. Thalli spheroidal, attached by small unbranched rhizoids cut off by a septum from the main cell . . . . . **Valonia (ventricosa)**
7. Thalli short club-shaped, attached by branched, nonseptate rhizoids . . . . . **Boergesenia**
8. Thalli multicellular or noncellular, branched if uniseriate 9
8. Thalli multicellular, but each filament consisting of only an unbranched row of cells (the false branching in *Plectonema* and *Scytonema* is the result of protrusion of a broken trichome through a rupture in the sheath) 99

Caulerpa urvilliana Montagne; Taylor 1950: 60, pl. 31, figs. 1, 2, pl. 32, fig. 1; Dawson 1956: 37, fig. 21

D. 13607, 13632, 13674, 13757, 13818, 13845, 13862. P. 2824, Runo Is. seaward reef, 3/8/55; P. 2819, Bokanjoio Is. seaward reef, 3/8/55; P. 1225A, Parry Is. lagoon in 6 ft., 4/19/54. These specimens are variable, but for the most part approach the f. *tristicha* (J. Agardh) Weber van Bosse of the type variety of the species.

Caulerpa vickersiae Børgesen; Dawson 1956: 36, fig. 18; Dawson 1954: 392, fig. 9f (as *C. ambigua* Okam.)

D. 13617a, 13988a.

Codium arabicum Kützing; Dawson 1956: 38, fig. 24

D. 13947, 14004. P. 1220, Bogombogo Is. seaward flats, 4/15/54; P. 2831, off Igurin Is. in lagoon at 50 ft., 3/16/55.

Codium geppii O. C. Schmidt; Dawson 1954: 395, fig. 13 k; Dawson 1956: 39, fig. 26

D. 13722, 13951, 13926, 14003. P. 2593, Bogallua Is. lagoon, 2/11/55; P. 52–25, Aomon Is., 10/22/52.

Dr. Silva, in a personal communication, states that reef material of this plant collected by A. Conger and examined by him certainly belongs to the *C. geppii* complex, but is referable to *C. bulbopilum* Setchell, which he is about to decide to recognize in his monograph on *Codium*.

Codium edule Silva, mentioned by Odum and Odum (1955), has not been examined, but may be referable here.

Codium saccatum Okamura 1915: 145, pl. 135, figs. 1–5 (Futaye, Amakusa Island, Japan)

Fig. 11*a*

P. 2835, Bogombogo Is. on coral of tidal flats, 5/30/54. This plant agrees in size and shape and in the morphology of the utricles except for a slight development of alvaeolae in the utricle end-walls, not shown by Okamura for the type.

FIG. 11. *a*, *Codium saccatum*: A somewhat damaged plant of P. 2835, × 0.8. *b*, *Avrainvillea lacerata*: Habit of plants of D. 13629, × 1.05.

Codium tenue (Kützing) Kützing 1856, Tab. Phyc. 6: 33, pl. 95, fig. 1; Taylor 1950: 94. *Codium tomentosum* var. *tenue* Kützing 1849: 501 (Cape of Good Hope)

T. 46–436. Not collected again. Dr. Silva has reëxamined some preserved material of this collection and states in a personal communication that he considers it an undescribed species.

Pseudochlorodesmis furcellata (Zanardini) Børgesen; Dawson 1954: 395, fig. 11c

D. 13704b, 13987, 14048.

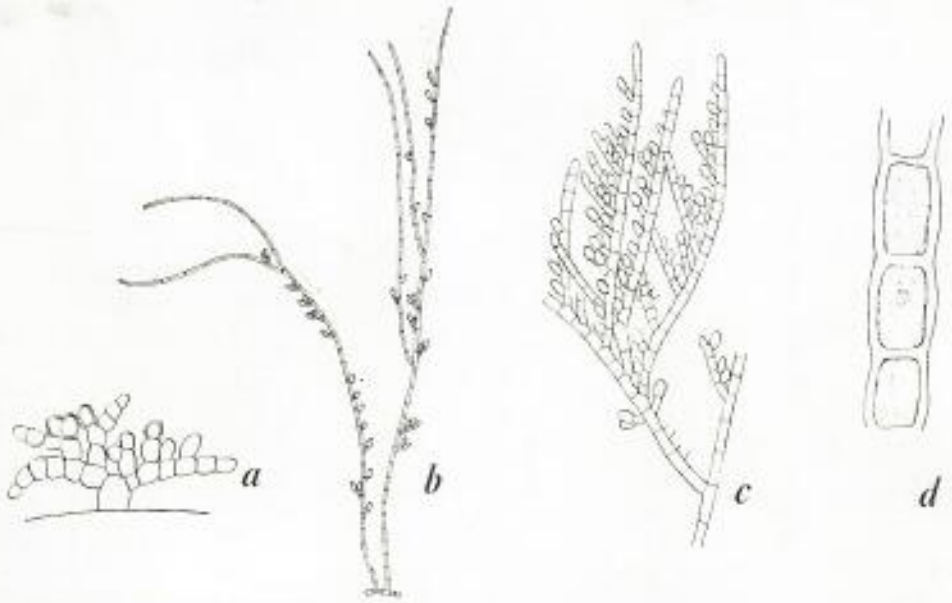


FIG. 17. *a*, *Kylinia crassipes*: Habit of a plant, × 290. *b*, *Acrochaetium gracile*: Habit of part of a plant, × 150 (after Børgesen). *c*, *d*, *Kylinia secundata*: *c*, Habit of the upper part of a plant, × 160; *d*, detail of stellate chromatophores in part of a filament, × 1000 (after Dawson).

Falkenbergia hillebrandii (Bornet) Falkenberg = sporophyte generation of *Asparagopsis taxiformis* (Delile) Collins and Hervey; Dawson 1954: 414, fig. 25l; Dawson 1956: 45

D. 13623, 13913, 14018a. P. 2836b, Parry Is. seaward reef edge, 4/4/54.

Galaxaura fastigiata Decaisne; Dawson 1954: 419, fig. 30b

P. 2805, Bogombogo Is. seaward reef flats, 2/9/55.

Galaxaura filamentosa Chou; Dawson 1954: 419, fig. 30a; Dawson 1956: 46

D. 14005. Rather scant, young material.

Gelidium crinale var. *perpusillum* Piccone and Grunow; Dawson 1954: 421, fig. 31e, f

D. 13798.

Gelidium pusillum (Stackhouse) Le Jolis, formas; Dawson 1954: 420, fig. 31a–c; Dawson 1956: 46

D. 13819, 13841.

Gelidiella hornetii (Weber van Bosse) Feldmann and Hamel 1934: 528; Børgesen 1938: 210, fig. 2a, b. *Gelidium hornetii* Weber van Bosse 1926: 107 (Kei Islands)

Fig. 21

D. 14035 is a good match for Børgesen's 1938 figure. The small size and compressed to flattened branches lacking rhizoidal filaments are distinctive.

Gelidiella tenuissima Feldmann and Hamel; Dawson 1954: 422, fig. 33e; Dawson 1956: 46

D. 13660a, 13908, 14032.

Gelidiopsis intricata (C. Agardh) Vickers; Dawson 1954: 423, fig. 34a–d; Dawson 1956: 46

D. 13903.

Wurdemannia miniata (Lamark and DeCandelle) Feldmann and Hamel; Dawson 1954: 424, fig. 35; Dawson 1956: 47

D. 13640b, 14036.

lateribus ambis corio cellulis minoribus anguloris ad 10 μ diametro, tetrasporangiis cruciatis ovatis ca. 40 μ longis in involucris valde inflatis eis ex vittis nodoris proxime juxtaposis axilarum erectarum acropetaliter productis, loculis fertilibus terminalibus 220–250 μ diametro eis *Equisetum* similantibus.

TYPE: Dawson 13620a, growing within tufts of *Ectocarpus breviarticulatus* near the margin of the seaward reef opposite EMBL, Parry Island, August 19.

This material is nearest to *Ceramium nakamurai* Dawson from Garanbi, Formosa (*C. equisetoides* Nakamura), but is not dichotomously branched. It is identical with tetrasporangial specimens cited and illustrated by the writer as a probable undescribed species from Isla San Benedicto, Mexico (Dawson 1954a: 6, pl. 4, fig. 2).

Ceramium gracillimum var. *byssoideum* (Harvey) G. Mazoyer; Dawson 1954: 448, fig. 55e, f; Dawson 1956: 53; Taylor 1950: 138 (as *Ceramium byssoideum* Harvey)

D. 13616, 13707, 13715, 13790, 13831, 13860, 13891, 13924, 13916, 13951, 14028.

Ceramium mazatlanense Dawson; Dawson 1954: 448, fig. 55g–j; Dawson 1956: 53

D. 13752, epiphytic on *Caulerpa*.

Ceramium serpens Setchell and Gardner ?; Dawson 1956: 54, fig. 53

D. 13610b, 13857. Both are sterile and not positively identified.

Ceramium taylori Dawson; Dawson 1954: 446, fig. 55b, c

D. 13637, epiphytic on *Udotea*, 13817, 13942.

Centroceras apiculatum Yamada; Dawson 1956: 55, fig. 55

D. 13941a, 14016.

Centroceras clavulatum (C. Agardh) Montagne; Dawson 1954: 446, fig. 54b; Dawson 1956: 55; Taylor 1950: 139

D. 13639, 13794, 13808, 13838, 13958 (this latter collection consists largely of f. *inerme* (Kützing) Piccone. P. 52–29, Aomon Is. shore rocks, 10/22/52.

Centroceras minimum Yamada; Dawson 1956: 54, fig. 54

D. 13640a, 14009a.

Spyridia filamentosa (Wulfen) Harvey; Dawson 1954: 444, fig. 54i, j; Dawson 1956: 56; Taylor 1950: 139

D. 13677, 13816, 13884, 13911. P. 1163, Mui Is. lagoon, 4/11/54; P. 1190, Bokanjoio Is. lagoon, 4/14/54.

Hypoglossum minimum Yamada 1936: 138, fig. 2A–D (Naha, Okinawa)

Fig. 30*c*

D. 13704, 13755, 13901, 13999d. These show considerable variation in form and habit. Those under 13999d, epiphytic on *Halimeda* from a depth of 135 feet, are most like Yamada's type.

FIG. 28. *Hemitrema fragilis*: Habit of dry plants of D. 13801, × 1.3.

Received 2/10/76

DO YOU COPY
KKK

GOOD COPY GO AHEAD
KKKKK
NR 513
HIMB DE HIG
R 110122Z FEB 76
FROM LAMBERSON, MPML ENEWETAK
TO BALAZS, HIMB COCONUT ISL
INFO MPML LIST A
BT

RE YOUR 040049Z FEB 76:

1) NO EGGS, HATCHLINGS OR BABY TURTLE TRACKS OBSERVED ALTHOUGH BIKEN VISITED ON 1 AND 11 AUGUST
2) NO OTHER NESTING SEEN, BUT AT LEAST SIX AND POSSIBLY SEVERAL MORE GREEN (TENTATIVELY) TURTLES SEEN MONDAY 9 FEBRUARY IN SHALLOW WATER CLOSE TO SHORE OF BOKOLUO (ALICE) ISLET, OCEAN SIDE REEF. Big?
3) WE HAVE TAGGED ONE SMALL HAWKSBILL AND ONE SMALL GREEN. NEITHER SEEN SINCE RELEASE. data?
4) NO MORE FORMS NEEDED.
5) WE NEED MORE TAGS SINCE I USED SOME FOR LOBSTERS.
6) YOKWE.

BT

V
NR 288
TO HIMB DE HIG
DTG 260129 Z JUN 75

TO BALAZS HIMB COCONUT ISLAND MPML LIST A
FROM LAMBERSON MPML ENEWETAK

Rec'd June 25
4:30 PM
T. Mc Adams

BT

SIGHTED APPARENTLY FRESH TURTLE TRACKS AND NEST ON BIKEN (LEROY) ISLET ONE JUNE. WHEN CAN WE EXPECT HATCHING?

BT

NR 281
TO HIG DE HIMB
DTG 012330Z JULY 75
BT
TO LAMBERSON (MPML,ENEWETAK),MPML LIST A
FROM BALAZS (HIMB,COCONUT ISLAND)

BT

WITH REFERENCE TO APPARENT TURTLE NEST ON LEROY, DEPENDING ON LOCAL TEMPERATURES AND RAINFALL, HATCHING EMERGENCE COULD BE EXPECTED TO OCCUR 50 TO 65 DAYS AFTER DEPOSITION. UNLESS YOU POSITIVELY CONFIRMED THE PRESENCE OF EGGS, IT IS POSSIBLE THAT OBSERVED EXCAVATION WAS A "FALSE" NEST. IT IS COMMON FOR SEVERAL SUCH PITS TO BE FORMED BEFORE SUCCESSFUL EGG LAYING. IN ANY EVENT, DO NOT DISTURB SITE AT PRESENT TIME AS MOVEMENT OR ROTATION OF EGGS DURING DEVELOPMENT WILL INCREASE EMBRYO MORTALITY. WILL APPRECIATE FURTHER REPORTS OF THIS NATURE. PRESERVE FOR IDENTIFICATION ANY DEAD SPECIMENS THAT ARE FOUND AFTER HATCHING AND EMERGENCE.
BT

Sent July 1, 1975
2355Z

1975

Marine Turtle Tagging Data - George H. Balazs
Hawaii Institute of Marine Biology
P. O. Box 1346, Kaneohe, 96744
Tel. 247-6631 or 946-1760

Tagged by: P Lamberson

Type of turtle: Hawksbill

Tag numbers: location A (left flipper) 964 location B (right flipper) 1426

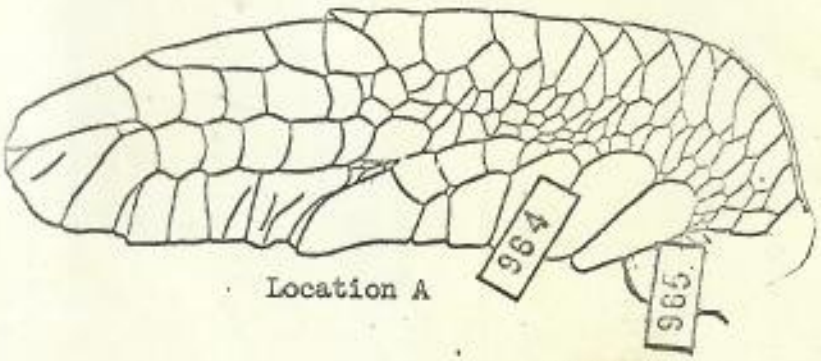
Previous tag numbers (if present): none

Curved upper shell measurements: length 37.5 cm width 35.5 cm

Length of tail past end of upper shell: —

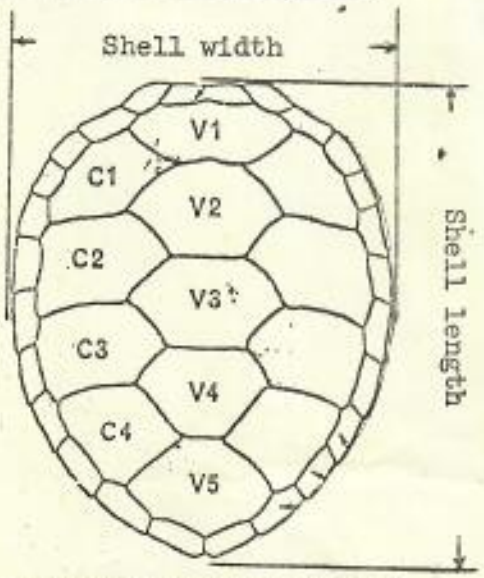
Location and date of capture and release: Captured Sat 20 Dec in 5' of water in Acropora bed lagoonside of Elle (Nancy) Islet, Eniwetok Atoll. Released same location

General description of turtle (upper and lower shell colors, injuries, tumors, barnacles, abnormal plate counts, etc.) weight 5 kg. algae on both ventral & dorsal surfaces



Location A

Location B



Top view of upper shell (green and hawksbill)

Attach tag at location A on left flipper, location B on right flipper. Tag should extend approximately 3/4 of the way on flipper, as illustrated. Tag at location A should pierce webbing between scales.

Marine Turtle Tagging Data - George H. Balazs
Hawaii Institute of Marine Biology
P. O. Box 1346, Kaneohe, 96744
Tel. 247-6631 or 946-1760

Tagged by: P. Lamberson

Type of turtle: Green

Tag numbers: location A (left flipper) 967 location B (right flipper) 1424

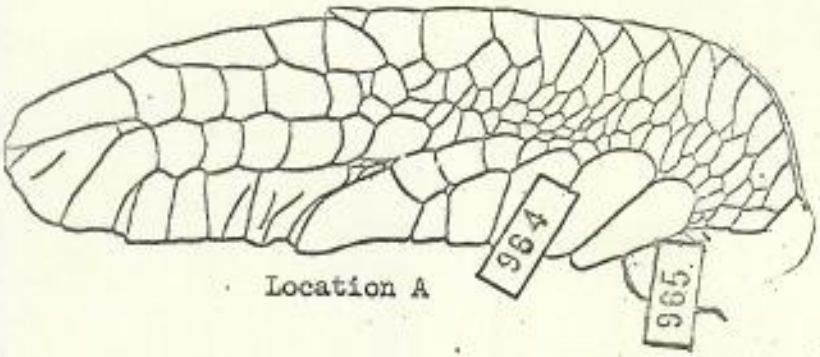
Previous tag numbers (if present): _____

Curved upper shell measurements: length 48cm width 45.5 cm

Length of tail past end of upper shell: None ♀

Location and date of capture and release: Dec 21, 1975, Shallow Reef on lagoon side of Skinimi (Clyde) Islet, Enewetak Atoll. Released 22 Dec. same location.
Wt. 12.5 kg.

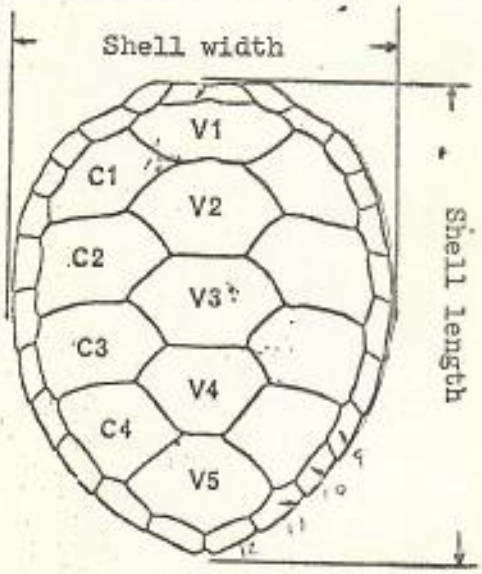
General description of turtle (upper and lower shell colors, injuries, tumors, barnacles, abnormal plate counts, etc.) Female
Algae present, most conspicuously on ventral surface near tail



Location A

Location B

Attach tag at location A on left flipper, location B on right flipper. Tags should extend approximately 3/4 of the way on flipper, as illustrated. Tag at location A should pierce webbing between scales.



Top view of upper shell (green and hawksbill)

3/31/83

George,

Thanks for sending this. I found it very interesting reading.

In regards to turtles for tasting from Brian I wrote to one of my former workers who I assigned to DOE on a loan basis to aid in the collection of reef fish during the 1978 trip. I'm hoping to get a reply from him soon. Off hand, I don't remember him telling me he collected any turtles.

In regards to your letter of 3/29 re input from neighbor island biologists on turtle info, nothing specific but we keep them informed of our activities and I like to think we contribute in this way.

Sorry we didn't touch base on your recent trip to Molokai. When you

& dropped off the Calipers, we were
Jamaby at the Airport picking up
Linda's sister who came over for a
week's stay. & that you were going
to call me that Friday night to firm
up Saturday's Rendezvous? Tol had
the chips ready!

Aloha,

Bill

Sent Large Tags 966 through 971
Intermediate 1424 through 1429

University of Hawaii at Manoa

Hawaii Institute of Marine Biology
P.O.Box 1346 • Coconut Island • Kaneohe, Hawaii 96744
Cable Address: UNIHAW

March 1, 1975

Mr. Phil Lamberson
MPML
Enewetak, M.I. APO SF 96333

Dear Phil,

Many thanks for the turtle reports which I received this morning. Although the sightings will obviously be biased for the areas commonly frequented and the intensity of the observations, I nevertheless believe that the forms will help to give me a general idea of the status of Enewetak's turtles. Your continued support in this matter is therefore greatly appreciated.

Concerning the shell in the tiger shark stomach, Helen Randal brought it out to the Island and there is little question in my mind that it is a green. Based on the size of one of the lateral laminae, it was undoubtedly a full size adult (200lbs plus). I noted with amusement and interest (but no particular concern at this stage) the "tasty!" comment for January 20th. I would not kill a turtle myself, however, if others are so inclined perhaps in each case we can get useful data. Of interest would be carapace length and width, total body weight, length of tail, stomach contests, and a few photos(color slides if possible) of the dorsal and ventral surfaces.

After discussing the matter with Steve, I can agree that starting a tagging effort (involving the purchase of tags by MPML) at this time would not be fully productive. However, in the event that you happen to catch (and want to release) a turtle, I am sending several tags for this purpose. Unfortunately I cannot spare sending the correct pliers, therefore in applying the tag you could first make an incision with a sharp knife, insert the piercing end through, and cinch it with an ordinary pair of pliers. With some care, you should beable to do an adequate job of getting the thing to stay on. The smaller size tag can be used on smaller turtles less than say 20 inches in shell length.

Please give my best regards to Janet- I will be looking forward to seeing the turtle photos.

Sincerely,

George H. Balazs

Kiesch

Feb 23, 1983

Dear George,

This is just a quick letter to pass on to you something interesting that Scott & I recently heard. I have a picture of a Hawaiian Monk Seal by my desk. Recently, a Marshallese friend of ours was visiting and told us that a Monk Seal lived for a while on the atoll of Maloelap, Marshall Islands. He said it just showed up on a beach there in 1958, and that the natives were afraid of it, probably because they'd never seen one before. Apparently, it lived there for weeks and never bothered anyone, but because they were afraid of it they killed it with some big rocks. I don't think they ate it. The guy who told us this story we trust in, and he is unusually well educated and traveled, so we believe him. While he didn't see the seal with his own eyes, the story of a seal visiting the Marshalls seems well established. Interesting, huh? I thought perhaps you would know who is involved in seal work these days and would pass the story along. Of course we can't be sure it was a monk seal, but it seems the most likely candidate since we know they make it to Johnston Atoll, and that is 1/3 of the way between Hawaii and the Marshalls.

→

We see lots of turtles here but no evidence of nesting. The Marshallese say the turtles don't nest here. They kill and eat about 50 turtles a year, mostly around the Christmas season.

We've seen turtle nests on the atolls of Rongelap, Bikini, and Ujelang; at Ujelang we saw empty turtle egg cases floating in the surf. Also at Wotje Atoll, Marshall Islands, one of the natives had captured about a dozen newly hatched turtles.

That's all the news we have for you. I hope that these little anecdotes are somehow useful to you. Scott & I are still enjoying Enewetak. Hope all is well with you and your family.

Sincerely,
Lisa Boucher

Lisa Boucher
Mid Pac. Res. Lab
Enewetak, M.I.
P.O. Box 1768
APO San Francisco 96555

Mid-Pacific Research Lab
P. O. Box 1768
APO San Francisco 96555
March 23, 1983

Dear George,

It was nice to hear from you, and I'm glad that my information was useful and interesting to you. We really liked the poster too and have hung it up in the lab for decoration - many thanks.

In order to answer many of the questions that you asked about turtles here, I talked to an anthropologist, Dr. Laurence M. Carucci, who lives here among the Marshallese people. He has lived with them for several years, both here and at Ujelang (the atoll where the Marshallese lived during the period of bomb testing and clean-up), and he is very knowledgeable about their ways. Here's what we were able to find out:

My original estimate of how many turtles the Marshallese here catch per year was too high. They probably take only 25/year, though they take as many as they can catch. The islands in the northern part of the atoll (around Engebi) and the western part (Glenn to Leroy; the Marshallese names for these islands are Ikuren and Biken) are considered to be the best fishing grounds for turtles. The Marshallese say that turtles are more rare in the summertime and more common in the winter. This may explain why they are considered to be a Christmas feast food - most of them are sought after and taken at Christmastime.

There are two main methods of fishing for turtles. One way is they stake out the nesting grounds and camp out on the small islets where the turtles come ashore (care being taken not to light any fires or make any sounds) and nab the turtles when they come up on the beach). Larry says they are very good at figuring out when the turtles will come ashore. One way they do it is to check the stage of development of eggs that are already on the beach. They seem to think there is a nesting cycle, and supposedly can look at eggs that have already been laid and figure out when the turtle will come ashore to lay again. Perhaps this makes more sense to you than it does to me. With the Marshallese it is sometimes hard to separate fact from fiction or their "old wives tales." They are a very superstitious bunch to be sure.

The second method of fishing for turtles is to jump on top of them from moving boats. They try to find turtles in relatively shallow water (30 feet or less) jump on top of them, flip them over, and bring them to the surface. It is interesting that they traditionally did this from their sailing canoes. Obviously, its a lot easier to do from a motorboat than from a sailing canoe which requires tricky sailing, so the advent of outboard motors in these islands means that turtles are easier to catch.

The Marshallese also love to eat turtle eggs. By tradition, half of the eggs in each nest were always left behind as a conservation measure. These days the old traditions are dying out for a number of reasons, and Larry has seen them clean out the nests totally. Also, by tradition, every turtle taken and all turtle eggs (all food of any kind really) belonged to the chief who divided it among all the people. This distribution system was in effect as

(the Marshallese word is 'irooj')

recently as 15-20 years ago, but the chief has now lost his power to a more democratic form of government, the old ways are dying, and its more or less every family for itself. Now when a turtle is taken, it is generally consumed by the family that got it instead of divided up for everybody.

As for species, both greens and hawks are taken. They say there is a third species here too. Neither Larry nor any of us has ever seen a third species, but the Marshallese say they sometimes get a large, ocean going turtle. Your guess I'm sure, would be a lot better than mine as to what species this might be. Hawks are not considered poisonous here.

Larry Carucci also told us that traditionally, small turtles were not taken, only medium to large ones. Certainly, the turtles we've seen them take have been very large, but I'd be hard pressed to guess what they weighed. One turtle I saw took two big Marshallese men to lift it so it must have been pretty heavy. Larry says that the turtles he's seen taken for food were usually on the large side, but couldn't give a good weight estimate.

The Marshallese say that nests around this atoll are few and far between. They say there are neither as many nests or turtles here as there are at Ujelang (a much smaller atoll 130 south of here) and that this has always been the case. They cannot get to all the other islets here at will, mostly because fuel for the outboards is scarce and very expensive (as much as $6 per gallon). A single round trip to the other end of the atoll can cost them as much as $50 for their tiny boats depending on how many people are on board. I don't know why there should be fewer turtles here, but I can attest to the fact that we have never seen a nest or tracks on any island here, though we get around a lot. But we saw <u>plenty</u> at Ujelang, Rongelap, and especially Bikini (so it can't just be a matter of radiation).

The catching of a turtle here is always a big event, and the story gets told over and over and over again. As for the turtle shells, Scott and I have seen them discarded at the local dump (a shame really). One Marshallese man gave a turtle shell to me, but for obvious reasons, Pat Colin didn't think I should keep it - so the man later traded it to a haole guy from Kwajalein for a carton of cigarettes.

Sorry, I forgot to mention above, that the reason only medium to large turtles were taken traditionally was as a conservation measure. Smaller turtles could be found but were released. Now though, they probably take whatever they can find.

About the seal that cäme to Maloelap - I am told that the remains were disposed of at sea. As I have said, the Marshallese are very superstitious, and killed the seal because they were afraid of it. To this day they still believe in spirits and demons. I'm sure they didn't want the evil spirit of that seal hanging around on their island.

Well, I hope that some of this information will help you in writing up your chapter on the Enewetak book. If you use this info, it would be really great if you could acknowledge Larry Carucci. If you want more detailed info about turtles here or at Ujelang, you may want to write him directly c/o us. He keeps excellent detailed notebooks of his observations, and may even be able to give you precise numbers of turtles taken on Ujelang while he lived there.

The 3 underwater slides were taken by Pat Colin - he says you can have them. The other two I'm sending so you can see what size some of the turtles taken are, I'd like them returned. That's all for now. Hope things are fine with you. We're really enjoying our stay here. Yokwe,

Lisa

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Fisheries Center
Honolulu Laboratory
P. O. Box 3830
Honolulu, Hawaii 96812

December 1, 1981 F/SWC2:GHB

Dr. Victor Noshkin
Lawrence Livermore Laboratory
P. O. Box 808
Livermore, CA 94550

Dear Dr. Noshkin:

For the past 10 years, I have been involved in various aspects of research on sea turtles here in Hawaii and at several other areas of the Pacific. It has come to my attention that the native people that returned to Enewetak are highly motivated to catch and eat turtles. This is not surprising since islanders throughout the Pacific are fond of turtles and their eggs. Usually the entire animal is consumed with the exception of bones, gastrointestinal contents and the gall bladder. There is little waste.

If I understand the situation correctly, over the years there have been very few, if any, analyses of sea turtles at Enewetak or Bikini to determine radionuclide content. Is this in fact the case? If so, it would seem highly desirable to have some of this work conducted. The two species that regularly occur at Enewetak are the green turtle (Chelonia mydas) and the hawksbill turtle (Eretmochelys imbricata). The green turtle is predominantly herbivorous, feeding on benthic algae and sea grasses where they occur. Adult green turtles are also highly migratory. The green turtles at Enewetak could very well be regularly undertaking reproductive voyages of 1,000 miles or more to other areas of the Pacific where they may also be used for food. The hawksbill appears to be less of a high-seas migrator, but this could just be a reflection of less research focused on the species. Hawksbills are omnivorous and seem to feed heavily on sponges and ascidians.

I would appreciate hearing from you on this important matter. I am prepared to assist you in any way that may be helpful.

Sincerely,

George H. Balazs
Fishery Biologist

cc: Dr. Robison, Lawrence Livermore Laboratory

RESEARCH
MID-PACIFIC ~~MARINE~~ LABORATORY
ENEWETAK ATOLL, MARSHALL ISLANDS
Supported by
UNITED STATES DEPARTMENT OF ENERGY

Helfrich

17 December 1980

Dr. Bill Robison
Lawrence Livermore Laboratory
P.O. Box 808
Livermore, California
94550

Dear Bill;

This letter to Vic Noshkin should be self explanatory. I just wanted you to know that the sea turtles are making a significant contribution to the diet of the dri-Enewetak and that if you do not have any data already, the bones I am sending might give you some information on some of the radionuclides. As I told Vic we are attempting to get samples of the muscle, internal organs and more bones. The sea turtles are not identified as to species. We are getting the remains after they have been eaten, but are most likely green turtles.

Sincerely yours,

Pat

Patrick L. Colin
Resident Scientist

cc: P. Helfrich

MPML

RESEARCH
MID-PACIFIC MARINE LABORATORY
ENEWETAK ATOLL, MARSHALL ISLANDS

Supported by
UNITED STATES DEPARTMENT OF ENERGY

DEC 19 '80

17 December 1980

Dr. Victor Noshkin
Lawrence Livermore Laboratory
P.O. Box 808
Livermore, California
94550

Dear Vic;

Since the return of the Enewetak people in force a couple of months ago it turns out that sea turtle is a prized item in their diet. During the two weeks before I came out of Enewetak, I know of at least 12 sea turtles being captured and eaten. During the Christmas season, the people travel long distances to gather these and other sea food, with the prime turtling spot being very close to the Mike and Koa craters at the north end of Enewetak.

Consequently I am sending you a number of turtle bones under separate cover that you may want to use for radionuclide analysis. Looking at the NVO-140 radiological survey I see there was no information obtained at that time on turtle radionuclides, so hope these samples will be of some use. In addition I have some frozen flesh from the turtles at MPRL which I will give to the researchers coming on the Liktanur II in January. I hope to obtain samples of the internal organs, more flesh and bones whenever another turtle is caught, but will have to rely on the local fishermen to catch it. With a little luck we can also have these ready to go on the Liktanur II, thus simplifying our shipping arrangements.

The bones I am sending were from a cooked turtle, if that makes any difference and were air dried. The turtles are making a significant contribution to the diet of the dri-Enewetak; I would say as much or more than the coconut crabs. Perhaps once they get fished down somewhat this will not be the case, but for the present they are something to be considered in any reevaluation of dose rates.

Since I am uncertain whether you or Bill Robison have the most interest in these samples, I am sending a copy of this letter to him also.

Sincerely yours,

Pat

Patrick L. Colin
Resident Scientist

PS. Forgot to mention that these are most likely green turtles, but since we have only gotten the remains after eating and the shells are destroyed in the cooking process, we can not be absolutely certain.

cc: P. Helfrich, Director, MPRL
B. Robison, LLL
H. McCammon, USDOE

Administered by the Hawaii Institute of Marine Biology, University of Hawaii
Address reply to ☐ Box 1346, Kaneohe, Hawaii 96744
☐ Enewetak, Marshall Islands 96737

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ATOLL RESEARCH BULLETIN

No. 11

Land Tenure in the Marshall Islands

by J. E. Tobin

Issued by

THE PACIFIC SCIENCE BOARD

National Research Council

Washington, D. C.

September 1, 1952

INTRODUCTION: LAND TENURE

Land in the Marshall Islands is placed in many categories, each with its own descriptive name and rules of inheritance. The land is of paramount importance to the Marshallese people whose agricultural economy is based on copra production and much of whose diet comes from their land. This land area is so small--74 square miles scattered over 29 atolls and five islands throughout 375,000 square miles of ocean, that it is patently precious to its 11,000 inhabitants, each of whom is born with land rights.

The Marshallese system of land tenure provides for all eventualities and takes care of the needs of all of the members of the Marshallese society. No one need go hungry for lack of land from which to draw food. There are no poor houses or old peoples' homes in the Marshall Islands. The system provides for all members of the Marshallese society; it is, in effect, its social security.

The Marshallese have an attitude of security which is undoubtedly due to a great degree to their system of land tenure. Despite the fact that they have seen three foreign powers take over their islands--German, Japanese, and American, they still have possession of most of their land, unlike the unfortunate indigenes in many other areas of the world.

The present policy forbids sale of land to non-indigenes and, at long last, steps are being taken to return lands occupied by American forces during the war and to pay retroactive rent for their use.

It is anticipated that former Japanese Government lands and land seized by the Japanese for military installations will be made available for the use of the Marshallese people. Other land needed for U.S. military and Civil Administration use, a relatively small amount, may be leased or purchased from the owners. High level policy in regard this important matter is undecided, however, at this writing.

Although the Marshallese system of land tenure may seem overly complex, it has developed to meet the needs of this particular group of people and is an integral part of the culture. Any radical change by outsiders would disturb the society and do irreparable damage--as any student of social-anthropology well knows.

Future administrators would do well to respect this system of adjustment to the environment which the Marshallese people have evolved and should allow any changes in the system of land tenure to come from within the culture. The U.S. Naval Administration, in accordance with the Trusteeship Agreement, has on the whole respected indigenous customs and has not attempted to force the Marshallese people into an American mould or to drastically modify the culture. It is hoped that the future administrations will follow this wise course.

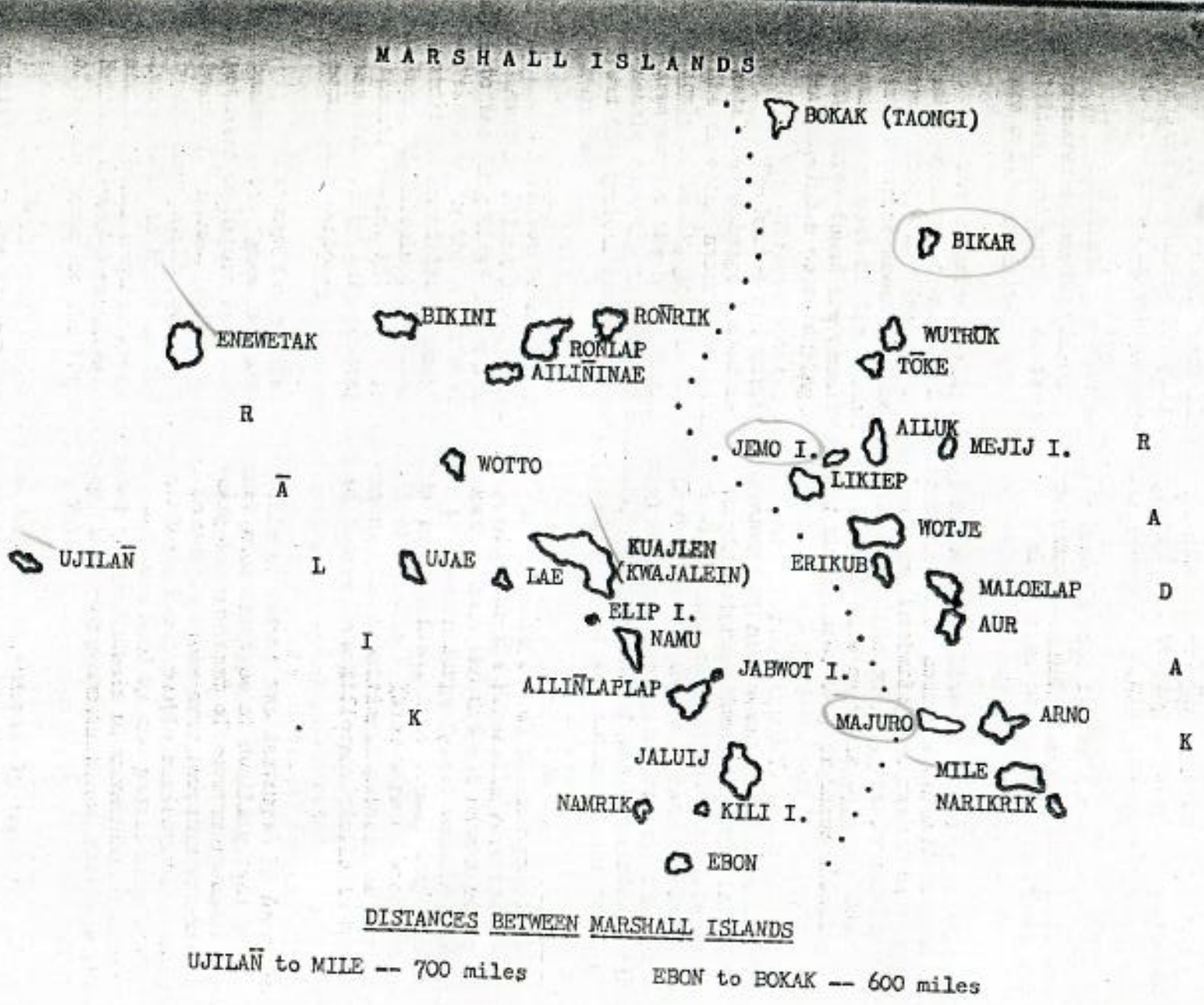
MARSHALL ISLANDS
BOKAK (TAONGI)
BIKAR
BIKINI
RONRIK
ENEWETAK
RONLAP
AILININAE
WUTRUK
TOKE
R
A
L
I
K
AILUK
JEMO I.
MEJIJ I.
WOTTO
LIKIEP
WOTJE
UJILAN
UJAE
LAE
KUAJLEN
(KWAJALEIN)
ERIKUB
MALOELAP
AUR
ELIP I.
NAMU
JABWOT I.
AILINLAPLAP
MAJURO
ARNO
JALUIJ
MILE
NAMRIK
KILI I.
NARIKRIK
EBON
DISTANCES BETWEEN MARSHALL ISLANDS
UJILAN to MILE -- 700 miles
EBON to BOKAK -- 600 miles

Figure 1.

PHYSICAL DESCRIPTION

The typical Marshallese land-holding or wāto consists of a strip of land stretching from lagoon to ocean and varying in size from about one to five acres in extent. Each wāto has its own name and history.

Sometimes the wāto may be broken up into two or three wāto(s) with transverse boundary lines. The boundaries, kōtan wāto are marked off by lilies, red shrubs, or frequently by slashes on coconut trees. These markers are called kakōlle.

The extended family (bwij) members may live on the wāto or merely make copra on it and use its food resources: coconuts, breadfruit, pandanus, arrow root, taro (mainly in the Southern Marshalls) and fish from the adjacent marine areas, if they possess more than one wāto as is usually the case. On most of the islands, the people live on their wāto(s). The structures found are usually a cook house, one, two, or three sleeping houses, and a copra drying shed.

The houses are mainly constructed of native materials with sheet metal and salvage lumber used in varying degrees throughout the islands. The sleeping house area is covered with small coral stones from the beach--ionle in Rālik, iole in Radak. These serve as drainage and prevent the area around the house from becoming a morass during the rains. This permeable covering is renewed regularly by the women of the household. This was the typical household arrangement prior to the coming of the foreign regimes.

When the Germans and later the Japanese set up their capital at Jabwor in Jaluit Atoll, people from all over the Marshalls were attracted to the "Big City" for various reasons. Those who did not have land or relatives in the atoll were forced to live in large "guest houses" each of which accommodated as many as sixty people, i.e., Arno house, Wotje house, Namu, Ailiñlaplap, etc.--almost all the atolls. These were of wooden construction--ca. 40' x 60' in dimension. The traditional pattern of living was changed by this congregation of people from different atolls in large population centers.

Although the beehive metropolis of Jabwor was destroyed by American bombers, the "guest house"--communal quarters type of dwelling, was perpetuated on Majuro Atoll which became the new seat of government under the American regime. Here, two large former Japanese army barracks are used by the Arno Atoll people and the northern Radak people respectively. Another large house is known as the Mille house and used by the people from that atoll. Still another group composed of individuals of mixed Gilbertese-British-German-Marshallese ancestry, in varying combinations, occupy a group of houses known as the "Gilbertese Village".

The "villages" on Majuro and Kuajlen constructed by the Naval Administration for its employees represent another change in the traditional pattern of life. The household routine remains relatively unchanged in the new type surroundings except that living is done in closer proximity than before. Cook houses, bath houses, and benjo(s) are shared by all who live in the communal houses and "CivAd Villages".

The CivAd [Civil Administration] center of Majuro is atypical also in that a "squatters'" town has arisen on Jarej (Rita), one of the islands adjacent to the CivAd center. Many Marshallese, attracted to the administrative center by much the same motives that attracted people to Jabwor in the Japanese period, have occupied abandoned quonsets or have built houses of their own of salvage material. A small quasi-"shanty town" has arisen on the island, perpetuating the Japanese acculturative influence of Jabwor. Spoehr gives an excellent account of an acculturated Marshallese community in Majuro. (2).*

Aside from a few atypical communities, the pattern of land usage remains as it was before the advent of foreigners except, of course, that the large villages have added stores, council houses, dispensaries, and church buildings. The system of land tenure and usufruct has changed but slightly despite the acculturative forces of three different regimes.

LAND USE

Members and associated members of the bwij (lineage) work the land, clearing it of underbrush and performing other tasks necessary for the simple type of agriculture practiced in these low-lying coral atolls with their limited resources. In some instances people will be allowed to work land not belonging to their lineage and when lineage members do not require its use, i.e., when they have more than enough land for their own needs or want to help some less fortunate person.

The head of the lineage (alab) is in charge of the land and workers on the land, and a share of the food produced on the land as well as a share of the money received from copra sales is collected by him. The alab represents his or her lineage in their relations with other members of the society, the iroij, and, today, as a member of the atoll council, vis-a-vis the representatives of the American administration.

The iroij (paramount chief) also receives a percentage of the money received for each pound of copra produced on land in which his suzerainty is recognized.** This share varies, ranging from 1 1/2 mills in part of Ralik to 1 cent in the Radak chain depending upon the amount of copra potential of the atoll or island and the attitude of the people toward their iroij. "First fruits" and a share of the food taken from the land and sea are also presented to the iroij, formally and informally. In Radak where the position of iroij erik (little chief or king) still exists, the iroij elap gives that subordinate intermediary a regular percentage of the money he has received from the alab in return for services rendered as his representative over a certain area.

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* See Bibliography

** Except on Ujilañ Atoll, home of the displaced Enewetak people. The pattern is different here in that each of the two iroij lablab has an island and a wāto of his own which he works with the help of the kajur. He does not receive income from any other land. This same pattern was followed on Enewetak.

Here we have a system of land use roughly analogous to the feudal system of medieval Europe ... a stratification of individuals with reciprocal duties and obligations as well as privileges.

MECHANICS OF DIVISION OF COPRA SHARE

The cash crop, copra, is sold by the individual producers to the copra buyer on the atoll or island or more often to the local general store which is usually a cooperative enterprise owned by all or a large segment of the atoll population. After the iroij share (which varies) has been withheld by the alab, his share, usually 30% of the total cash, is retained and the remainder turned over to the dri jerbal ro (workers). The senior dri jerbal under the alab may keep all of the cash and give the other workers spending money, clothes, food, etc. whenever they need it, or he may distribute the cash on a per capita basis to those who have actually made the copra. The former is the general method of division of proceeds from copra sales.

Sometimes the alab may keep all of the proceeds less the iroij share and allow the workers to do the same thing with the next copra sale. The workers may also follow the same procedure rather than attempting to divide the money up regularly with the alab, this being especially advantageous when there are a large number of workers on a small piece of land.

Although there are some deviations from this pattern, the recognition of the interests of iroij and alab are manifested by the general adherence to the payment of the share.

DEVIATIONS FROM THE GENERAL PATTERN

The most notable exception to the general pattern of land tenure is the atoll of Likiep owned in fee simply by the descendants of two European adventurers who purchased the entire atoll from the iroij lablab of Northern Radak (JURTAKA) in 1877, with all rights and privileges appertaining thereto.

The land is worked by these "mixed-blood" descendants and a larger group composed of descendants of the original inhabitants of the atoll and others brought in from neighboring atolls. This latter group produced copra on a share-crop basis.

Relationships between the two groups have been strained for years, the "owners" complaining of absenteeism and non-production and the workers complaining of peonage and oppression. Investigations were made of this situation, and a working agreement was negotiated early last year. Conditions seem to have been ameliorated; however, as was anticipated, complete mutual satisfaction and accord do not prevail on Likiep today. This is a salient example of the problems created by the intrusion and implementation of foreign concepts of land tenure into an indigenous system.

Before the turn of this century, the twenty or more inhabitants of Ujilan Atoll were forced to leave their atoll forever to make room for a German copra plantation. They went to Jaluit and Ebewetak; their descendants are dispersed throughout the Marshall Islands today.

Large scale alienation of land occurred again during the post-World War II period when the inhabitants of the atolls of Enewetak and Bikini were required to leave their atolls which became testing grounds for atomic warfare. The Enewetak people, transplanted to the uninhabited but much smaller atoll of Ujilan̄, have been able to make a fairly successful adjustment to a less-favorable environment and have modified their traditional land tenure system in their new home. (See APPENDIX).

The Bikini people, on the other hand, have not been able to make a successful adjustment, due principally (in the opinion of this observer) to unfavorable ecological conditions. Kili, their new home, is a small island, limited in land area and lacking the natural resources afforded by a lagoon environment. Kili is isolated from the rest of the Marshalls many months of the year due to heavy surf, another factor for discontent.

The land tenure pattern on Kili differs markedly from that which prevailed on Bikini. A communal type of land tenure prevails in which the former iroij lablab (king) of Bikini is not recognized.

The traumatic exodus, the limited land area, the personalities of the iroij involved and his heir, ill-advised statements by outsiders, and erroneous press releases, were some of the factors responsible for discontent and change in the socio-economic pattern.

The general attitude of everyone concerned at this writing is one of insecurity and dissatisfaction. This unfortunate situation aside from its obvious aspect of a transplanted group in the throes of adjustment to a new environment is another excellent example of sudden change in a socio-economic system brought about primarily by external forces. For a detailed report on the removal of the Bikini people, see Mason, L., (1).

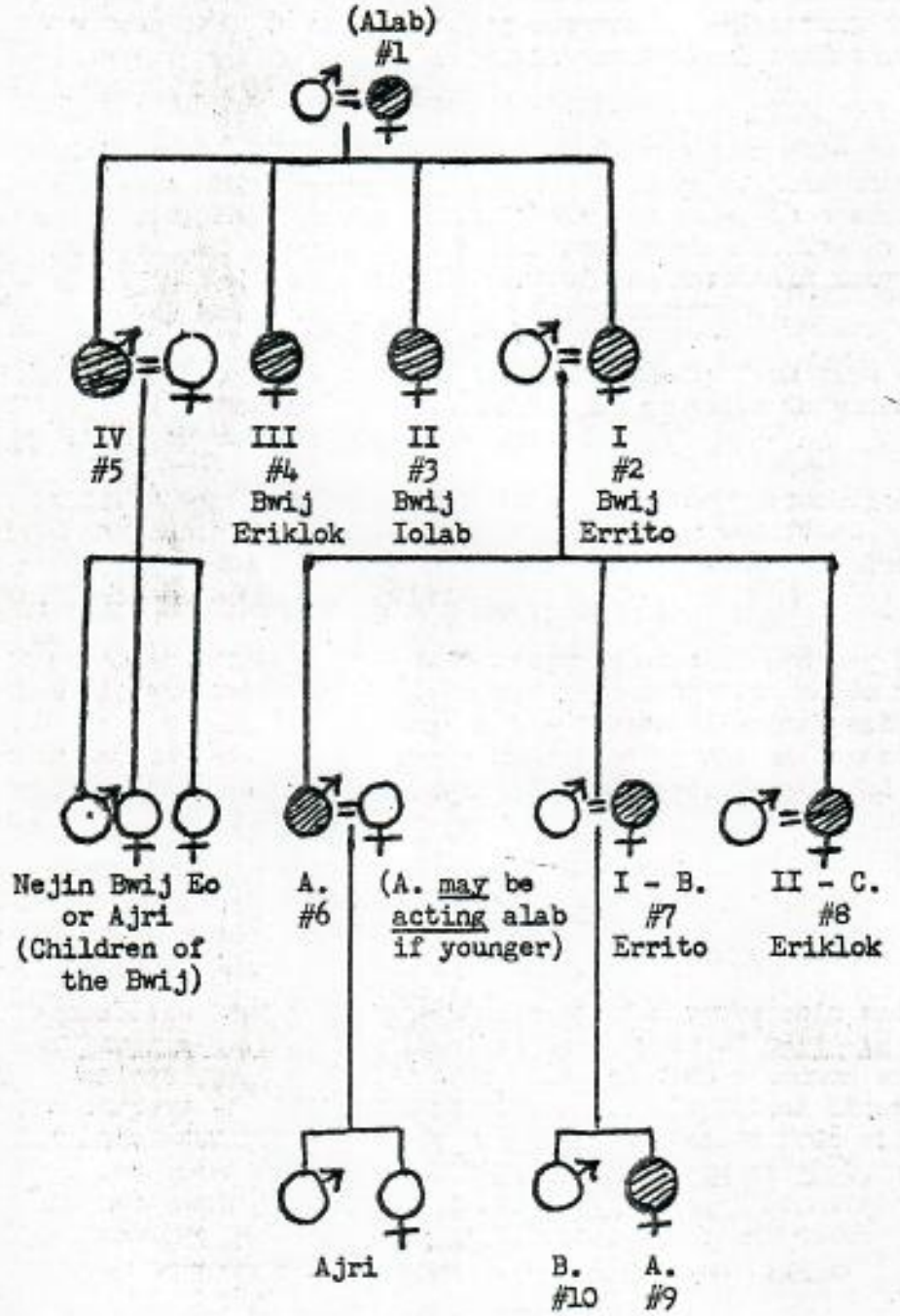
INHERITANCE PATTERN

The Marshallese system of inheritance of clan membership and of land rights (all of lāmoren-kabijukdinen land and most types of burij in aje) is matrilineal. Lineage (bwij) members trace descent from a common ancestress (alab) for the purpose of claiming land rights. The original lineage normally has been split into associate lineages or bwij descended from sisters. These associate bwij are known as the older bwij--bwij errito or jiōb, middle bwij--bwij iolab (all intermediate bwij are known as bwij iolab no matter how many there are), and younger bwij--bwij eriklok, etc., according to the relative ages of the common ancestresses who belonged to the same clan (jowi).

Initially the senior sibling in the bwij--bwij eritto is alab or bwij leader followed by all of her surviving brothers and sisters in chronological order. After all of these siblings have been alab, the next generation, personified in the oldest child of the eldest female, becomes alab and is in turn succeeded by his or her siblings in chronological order. This pattern of succession continues in one maternal line of descent until the line becomes extinct; in this case, the next associate bwij in order of seniority will inherit the "alabship" and rights in a particular piece of land or lands. Every Marshallese is, as may be seen, a potential alab.

THE IDEAL INHERITANCE PATTERN OF LAND RIGHTS

BWIJ EO (THE LINEAGE)



II, III - Lineages will inherit land rights in succession - "in toto" if the "bwij" senior to them becomes extinct - "bwij eo elot".

— Cross hatch -- maternal line of descent of a lineage.

Figure 2.

Although theoretically, relative age is the determining factor in succession to the position of leadership, actually a younger brother will assume all of the duties and responsibilities of the position from an older sister who by virtue of seniority is alab. He will become alab "de facto" but she will remain alab "de jure" and will be respected and deferred to as alab. Her brother will bring her the alab'(s) share of the produce of the land but will relieve her of all of the burdensome duties connected with the position, e.g., iroij Kabua Kabua of Rālik has three older sisters, but he assumed the alab position because he is a man. After he dies, his older sister remaining will assume the position of alab, followed by her eldest child, in the pattern previously described.

Males assume this trusteeship position; are alab first unless the women are very strong or have no male relatives to take over for them. If the male who inherits the alab position is too old, feeble, or otherwise incompetent, the next in line of succession will assume the responsibilities of the alab; will be in effect, the representative or regent for the alab. The alab will be recognized and honored as such by his own people, however, if the whole bwij (maternal lineage) becomes extinct (bwij elot) which has happened, e.g., Ralik iroij, the alab or iroij positions may be inherited patrilineally for the one generation, from fathers to sons and daughters in chronological order as described previously, after which they pass in matrilineal line of succession. This is the ideal pattern of inheritance and is recognized as the mantin ailiñ kein (the Marshallese custom) and is followed in the main. However, as in other cultures, the custom is sometimes honored in the breach. Deviation from the accepted custom is the basis of disputes, several of which are burning issues on various atolls today.

PATRILINEAL USUFRUCT RIGHTS

Although land rights, with very few exceptions are inherited through the maternal lineage, individuals are not excluded from usufruct rights in their paternal lineage land. Even though an individual may never become leader alab on his father's lineage land (unless the entire paternal bwij and all associated bwij become extinct), he does have the right to live and work on his father's land. These use rights are inherited patrilineally by succeeding generations, each of which has a descriptive name. (The same terminology is used for titles of individuals of iroij descent to indicate the amount of royal "blood" possessed by the individual title holder.)

1st generation	of	ajri	(children)	of	the	paternal	bwij-bwirak
2nd generation	"	"	"	"	"	"	lajibiib
3rd generation	"	"	"	"	"	"	jibtok
4th generation	"	"	"	"	"	"	jiblok
5th generation	"	"	"	"	"	"	jibbotto
6th generation	"	"	"	"	"	"	jibbinaretto
7th generation	"	"	"	"	"	"	tibjer

The ajri are allowed to live on and use their paternal land if they are cooperative and do their share of the work. Shirkers and trouble makers and those who do not give the alab his copra share or refuse to make ekkan, etc., may be removed by the alab of the particular land involved, however. These rights may be extended to include the seventh generation, tibjer, but are usually taken advantage of only as far as the fifth generation; the ajri rights become weaker with each succeeding generation and are absolutely concluded with

the seventh generation, tibier , which translated means "depart from glory".

Individuals usually forego their usufruct rights on the paternal land before many generations have passed. They are usually satisfied with the use of their maternal bwij lands and their spouse's lineage lands.

This system operates to equalize land rights, prevent over-crowding and serves primarily to strengthen the in-group feeling among relatives.

ADOPTIVE RIGHTS

Adoption of children or kōkajiriri (v. and n.),(rough translation: "look out for the child") has always been a common practice in the Marshalls. Adoption here, however, does not mean alienation of the child from his biological parents as it usually does in our culture. The Marshallese child becomes a part of another extended family group but also retains his ties, emotional and otherwise, with the biological parents and other bwij relatives. The child may reside with either the foster or biological parents, or with both at different periods, as is usually the case. This pattern of extended relationships obviously makes for a greater degree of emotional security as far as the adopted child is concerned.

An adopted child, kōkajiriri, is also described as kanni lujien (rough translation: "stomach food"), i.e., the child will be eating the same food as his foster father and from the same land; i.e., he is intimately connected with his foster father.

Adopted children are allowed the right to work on and enjoy the benefits derived from the land with the permission of the alab and the bwij.

Kōkajariri may remain on the land after the foster parent dies. The children of the kōkajariri also have rights in the land which become progressively weaker with ensuing generations. These rights must also be confirmed by the alab.

The adopted child possesses much the same rights as the biological children except that he may only become alab of land of the bwij into which he has been adopted upon the extinction of all bwij relatives. A case is now pending on Majuro in which an adopted son of an alab now deceased, the last of her bwij (bwij eo elot), claims to be alab of his foster mother's bwij lands. His claim has been contested by other relatives of the deceased alab.

In addition to the rights acquired by adoption, the kōkajariri also retains his birthright in his bwij land. The adopted child is also under obligation to his foster parents and regards them as jemma (father) or jinō (mother) as the case may be, giving them the same respect and loving care in their old age that is owed and given the biological parents, e.g., "A" was adopted by "B" and his wife when he was a small child, in 1899. The biological father and mother of "A" went to another island in 1904 and remained there for eight months; during this time "B" cared for his adopted son. The father of "A" built a house nearby his own home for "A" and his foster parents with whom the latter lived most of the time even after his father and mother returned from their trip. He was not alienated from them or any other of his biological relatives, however, but retained a close relationship with them.

In the ensuing decades, "A" and "B" maintained a close father and son relationship. "A" recently brought his now aged foster father to live with him on Majuro and has assumed the responsibilities for his care although "B" has four grown children of his own. This one example shows the differences in Marshallese and Western concepts of adoption.

Individuals who possess the inherited rights in their bwij land have unquestioned usufruct rights and may even become alab. Ajiri or those who possess paternal rights are considered to have less right in the land. Kōkajariri, adopted children, are considered to have fewer rights than the members of the bwij or the ajiri.

USUFRUCT RIGHTS ACQUIRED BY MARRIAGE

Residence after marriage is neither strictly patrilocal or matrilocal, nor is there a regular periodic bi-local residence pattern as in parts of Melanesia. A man may live and work on the bwij land of his spouse or vice versa. Matrilocal residence, however, is considered more desirable in view of the fact that the interests of the offspring are bound closer to the maternal bwij land, where someday they may become alab and where they possess "real" dri jerbal rights.

Marshallese have been marrying into other atoll groups for centuries. This process has become progressively accelerated with improved transportation and communication. Opportunities for marriage outside of the home atoll have increased tremendously and today many Marshallese possess land rights in widely separated areas throughout the Marshalls. This, of course, has done a great deal to break down atoll ethnocentrism.

If a married couple should reside on the wife's bwij land and the wife should pre-decease her husband, the husband has the right to remain on the land providing there are children; in that case, the widower may not be evicted even if the alab should so desire. The offspring (who have a vested interest in their bwij land) look out for their father's welfare and help him to remain on the land.

If there are no offspring, the widower does not have a real claim and the alab may evict him or allow him to remain at his discretion. The latter course is usually followed unless the widower is a trouble maker or shirks his responsibilities. Informants have never heard of a widower or widow being evicted from their deceased spouses' bwij land. In most cases, the in-laws want them to remain. If a widower should remarry to someone outside his deceased wife's bwij, they both may remain on the land, at the discretion of the alab, but this is not usually done.

WILLS-- KALLIMUR (WILL OR PROMISE)

In pre-contact times the iroij would, if they felt that their demise was imminent, call their people together and name their successor, normally following the accepted custom of inheritance.

The German government started to register wills and the Japanese government insisted that everyone, iroij and kajur alike, should make a properly registered and documented will. This edict was complied with in the main during the Japanese occupation but fell into abeyance after the Japanese were expelled from the Marshalls. Since that time only a few individuals, mostly iroij, have executed written wills.

RENTALS

The concept of rental of land or houses was non-existent aboriginally. This concept was introduced by foreigners who wished to acquire sites for their commercial ventures, and who did so.

Transactions of this type involving Marshallese alone have been very rare. In fact, only one such case is operative today. This case occurred very recently and has political motivations rather than a mere desire for monetary gain.

The land involved had been rented previously to a Japanese entrepreneur. Interestingly enough in the recent dispute, the alab involved, in pressing her claim for rent, made the distinction between land used for business purposes (bakery and store) and that part of her land being used for dwelling purposes. Rentals were demanded for land falling in the former category only.

An individual who has obtained the alab'(s) permission to erect a house, etc., not on his own bwij land may from time to time voluntarily bring food to the alab of that land. However, the concept of rent "per se", is not implied.*

ENCLAVES

TREES (kān)

Individual trees may be given to a person outside of the bwij by the alab. Nearly every wāto on Majuro has trees (coconut mostly) that have been set aside for Protestant Church use. There are also many gifts of this kind on Arno and Ebon and other, but not all, of the atolls. Many of the government schools have received trees also. Trees are called ni kān (coconut tree) or mā kān (breadfruit tree), etc., depending on the type of tree. The affix kān means tree or stump.

Only the recipient may use the produce of the tree involved. He may give the alab or others permission to use the tree in his absence, however. A gift of this sort may revert to the donor upon the demise of the recipient, (it is considered a transaction between two individuals) or the recipient may be allowed to retain the kān at the discretion of the alab.

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* See ADDENDUM

TARO PATCHES (sing. bwil; pl. bwil ko)

A bwil or taro patch within a wāto may be given to individuals outside of the bwij or it may be retained within the bwij, at the discretion of the alab. An example of the different categories of bwil which may be found on one wāto may be seen on Eram wāto on Ebon Atoll, one of the southern Marshalls, where the largest amount of taro is to be found. Viz: 1. One bwil is assigned as iroij bwil (bwil an iroij). It is tended and cleared by the dri jerbal but is not harvested except when the bwij makes special ekkan (ar makie)-"our (bwij) alone", to the iroij. The bwil produce is not used for any other purpose, and bwil an iroij are inherited by the heir of the iroij.

2. One bwil assigned to "A" who is a kōkajariri (adopted child); she tends the taro patch and harvests the taro for the use of herself and family. The alab will not touch this taro patch; if he should do so (cultivate it, etc.), it would imply that he wished to evict the person to whom it had been assigned. (This is also true of land in general). A new alab will subtly signify his approval of previous assignments to bwil and will ratify same by saying to the incumbent: "I would like a basket of taro from your bwil."

3. Another bwil was assigned to "B" and his brothers. Before the turn of the century, "B" had been born into a lineage holding Eram wāto. At that time, male and female twins were considered as being incestuous, having spent the prenatal period in juxtaposition--within their mother's womb. "B" was, unfortunately, one of these. According to custom, his twin sister was allowed to live ("to become alab") and "B" was buried alive. He was exhumed immediately, however, by a pitying neighbor who reared him as her kōkajiriri (adopted child). When "B" had grown to young manhood, "C", his female cousin, invited him back to the bwij lands. She had attended the Protestant Mission School on Kusaie and disapproved of the rejection of "B" by their lineage. "C" was the senior female in her lineage and next in line to be alab, consequently very powerful and much respected. "C" allocated a bwil and the dri jerbal rights in two of their bwij wāto(s)to "B". Although "B" could never become alab because of the "incestuous" circumstances of his birth, he was tacitly accepted within his bwij by the other bwij members. When "B" died, his bwil was inherited by his son who holds the use rights to it today.

4. There are six other bwil or Eram wāto, the taro of which is used by the dri jerbal of the wāto. An alab may reserve all of the bwil for himself to be used for ekkan. In this case the dri jerbal will not use the produce from the taro patch unless the alab gives them explicit permission. This is not the case on Eram wāto, however; the alab allows the dri jerbal free access to the bwil which was not true of some of his predecessors.

5. Another type of bwil is that which is exchanged for another bwil or a good breadfruit tree (mā kān). This is usually done to cement ties of friendship and marriage, e.g., about thirty years ago a bwil on Eram was given to "C", a man who had married into the bwij, in exchange for a breadfruit tree located on "C"'s bwij land. The taro from this particular bwil was considered to be the property of this individual and respected as such. Conversely, the fruit from the particular breadfruit tree was considered to be the exclusive property of the alab and people of Eram.

About nine years ago, "C" commenced "stealing" the breadfruit from the tree and later signified his desire to regain his former property by climbing the tree and openly stripping it of its fruit. This angered the people of Eram,

who felt that "C" had broken tradition and affronted them by taking breadfruit from the tree while continuing to use the bwil and then seeking the return of the tree (which was a very good one).

6. Temporary usufruct rights: a section of a taro patch may be allocated as a source of food for people who are visiting an island for a short while (this is not an outright gift), e.g., Namrik Atoll people visiting their children who were attending the Japanese Government School at Ebon were afforded this privilege.

7. Gift, as kitre to one's wife: taro patches may be given by a man to his wife as kitre. There are some instances of this on Ebon, Likiep, and Mejij, etc. Permission of the alab and bwij must be obtained before a bwil may be given as kitre. Failure to do this may cause serious disputes, e.g., on Mejij, an iroij who had worked a taro patch without any assistance from his relatives gave the bwil to his wife as kitre three years before he died. This was done without consulting his bwij. After he died, his bwij contested this gift. The dispute was finally settled amicably a few months ago. The bwij agreed to allow the childless widow to use the bwil until she dies, at which time it will revert to the bwij. The bwij may allow the decendants of a woman who received kitre to retain possession of the taro patch involved. Non-Mejij Marshallese who heard of this case stated that the woman's bwij is entitled to possession of this bwil according to custom.

REEF RIGHTS

Throughout the Marshalls the reefs were claimed by the iroij as emo or personal property if the fishing was good around them. The iroij would declare: "Wur in buruan." (My own reef) or else "Wur in iroij" (reef of the iroij). After this tabu was instituted, no one else was permitted to fish that particular reef on penalty of death or expulsion from his land. In 1934 the Japanese authorities "broke the tabu" by declaring the reefs open to everyone. From then on everyone who so desired has utilized these once forbidden fishing grounds.

These reef areas were usually near the entrance to the lagoon where fish are especially plentiful, e.g., within Arno Atoll about one half mile from the shore of Malel Island lies a reef called "Moen". This reef is the habitat of many tuna and other fish which feed around it. The tabu described previously applied here also. The reef fishing on Ebon is very good, several isolated reefs are the habitat of a large fish "ellok", whose flesh is considered particularly good. There were five wur in iroij here: Tokāinbarao, Wodrenlap--(translation: big reef), Tokimkil, Buruan Lewoj--(translation: Lewoj, an old Ebon iroij, wants the reef), and Naminaujedr.

These choice fishing spots were reserved for the iroij lablab alone as previously described. Other people were afraid to disobey the tabu until it was lifted by governmental edict. Small islands were also occasionally tabooed, e.g., Kaben, a small island with a few trees on it on Wotto Atoll, was taken by the iroij for his personal use because of the abundance of coconut crabs on it.

On Likiep Atoll a stretch of beach on the main island extending from the site of the Catholic Mission to the Northern tip of the island, a distance of about 2000 meters, was forbidden territory. It was emo to fish within thirty

yards of the shore along this area, which is the habitat of large schools of tou (mackerel). The "owners" of Likiep considered themselves as iroij and instituted this prohibition in German times. Here again the tabu is not enforced today. Emo (forbidden) fishing sites were in existence on every atoll.

FISHING RIGHTS

According to custom, the property rights extended out to the area where people stood, usually waist deep, in order to fish with a pole. Momo and rijo were the fish commonly sought. These rights belonged exclusively to the lineage, bwij, whose land holding, wāto, bordered the marine area.

This custom continued until 1934 when the Japanese authorities declared that all marine areas, up to the high water mark, belonged to the Japanese government. Marshallese informants believe that this change was made in order to allow the Japanese to claim logs, barrels, lumber, and other items of flotsam and jetsam. These objects were highly prized in this area where heavy timber was scarce and especially so in pre-contact days when metal was only obtainable from the above mentioned sources.

The iroij lablab of the particular area into which these materials drifted claimed exclusive rights to them. The loss of royal prerogatives and attendant revenue was, of course, resented by the iroij, who were powerless to prevent it, however. This break with tradition has continued under the American trusteeship and is apparently accepted by everyone today.

GAME RESERVES--"BIRD ISLANDS"

The Northern Radak atolls of Bikar, Bokak (Taongi), Tōke, the island of Jemo, and the islands of Erik and Luij in Erikub Atoll have been used from time immemorial as game reserves. These areas are the habitat of myriads of sea turtles and nesting fowl. Periodically, turtles and turtle eggs, birds and their eggs were taken, as described later (see emo).

Due to the scarcity of water supply, these islands have never been regularly inhabited. The Germans used this fact to justify the seizure of the atolls of Bikar and Bokak as government property. The Japanese took them over with all the other German government properties. They were not exploited by either foreign power, however, and the Marshallese from Northern Radak have continued to utilize their resources.

Lammoj, the iroij lablab of northern Radak, whose ancestors owned the two atolls, claims personal title to Bikar and Bokak as mo land and has stated that the German claims were invalid. This writer agrees with the Marshallese position that land used as a source of food supply, etc., should not be alienated from its owners merely because it is not regularly inhabited and cultivated.

It is recommended that the United States Government withdraw all claims to Bikar and Bokak in favor of the Marshallese who feel that they have never legally lost their rights in them.

INDIGENOUS ATTITUDES TOWARD THE LAND

Land is considered to be the most valuable asset to the Marshallese who are so dependent upon it for their day-to-day existence. Land disputes have been and still are the cause of almost all family schisms. People are always plotting to obtain more land, by marriage today and by warfare, marriage, and black magic in the past.

Black magic, ekabel, was sometimes used to kill off the older members of the lineage, particularly in the case of the iroij bwij: "Rubrub ñon ro nejin" (destroying the obstacle to her children), i.e., removing the obstacle (person) to her children's succession to land rights. A non-relative is always asked to make the magic. It is believed that the illness or death sought for the enemy will "boomerang" and also afflict the person who performs the magical rites if he or she is related to the proposed victim of black magic. According to informants, ekabel, is sometimes performed today.

Land is regarded as sacred "something to fight for and die for" and has been, as far as may be ascertained, sold or given away to outsiders only because of fear of either physical or moral force. A salient example of this attitude was observed recently at Majuro. A rumor had been circulated to the effect that the United States Government was planning to reimburse the owners of the land upon which the administration functions are located by giving them pieces of former German-Japanese government lands located in Majuro and nearby atolls. This rumor created a tremendous amount of anxiety, insecurity, and distrust on the part of the individuals concerned. This writer was deluged with queries as to the validity of the rumor. The concensus of opinion of the Marshallese involved was: "We will never willingly accept any other land in exchange for our lineage lands."

They will not willingly accept complete alienation of their land. The individual Marshallese is fully aware of the particular categories into which his lineage lands fall and what rights he possesses in them. Genealogies, both royal and commoner, are traced back in some cases ten or more generations and many of them have been written down, are carefully preserved by their owners, and used as evidence to support claims in land disputes.

The younger generation of Marshallese, however, those under thirty or so years of age, as a whole are not fully cognizant of the less basic concepts and customs of land tenure.

CONCEPTS OF LAND OWNERSHIP

In the pre-contact period, the iroij lablab (the senior ranking member of the senior lineage of the ruling clan (iowi) was the acknowledged owner of all the land and moveable property in his realm in a socio-economic system roughly analogous to the feudal system of medieval Western Europe or closer at hand, to the social system of pre-contact Polynesian cultures with the reciprocal rights and obligations of all classes within the framework of the society. The subjects of the iroij could not be evicted from the land without good reason, however, (mainly for offenses against the iroij himself), and their rights were as a rule, respected by the iroij. The more commoners (kajur) an iroij had in his

realm, the more power he possessed--a large reservoir of human beings to draw upon for labor and warfare. (The word kajur itself means power). It was therefore manifestly incumbent upon the iroij to treat his subjects with consideration and retain their loyalties.

A regular channeled tribute system, ekkan, was adhered to by the subjects of the iroij. In the latter part of the nineteenth century with the development of copra as the cash crop, the share of the iroij and the people who produced the copra was established. (See LAND USE)

The concept of iroij ownership of the land apparently continued and was unquestioned until Japanese times, prior to World War II. At that time the Japanese introduced the concept that the iroij owned the land and the kajur owned the trees growing upon the land. This was probably done to facilitate acquisition of the land needed for military bases and installations.

Some informants believe that the new concept was a result of Japanese misunderstanding and jumping at conclusions. It is alleged that when the Japanese officials queried as to who planted the trees, the Marshallese replied: "The kajur did." The Japanese then supposedly assumed that the trees were the property of the kajur who had planted them. As a corollary, we may logically assume that the iroij upon being questioned, informed the Japanese that the land belonged to the iroij, as per custom.

This foreign concept of separate ownership title to the land and of all of the trees growing upon the land was implimented by the Japanese officials who paid some of the iroij and alab(s) involved for land and trees respectively. The foreign concept of division of ownership plus the fact that the foreigners beginning with the Germans had supplanted the iroij as the supreme authorities were undoubtedly contributing factors to the gradual shift of orientation which has continued to the present time and which was accelerated by the social disruption attendant upon World War II and the American invasion and occupation of the Marshalls. The concepts of "liberty", "freedom", and "democracy" were freely disseminated by the new rulers without, it is believed, adequate definition or explanation. This further contributed to change in attitude in regard to socio-economic concepts on the part of a segment of the population especially, as might have been expected, on the younger element who were in closest contact with the Americans.

The general attitude today in regard land rights (as far as this writer has been able to determine) is one of joint ownership of land rights with the iroij possessing certain rights and the kajur possessing other rights in the land, holding these rights as a member of a lineage (bwij) in common with the other bwij members.

The general concensus of opinion seems to be that the Japanese concept was an artificial one and that the trees cannot be separated from the land. The concept of joint ownership of land rights is stronger in Rālik than in the Radak Chain, probably because the true iroij have become extinct with a few exceptions in Rālik while the true iroij still flourish throughout the Radak Chain.

The prevailing opinion was exemplified by the actions of the last "Marshallese Congress", where representatives of the mass of the population,

the "House of Assembly", met with the iroij, "House of Iroij". At that time, this matter was debated at length. The iroij declared that they owned all of the land and were upheld by a small percentage of the older kajur. However, the majority, young and old, disagreed, stating that the land is owned by everyone.

A small anti-iroij sentiment exists today, largely composed of younger men most of whom have been closely associated with Japanese and Americans. These individuals (none of whom are organized as a group) are anti-iroij only in the sense that they are opposed to deferring to certain individual iroij. They are not against the institution of iroij per se. In fact, the desire to retain the economic prerogatives of the iroij for themselves is the principal motivation for their deviation from the norm.

At the other end of the pole are, of course, the iroij and their adherents, most of whom are the older and more conservative element. It is anticipated that the iroij position, "where disputed", will become correspondingly weaker as this older and more conservative element dies out.

It is hoped that the administration will continue the "laissez faire" policy insofar as possible in regard to the land rights situation. Any disagreements may be brought before the District Court if the disputants themselves fail to reach an amicable agreement. (This is the current available mechanism for settlement of land disputes of which there are many.) However, at this writing, only one case involving land rights has been brought before the District Court. Apparently the Marshallese are wary of legal processes that are outside of the local culture pattern and are reluctant to bring the highly important problem of land rights before an outsider. This writer has personal knowledge of many instances where land disputes have been channeled through to the traditional authorities rather than through the alien American mechanism for handling these problems.

The administration should not support one group or the other involved in land disputes; but should remain neutral offering advice to all sides if requested. This obviously requires a great deal of "tight wire walking", so to speak, but it is absolutely necessary if the governing authorities are to have the confidence of everyone and accomplish their mission. The Marshallese are watching every move that the Administration makes regarding land matters. Any ill-advised move by the administration might very well upset the present balance, causing any of those who may be uncertain and wavering in their attitudes to follow the administration's lead. It is, therefore, obviously necessary for the administration to treat all situations involving land rights with the utmost discretion. These problems should be worked out by the Marshallese people themselves with the minimum of American interference and that only when absolutely necessary.

CATEGORIES OF LAND

Land is divided into three general categories:

A. Lēmoren or Kabijukinen (rough translation: old "family land").

B. Ninnin (literally: "nurse from the breast")--land allocated by a parent to offspring.

C. Imonaje (burij in aje)--(Literally: "divided land").

The terms lāmoren and kabijukinen are applied to the same type of land, the ancestral land holdings of the maternal bwij; however, there is a shade of difference of meaning in the two terms. Lamoren (literally: "old stone", from the lā--"beach stones", pebbles,, placed around the home site, inside and out) refers to the ancestral land (earth) itself, while kabijukinen or birbir (foundation) as it is sometimes called, has a poetic connotation of deep affection and sentiment and is used in much the same way on a larger scale, as the Japanese sometimes describe their homeland by the word "Yamato" rather than the more commonly used "nippon" or as the Irish refer to "the ould sod", the Russians to "Mother Russia", etc. The majority of land holdings in the Marshall Islands belong to this category.

Burij in aje (imon aje) is the descriptive term for land that was given by the iroij for outstanding services in war and peace time. Many types of land are included in this general category each with its own descriptive name.

With the end of local warfare (during the German period) gifts of land resulting from warfare, i.e., marujinkot, waenbwe, etc., ceased. Other burij in aje such as rewards for magic, medicine, and navigation, etc., are made very rarely today. Ninnin (land given by a parent to an offspring) is still made occasionally today, however.

BURIJ IN AJE - IMONAJE - DIVIDED LAND

Imonaje (Rālik and Radak) is land given to a person who helps the iroij by nursing, bringing food, etc., makes medicine, etc. The iroij may give food, mats, rope, etc., instead of land. This is known as mweien kalotlot (goods for nursing) or mweien tiriamo (goods of sorrow) and is given by the iroij only, to anyone. The iroij may make imonaje to a kajur, either alab or dri jerbal; no one else may do so.

In the old days two men remained with the wife of the iroij at all times in the capacity of watchmen or body guards. One remained outside at all times--escorted the iroij's wife, brought food to her, etc. This functionary was called dri jutak loto (translation: "man who stands by the iroij's room). These men received imonaje land for their services. They were related to the iroij on the father's side; they were last in succession and least likely to try to kill the iroij to gain his position; therefore, the most trustworthy.

An informant acted as dri jutak loto for the late iroij lablab Murjil of northern Radak ca. 1916 to 1919. He is a cousin to the said Murjil on the paternal side. His food was given to him by the iroij. He carried a knife with him at all times but was never forced to use it. Informant stated that he had to stay awake on guard against possible attack many nights because of trouble between two iroij--Murjil and Tonuia, iroij of Airok (Maloelap). This trouble lasted for about one year.

The person nursing the iroij as a baby is known as the dri-jutak lomalal; this person belongs to an iroij bwij, one of whose members has the honor of being the dri-jutak lomalal. The dri-jutak loto position goes to a brother or son like regular paternal inheritance, in order of seniority. The iroij always

chooses the woman he wants as wet nurse for his children from his bwij or that of his father, whether iroij or not.

Land was always given for these services; informant received land for his services. He became alab and receives the iroij erik share now but is not a real iroij erik, and he is not called by that title. There are no positions or title of this kind now, dri-jutak, etc. After iroij Murjil died (during the middle phase of the German occupation), these positions became extinct.

The offices were continued during the life time of the incumbents, from youth until their health failed and they were unable to discharge the duties of their positions. At that time, the iroij instructed the outgoing dri-jutak loto or dri-jutak lomalal to name the successor--someone he trusted in his bwij or on his paternal side as the case might have been.

Burij in aje is also used to describe land given by the iroij to refugees from an area devastated by typhoon, drought, tidal wave, etc. The iroij or leroij might allocate land to their respective spouses as burij in aje.

Inheritance Pattern:

The recipient of burij in aje, imon aje may either assign it to his bwij or to his children, as he so desires. In the latter case, all of the children will share in the use rights of the said land. The eldest of the children will become alab as per the customary matrilineal inheritance pattern.

The decision as to future disposal of the land may then be made by the alab in the succeeding generations. The land may be retained within the bwij or divided again between the siblings. It is alleged that in most cases, the land is retained within the bwij. Siblings usually cooperate with each other in this matter "because they all shared the same breast".

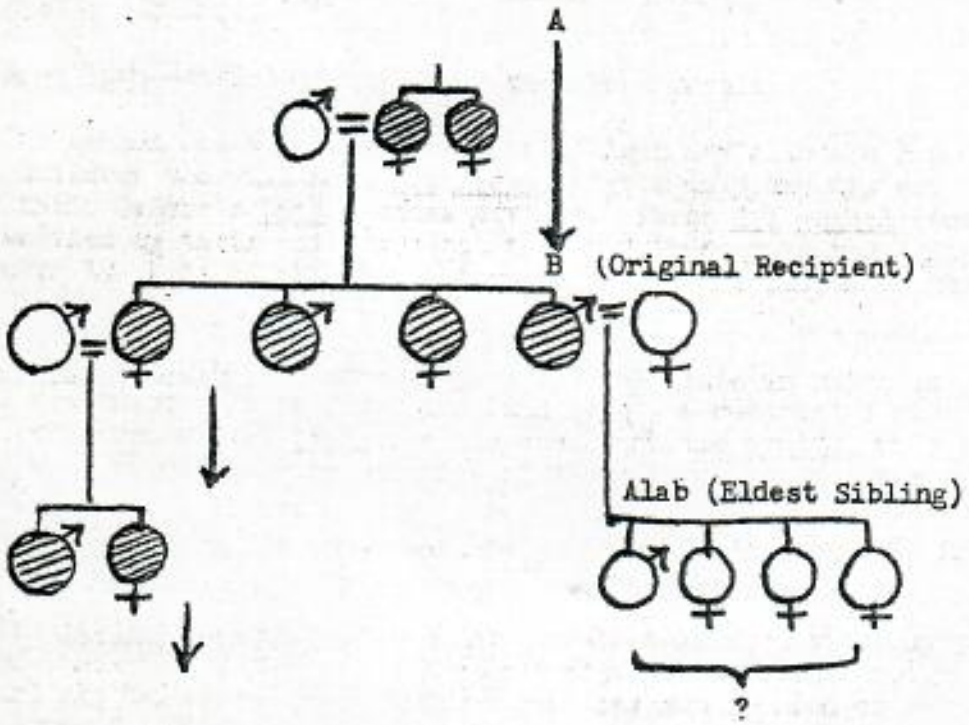
Jikin Kolotlot--Imon Kolotlot--Jemlok (The Ending) is land given for nursing or caring for iroij or alab when ill. Given on death bed usually or prior to death when person is becoming old. Gift must be approved by the iroij elap. The recipient may be a medicine man (dri uno) who nursed the donor of the land, e.g., when iroij Tobo was ill on Arno in 1950, many people gathered about him, as is the custom; some of them brought food to him, carried him to the outhouse, bathed him, etc. His dri uno remained near him at all times during his long illness. This functions as a sort of "sick care insurance". Land of this type is passed down through the bwij. During the German period, Kwier Island on Kwajalein Atoll was allocated to Leanmo as jikin kolotlot by iroij Jeimata and his half-sister, Libetok, upon the death of the former iroij lablab Leit. (See NOTE).

NOTE:

1. Men in kolotlot is personal property; clothing, fish hooks, money, etc., not belonging to all share holders of the land. The money, etc., is given to the eldest child to divide among the siblings. Adopted children are not included. Money may not be given to an outsider "because this creates disputes" as informants have explained. A man may leave a house, cistern, etc., to his

(NOTE continued on p. 18)

"IROIJ LABLAB"



"IMON AJE", "BURIJ IN AJE" (divided land) may be allocated to either "bwij" (I) or children (II).

Figure 3.

Imon Ato (Rālik), Montutu (Radak) (come ashore to get land)--land, not an island, given to a person who adopts, nurses, guards, and cares for the child of an iroij, gives him special anointment (kokabit) with coconut oil, etc. The guardian (kwor) may be either a man or a woman and his or her bwij become kwor also. Any member of this bwij may correct the child of the iroij when he misbehaves, by beating him and pulling his hair (usually very tabu) and may stop him from fighting; i.e., they are in the position of parents to the child of the iroij, whom their bwij member has nursed. The iroij provides food for the child and the guardian. When the child has grown up, his iroij father gives the land to the guardian (kwor). Someone other than the wife of the iroij nursed the children of the iroij. People vied for this respected and lucrative position.

Enen Tutu--an island given for the above services.

The person who receives this type of land may allocate a portion of it to his children who will have dri jerbal rights only and may not become alab unless their father's bwij becomes extinct. These dri jerbal (worker) rights are inherited by their children, but the land (enen tutu and montutu) as a whole belongs to the bwij of the original recipient and is passed on through this bwij.

Jikin In Kokabit--land used as a special place in which to give magical medical treatment. It is forbidden land (emo), a restricted area. The bwirak (noble) children of the iroij use the area, not the iroij. This is one of the devices used to enhance the prestige of the bwirak; as an informant explained:

Everyone knows who the iroij is; he does not need as much mo as his bwirak offspring."

The jikin in kokabit is usually a small island, but it may be a small piece of land. In either case, the land area is not large enough to till. This land may belong to any individual but may not be used or even walked on by the "owner". The purpose of these tabus is to prevent people from seeing the magical treatment.

The bwirak were annointed to make them strong and attractive and brave in war. Sexual intercourse was forbidden--sometimes for as long as six months following the treatment. If the treatment did not prove fruitful, people

(NOTE continued from p. 17)

son if he has built it himself. It will be very difficult to do this, however, if his brother, uncle, or other bwij members helped him to construct same.

2. Incorporeal property such as knowledge of magic, medicine, navigation, etc., is traditionally guarded jealously and transmitted within the iroij group or to individuals whom the iroij may designate. Possession of this secret knowledge has served to enhance the iroij position, adding to their prestige and bolstering their position as leaders of the society. This was especially true in the pre-contact period and immediately following, before an education (reading, writing, etc.) became available to all.

would say, "He spoiled his kabten"(head anointment), i.e., he had indulged in the forbidden sexual intercourse. These sites are still tabu although it is not certain whether or not the magical medical rites are still practiced. It is said they were up to the end of the Japanese regime.

Wuliej Lap (big grave)--the plot of land in which the iroij are buried. This area is forbidden (emo) to anyone not of the iroij ancestry, with the exception of the guardian bwij, kwor. It is believed that supernatural sanctions will automatically operate against those who violate the tabu.

This writer recently visited the wuliej lap on Mejruirōk Island, Jaluit Atoll in which lie the remains of Litokwa, Lajutok, and other Rālik iroij. Two Marshallese youths, one a member of the field party and native of another atoll (Kwajalein) and the other a local resident, refused to get within 150 feet of the small plot of ground in which the iroij are buried. The grandson of Litokwa, however, visited the graves with complete unconcern, explaining that he had the right to do so.

Ninnin (v. and n.)--land given by a father to his children; it belongs to the bwij. A man's daughter and son will only have dri jerbal (worker) rights. The bwij may not take these rights away from them.

The senior bwij member is always the alab. If the alab should try to take away the land right, the iroij will intervene and prevent it. The dri jerbal rights are passed down from parents to children from then on, but alab rights go down through the bwij. Alab and iroij may allocate this land, not dri jerbal. A dri jerbal may never allocate alab rights to another kajur. He may, however, allocate dri jerbal rights to his children--real or adopted. He may ninnin only if the bwij agrees. The alab himself may not assign bwij land away unless permission is granted by the bwij.

The alab has authority over division of food and work assignment, etc., but on land division matters, he must consult with his iroij and his bwij. He cannot do anything on his own accord in land division matters. This is true today and was true in the past, i.e., the alab is not the final authority or autocratic leader. He must consult with his lineage on these important matters. He does not have the exclusive rights in the land, e.g., an alab on an atoll in Northern Radak recently expressed the desire to evict the children of his mother's younger sister from the bwij land because they had been "too haughty", refused to bring him food (ekkan), etc. He complained to his iroij who told him that if he evicted the cousins from the land, he would be violating the custom (manit eo). The dispute was then settled amicably.

If the bwij does not concur with the desire of the alab or dri jerbal to ninnin to his children, the children may remain on the land as ajri in bwij. They will work for the alab's successor and have practically the same rights as the dri-in-bwij (people with matrilineal dri jerbal rights). The difference lies in the inability of the ajri to become alab (unless the entire bwij and associate bwij become extinct). Everyone must have the alab's permission to cut trees, build houses, etc.

After the recipient of ninnin dies, his or her children may be allowed to remain at the discretion of the bwij, i.e., the iroij or alab gives ninnin to one generation only, his son or daughter.

A lesser chief, iroij erik, may make ninnin to his kajur (commoner) son but he cannot leave him all his iroij erik rights and title. These must go to someone of iroij blood. If the iroij erik has no relatives left, the kajur child may take the iroij erik rights but not the title. "He is not a 'real' iroij erik." Cases were cited by informants where iroij erik have given a kajur child part of their lands as ninnin but not the iroij erik rights. The ninnin goes down through the children and their children.

The iroij lablab may make ninnin of special land parcels (wāto) to his children, but the bwij members are not excluded. Ninnin as may be seen is a mechanism by which a father in this matrilineal society may provide for his children. One informant stated, "Everyone likes to make ninnin because they help out their children and everyone likes to receive ninnin because they get more land."

This method of land division often creates problems; on Mejij, for example, it has been cause of disputes since German times. Some of the people who had received ajri rights refused to pay tribute or ekkan of produce from the land to their alab(s) on the ground that they had ninnin rights and did not have to recognize their uncles' authority; conflict ensued.

Sometimes the alab made the division before his death so each of his children had rights in a portion of land. The recipient generation of ninnin and their female children have dri jerbal rights in the land. The male descendants of this generation have ajri rights only. There is much of this today; especially on Maloelap, Aur, and Wotje.

Ninnin land is always given by the father to his children. The donor may be such a strong personality that he is able to go against the wishes of his bwij relatives to allocate the land outside of the bwij. There have been instances of this deviation from the norm. Most types of imonaje may become ninnin.

Morjinkot (Ralik), Bokman Mare (Radak), ("take at the point of the spear") --land given by iroij to a warrior for bravery in battle. After the battle was over, victorious iroij always called the iroij erik and alab(s), "the ones who know more than the others", together to talk it over. They sat and listened to the iroij. He would then call the men to his house and would say, "I give you (such and such a land holding)--morjinkot. Then he would pass the word to the assembled people who had come to honor him, bearing ekkan. Morjinkot was always given by the iroij only to kajur. Whenever land was given as morjinkot, the people living on the land might be allowed to remain on the land as workers for the new alab or they might be sent away and new people placed on the land. The iroij told the original dwellers on the land where to go.

The recipient could give the land to his children or to his bwij. It was not supposed to be given to anyone but a relative. The permission of the bwij had to be obtained in order to give land to son. If the original recipient gave it to the bwij, it followed the custom through the bwij. Once the land is passed down through the bwij, it must continue this way. It is up to the first recipient to decide: "He is a very important man". If it should start through the paternal side, it must continue this way; may not be changed.

This is very important but is sometimes violated and causes trouble. Sometimes, a man would give the land to his wife; this was "wrong", and was done very rarely. When land was given to the wife and from her to her bwij, much trouble started. Usually the first man who received morjinkot from the iroij gave the land to his bwij rather than to his children. A man receiving morjinkot could by-pass his brothers and sisters.

The recipient would tell the iroij how he wanted to dispose of the land he had received as morjinkot. The iroij then informed the iroij erik and alab(s) of the disposition of the land. The iroij could prevent the man from disposing of the land if he thought it was not right.

If the man's bwij had fought hard in the war, the iroij would instruct the man to leave the land to the bwij; or if the man and his son or his brothers were good fighters, the iroij might favor the paternal side, i.e., dependent upon actions in the war; which group fought the hardest. If the man had no brothers, sisters, children, or relatives on the paternal side, the land went to the bwij. Although this land is given to an individual, the bwij is included--paternal relatives also. Recipient conferred with his uncles, and they all divided the land.

A man usually had to confer with his alab for disposal of morjinkot (after he received it) even though the alab had no part in the war. The land was divided among the recipients and his siblings, only to clear and work, not to keep. The siblings were assigned to different wāto(s) if more than one wāto was given by the iroij, e.g., Lañar Island, Arno after the intra-clan (dri Mweijor) war of Tawij vs. Ujelañ.

Maternal relatives and paternal relatives both used the land. Maternal relatives have a "real right" in the land. Paternal relatives could get food from the land but did not have "real" rights in the land. After the senior bwij member died, the next senior person in the bwij became alab.

The land usually went to the whole bwij when the iroij made a morjinkot grant. All of the fighting men, dri terinae, were accompanied into battle by their female relatives who acted as "supply and hospital corps", carrying water and food for their men folk, usually in a coconut shell container. The women involved were called dri bōk bōka (person who brings a water or food container). The saying was, "They are following us to take care of us when we are hurt." The auxiliaries did not carry weapons but remained a little behind the warriors, watching and waiting for a male relative to fall wounded or dead at which time they would rush to his side to succor him or carry away his body.

The warrior's uncle would be alab on the land whether he went to war or not. The warrior was under him. After the old alab died, the alab title went to his siblings according to the customary matrilineal system, and after them, to the warrior's older brothers and sister, in order. In a case like this, the man who received morjinkot could never become alab until after his senior's demise, i.e., the benefit accrued to the bwij rather than the individual.

Ninnin could, however, be made in the first instance. The alab could make the division ajej for all of his children. This may be done generation after generation. This has been done on Mejij Island (as previously mentioned). There one may see small wāto(s) with only fifteen trees. This caused much friction. The alab divided up the land among all of the bwij members. This was last done during Japanese times. The Mejij people realized how impractical this was and have stated that they believed the practice of ninnin has been the cause of much trouble.

The children usually work the land together, and it is inherited like lāmoren land through the bwij.

A man could not allocate the land to his son alone; the bwij had to share. It was impossible for the land to be given to an outsider. On Wotje, land was given (in one case) to relatives of the mother due to extinction of the bwij. The iroij elap Jortaka turned the land over to the oldest of the mother's relatives. Informant never heard of a man giving land to anyone outside the bwij. The iroij would become angry." The land will automatically go to the next senior bwij when the oldest bwij becomes extinct, as has occured during time of war.

Waienbwe--land given by the iroij as a reward for forecasting the future. A dri bubu (magician) was attached to the iroij'(s) court and advised him as to the appropriate time for going to war, building a new house, going fishing, etc. But land was given for giving advice on war only; food, mats, etc., were given for prophesies not connected with warfare. A dri bubu was given land one time only by the iroij for past, present, and future prophesies. The dri bubu was and is a highly respected person and many tabus were and are still attached to his activities.

Informant's father learned magic from Bouliej, iroij lablab of Northern Radak, who taught his sons and grandsons. He was very proficient at bubu. In the past, the iroij knew more about magic than anyone else. However, the restrictions, especially sexual, caused the iroij to maintain a magician in his entourage. This knowledge, according to legend, was taught by two demi-gods, Lewij and Laniej, who came down from heaven and lived at Buoj Island in Ailiñlaplap Atoll for a while, teaching tatooing as well.

Waienbwe was a reward for personal services and could be ninnin to the recipient's children or could be passed on through his bwij at his discretion. The recipient becomes alab whether he is the senior member of the bwij or not. He may have an uncle or brother who is senior to him and his alab, but this man will be alab on the bwij land only. The recipient of waienbwe or kworaelem land will be an alab himself on this land.

Kwodraelim--land given by iroij to a man who sailed with him and bailed out his outrigger canoe (very hard work and necessary to keep the canoe afloat and enable it to keep underway) in war time and peace time. This type of land could be passed on through maternal or paternal side--son or daughter at the discretion of the recipient--like waienbwe. The reward of kwodraelim could be deferred until a later date. It was like waienbwe in that it was given as a reward once to an individual and was inherited like waienbwe.

Anburo (older word: kitre)--general term for presents of food, clothing, etc., given by a man to a woman before and/or after he marries her. Anburo (literally: "of the heart") and kitre ("out in the open") as opposed to bonerik (something one hides to buy the heart of the girl one loves). Kōbwōjbwōj is the new slang expression for the latter type of gift. An analogy is drawn by

informants, with two sailing canoes in a race. The paddling done by the men in one of the canoes which gives the extra advantage and wins the race is like the kōōwōjbwōj (gift) given by one of two men who are courting the same girl. The word has a slightly ribald connotation.

Taro patches are sometimes given as kitre.

Katleb--land allocated by the iroij lablab to a kajur. The word was derived from katleb (large planting), i.e., the iroij plants (trees) people on the land. "Plant the whole tree", i.e., "Plant the island, all of it, with people". Katleb means all former inhabitants were cleared off the land, no one remaining on it at time of the gift. Whenever land was given as morjinkot (reward for bravery) after a war, the inhabitants might be sent away if any survived, or they might be allowed to remain as workers for the new owner. If the people were thrown off the land because one of their bwij had offended the iroij (collective punishment), this iroij would not take care of their needs for land. However, another iroij, hearing of this expulsion, might invite the dispossessed ones to his side and would settle them on his land, thus gaining more adherents.

Katleb does not necessarily imply punishment. If the iroij moved people off the land merely to provide land for others (not to punish transgressors), he would find land for the people whom he had dispossessed. He usually "confiscated" land from a bwij that had plenty of land.

Some katleb land had no people on it when it was "planted", due to a natural disaster, e.g., land on Ebon where all people had been killed by a typhoon about 150 years ago.

Katleb is always given to an individual, not to a bwij. The individual may call the bwij in if he wants to. He may give it to his children as informant's ancestor did 100 years ago. Katleb land may be given away to outsiders, but informants have never heard of this happening. "A man naturally wanted to take care of his kin folk or children." Only the original recipient could give it to whomever he wished, but after that it followed the regular custom through the bwij. Katleb is then inherited through the maternal side (bwij) like lāmoren land.

Mo land, Kotra (Rālik and Radak), Juluburin Ne (Radak only)--personal land of the iroij. Each iroij lablab had land called mo. He might say, pointing to an island or a parcel of land, "That is my mo." From that moment on, that particular land was forbidden to anyone but the iroij or people to whom he gave special permission. The word emo itself means forbidden or tabu.

When an individual is being treated for certain ailments, he is mo. Sexual intercourse is forbidden both to himself and the dri uno (medicine man) who is treating him during the period of treatment.

This term is derived from Jemo, an island in northern Radak, which according to tradition is the residence of Lawi Jemo, the spirit or ekjab of an iroij lablab of long ago. It was believed that Lawi Jemo, the high iroij of Jemo, dwelt in a huge kañal tree from which he sometimes emerged to walk around the island. On these occasions he is said to have appeared as a tall, strong, handsome man "because he was an iroij."

Jemo is the home of myriads of turtles and birds whose flesh and eggs have been a valuable source of protein for the people of the neighboring atolls. Stylized ritual was connected with the first food gathering expedition of the year which occurred in the summer time (rak). A fleet of canoes would sail from one of the neighboring atolls under the command of the iroij. The kakollol (or navigation aid used to fix the position) of Jemo is said to be a large flock of birds that fly out to meet the canoes about ten or fifteen miles from the island. When the birds were sighted, the helsmen would exclaim: Drorer timmei or Drorer mei (eyes down), as a sign of honor and respect to Lawi Jemo.

When the canoe of the expedition came in sight of Jemo Island, the women in the party had to hide under mats in the canoe; otherwise, bad luck in gathering flesh and eggs was certain to follow, so it was believed. As soon as Jemo was sighted, it was emo to use ordinary Marshallese--the laroij language was mandatory.

When the canoes were being hauled up on the beach, special roro (work chants) were used:

"Rubrub kane in madren e wulik
Karoñroñ ie jitoñ,

"Jitoñ rik jitoñ."

"Break up firewood, firewood,
So that we will be able to
rest by the fire,
Charred wood, a little charred
wood."

This was followed by:

"Rubrub jitoñ in ib jen ko karoñroñ ie jitoñ.
Jitoñ rik jitoñ."

"Break up charred firewood so that we shall gather strength at
the charred firewood."

These canoe chants were used on all of the "bird islands". They were used as late as July, 1949, on Jemo. "To make the people stronger." Several elderly informants on Ailuk and Wutrōk (nearby atolls) expressed their belief that Lawi Jemo gives them strength to haul the canoes up on the beach when they use these chants.

The iroij and all of the expedition went ashore. The iroij had to lead the first trip of the year, and he was the first person to step ashore.

Before the party commenced their search for eggs, etc., divine sanction was requested. Everyone assembled on the beach before proceeding inland and cut a leaf of coconut frond. With the iroij leading the way, they walked toward Lawi Jemo (the kañal tree) in single file, each individual carefully stepping in the footprints of the person in front of him so that only one set of footprints would appear--as if only one person had been there.

Women were required to hold mats over their heads while on the island so that they could only see the ground well enough to gather eggs, etc. They were forbidden to see Lawi Jemo. Strict silence was observed on the way to worship Lawi Jemo.

When they reached the tree, each man placed his coconut leaf over a branch of the tree and then sat down in front of the tree and waited for a breeze to come and blow the leaf off. When this occurred, the kebbwi in bwil (ritual name for the iroij on this occasion) would say: "Wuriñ" (we are lucky). If some branches also fell, the same word would be repeated.

This kind of ritual (kabun) is called katobar.

Lawi Jemo had signified his approval. Everyone then proceeded (not in single file) to a special place where marutto, a small, rare plant, grew. The iroij made medicine by pounding the marutto plant. Three yellow leaves and three green leaves were pounded together, and the extracted juice was drunk by all. This was done to prevent anal bleeding and diarrhea which might result from the unaccustomed meal of turtle and birds' eggs. Kirin leaves were made into a medicine using the same recipe if marutto extract proved ineffective. (This treatment for diarrhea is still used today throughout the Marshalls; sometimes the leaves are merely sucked.) After taking the preventative medicine, turtle eggs were gathered independently.

Before eating, everyone reassembled before the sacred tree to resume the ritual. The iroij or a senior aiab whom the iroij had appointed stood before Lawi Jemo and commenced chanting:

"Jei jar um"-"we start to pray."
"Jelbo I jelbo, jelbo I lip ke kijen Lawi Jemo-"we worship, we worship, we worship--these eggs fed to Lawi Jemo."

"Ikri, ikbi eañ eo, Lajibwinemon"-"move it, take it, to the north for Lajibwinemon is the iroij of the north."

"Non rak Lorok"-"to south for Lorok is the iroij of the south."

"Non rear Lokbea"-"to east for Lokbea is the iroij of the east."

"Non kabiloñ Lokabiloñ"-"to the west for Lokabiloñ is the iroij of the west."

As each direction was named, four eggs were thrown out in that direction as an offering to the ekjab. The eggs were then recovered and the principal in the ritual consumed all of them. The remaining eggs were divided up and eaten by the others in the party after the leader had eaten the sacrificial eggs.

A special chant, roro, was used to obtain supernatural aid in pulling turtles ashore:

"Bwili erōk ki"- "push, rolling on shore."

"Erōk ki, erōk ki"-"rolling on shore, rolling on shore."

"Eraror wan tapeo"-"roll the food-bringing turtle. This roro is still used by some of the older northern Radak people who believe in its efficacy.

While on the "bird island", sexual intercourse was forbidden and as previously mentioned, the use of everyday Marshallese was forbidden. It was believed that supernatural punishment, mii i lāroij (sickness of the lāroij) would strike the transgressor in the form of dysentery accompanied by severe anal bleeding.

The lāroij language (stone, lā, or foundation of the iroij was mandatory at all times. This ritual language (which is still known today by some of the older people) may have been the ancestral tongue of the Marshallese, modified by centuries away from the homeland; it may have been an exclusive chiefly (iroij) language or an archaic courtesy language. At any rate, it may provide a clue in comparative linguistic studies today, e.g.:

A. ENGLISH	B. COLLOQUIAL MARSHALLESE (FORBIDDEN)	C. LAROIJ LANGUAGE (MANDATORY)
man	emman	dri kabbil
woman	kōrā	maar
boy	ladrik	laberik, naberik
pandanus	bōp	karkar
breadfruit	mā	waerar
coconut	ni	kebor
preserved pandanus	mokon	wairik
bird	bau	bebelber
octopus	kwet	werak
shark	bēko	niñniñ
sting ray	jemjo	jejanjōr
come	itok	jekabuñ
go	ilok	jekabuñlok
child	ajiri	nabdri
ship	wa	jitōñ
eggs	lip	unniñ
rat	kijrik	kilukor
sand	bok	jejakiki
fire	kijeek	mejwar
turtle	wun	wa

When the expedition was ready to depart from the island, the dri meto (navigator in charge of sailing) would order: "Jen rubrub, (let's sail!), ekwe, rube jiton kōne" (put the boat in the water). After all was ready: "Wui jitōñ kane" (anchors aweigh!). All these orders were given in the laroij tongue which was used until the canoes were half way home. A special roro was continuously chanted by the helsman to remind people not to use ordinary Marshallese: "Ainānā - nānā - ini - nene ene".....repeated (meaning unknown).

This ritual and special language was used on all of the "bird islands" each of which had its particular ekjab, all of whom dwell in trees with the exception of the ekjab of Bokak, Jo Bokak, a red bird (mum) who has been seen recently.

After this initial trip made by the iroij or senior person in the hierarchy, anyone else could make ensuing trips during the rest of the year. This ritual was apparently a method of conservation. Rather than allow people to swarm all over the island, possibly frightening away nesting fowl and egg-laying turtles, the iroij and senior people led the way and the food gathering proceeded in an organized, methodical fashion.

The early missionaries successfully used their prestige and persuasive powers to discourage the worship of Lawi Jemo and the other ekjab. This kabuñ (ritual) was last performed at Jemo during German times, according to a reliable informant, shortly after which the tree, Lawi Jemo, was cut down for boat timber. Today people gather turtle eggs and birds' eggs, etc., at any time of year and walk wherever they wish on Jemo. None of the tabus are observed as far as may be determined. This is true for the other bird islands as well. This religio-economic pattern clearly illustrates the close affinity of the aboriginal Marshallese religion to the ecology.

Mo or kotra land (Radak and Rālik), juloburin ne (Radak only) is land belonging to the iroij elap alone. When the iroij saw an island he liked, he had three tabu signs made and placed on the land (usually very good land), one on each end and one in the middle. These "signs" are called jtkiju or jabne (no foot), i.e., no foot but the iroij'(s) may step here, and were made of a plaited coconut frond tied to the end of a stick (informant made one for illustrative purposes). The word kotra itself means the leaf (coconut frond) that makes land mo (tabu). The itkiju were placed in position one time only and were not renewed...."people know about it."

Magic (bubu) was made on the itkiju. It is believed that if any unauthorized person takes food from the island or ever sets foot on it, he will get sick and/or die. Permission to go on the land had to be obtained from the iroij. If any people had been living on the land, they were forced to leave. An uninhabited island was usually chosen, however. When the iroij died, the people could return to the land unless the new iroij continued the kotra. The iroij appointed special temporary workers who had no real workers' rights and who shared the proceeds from copra sales or the produce of the land with the iroij.

This land may be passed from father to son or it may remain within the bwij. The iroij may do what he wishes with it; it is his personal property. If the iroij should leave no close kin, the workers on the land may have it. The next iroij may not recover any of the mo land that his predecessor may have given away.

An informant's father received two pieces of land on Wotje Atoll this way. His father was iroij erik in Northern Radak. His father, Jibunemon, was paternal uncle to Murjil, the iroij lablab of Northern Radak. The informant's father had the itkiju (tabu) signs placed on the two parcels of land, and the land was inherited by the informant who is in possession of it today. Informant is a member of the noble class.

There are other parcels of kotre or mo land in Ebon, Ailiñlaplap, Majuro, and other atolls, viz:

MO LANDS OF IROIJ KABUA KABUA

Ailiñlaplap Atoll:

Islands	Wāto ko (pieces of land)
Toleōn	Batō
Edridr	Barōnekmouij
Enekanloto	Lolinmak
Tōbo	Unbar
Mattōn	Kōkomōnmōn
	Kaiuikan
	Otojome
	Kimemekan

There are no alab(s) or people with real dri jerbal rights on these lands.

Jaluit Atoll:	Ebon Atoll:
Islands	Islands
Arbwe	Eneor
	Mōneak

There were alab(s) and people with real dri jerbal rights on these lands before iroij Nelu took them over as mo in German times. An agreement was made whereby the proceeds from the copra produced on these lands was divided on a 50-50 share basis. This division is still in force.

In Japanese times about 1921, Lobareo, iroij elap of northern Radak, had a juloburin ne (translation: sole of foot / of iroij only may touch this land /), island in Maloelap Atoll on Taroa Island, Drinjen wāto, which he had inherited from his uncle, the previous iroij elap, Murjil. He used to take all of the money from the copra proceeds--iroij erik and iroij elap share, alab and dri jerbal share. This is the richest land on Maloelap.

The iroij may give juloburin ne land to his children or to his bwij. Royal "blood" is a prerequisite for holding this type of land. If there are no royal descendants left, the iroij elap takes the land back.

Lobareo later turned Drinjen wāto over to his son (Laibwij) who inherited all the rights except iroij elap rights which were inherited by Jajua, the next iroij elap of northern Radak. There are no permanent workers on Drinjen today and no alab. Informants have never heard of iroij juloburin ne are passed down from alab to alab; however, there are no permanent workers either, only iroij elap and alab.

Metak in Buro (pain in heart)--land given by an iroij to his cast-off wife as "her husband", i.e., a sort of alimony.* This done at the discretion of the iroij. One informant knew of a case like this at Wotje Atoll.

Metak in buro land remains in the bwij. The cast-off mate was tabu sexually to other men forever after unless the iroij told a man that he could take her sexually. This latter usually happened. A woman who had sexual intercourse without this permission was sometimes killed and the land was confiscated by the iroij. When a kajur husband was cast off by a leroij, he did not receive metak in buro land. He also was tabu sexually at all times. Women avoided him for fear of being killed for having sexual relations with him. His illicit sex partner was the only one killed.

Lowiō--land that had never been used before because of heavy underbrush. There were many of these areas in the old days. There is no lowio land today. If a kajur wanted land, he asked the iroij permission to clear a parcel of lowiō land to have rights in it. If the individual cleared the land by himself, he could leave it to his desired heir.

If his bwij helped clear the land, the bwij inherited the land. The iroij might do the clearing with his own workers and he would keep the land as his personal land. This last happened during early Japanese times, e.g., on Majuro Atoll on Ajeltak Island, Mwōnbat wāto has an iroij and temporary workers only today. Dalap, Monworwor wāto is in the same status but now occupied by an air strip. On Roñroñ Island, Ēñlen wāto, iroij Laṁlan cleared it himself in 1912 and changed the name from Tur (a geographic term) to its present name. Dri jerbal were put on this particular land permanently and are working it today.

Lowiō by an iroij may mean that the land may have been used by a kajur but not worked or cleared by him. The iroij cleared the land and the kajur "lost" their rights in it, i.e., a sort of punishment for not carrying out duties and obligations.

Erenteb--"something, i.e., a gift, to put your shavings (from the canoe) in." In the old days canoes were very important in the economy and in the frequent wars. In the absence of metal tools, canoe building was a difficult and time-consuming task.

When the iroij wanted a new canoe, he sent hundreds of his people out to cut a huge breadfruit tree for the hull and other trees for the supports of the outrigger, the platform, etc. Only a few men in a few lineages knew how to construct a canoe. Special knowledge of measurements was and still is handed down within the lineage.

Folded pandanus leaves were used to "blue print" the canoe. Two of these skilled men were usually in charge of the building of a huge canoe for the iroij. These men were rewarded by the iroij with gifts of mats, rope, food, etc.--never land. The other workers received nothing from the iroij but food while they were working on his canoe. One informant saw the iroij Murjil's canoe built and land was not given. Informants have never heard of land called erenteb.

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* Nets, mats, boats, clothing, etc., given to a cast-off wife by the iroij are called mweien tiriamo (these goods- things - of sorrow) or jemlok (the ending).

The man or men in charge of the canoe building was forbidden to have sexual intercourse while the canoe was being built. A dri bubu made magic to aid in building a good canoe. Bola was used before the canoe was built to find an auspisgious time. A canoe should be made when there was no danger of surprise attack that would prevent completion or allow capture of the canoe.

Enen-Kojou (land-of-make disgrace), Jou-Mij (die without land)--the iroij never took land away for adultery if just kajur were involved. However, if an iroij or leroij were involved, he or she would get land from the erring husband or wife.

If a kajur male was married to a leroij who had sexual relations with another man, the kajur might have complained to the iroij elap who would say iroij loman (iroij custom), i.e., the iroij may do anything they wish. However, if a leroij had a kajur husband (known as iroij emman both in Rālik and Radak) who committed adultery, she confiscated the land of her husband's sex partner. She did not have to consult the iroij elap about it. She possessed enough power herself. The leroij could tear her rival's vagina open as additional punishment if she wished; this was done many times according to informants.

A kajur male who had sexual intercourse with the iroij elap'(s) wife was described by a special term, laff ebuñti (the heavens will fall upon the people / concerned /). The offending male was always speared to death by an iroij erik or bwirak-tak (lesser royalty). The offending wife could be cast off without metak in buro or killed, at the discretion of the iroij elap, but her land was not confiscated. The iroij confiscated the land of his wife's lover, kojjou (throw away). His whole bwij was thrown off the land and told: Jou mij (you will die because you have no land). The land was then called enen kojjou. Informant told of a case of this type that occured in Mutrōk Atoll in pre-German days.

A kajur male who had sexual relations with the wife of an iroij was killed and his land was given to an outsider, usually the person who executed him. His whole bwij was then evicted from the land.

Presumably this idea of collective punishment for individual transgressions of one member of the lineage was designed to prevent commoners from violating the iroij sexual rights and to accentuate the exalted position of the iroij class and everything pertaining to it. The iroij could dispose of the confiscated land as he pleased.

In the case of a kajur woman who committed adultery with the husband of a leroij, the offending woman was often taken to the ocean and drowned by all the leroij. An informant had heard of this happening in pre-European times. In one case, during Japanese times, according to an informant, a kajur male had sexual intercourse with the kajur wife of a bwirak lablab (son of an iroij lablab father and a libwirak--lesser royalty--mother). When his crime was discovered, the offended husband and all of the iroij erik and bwirak beat him into unconsciousness. The husband then forgave his wife and continued living with her.

All of the iroij were tabu sexually to kajur except on invitation of the iroij or leroij. The land of the offending mate leroij (if he was a kajur—iroij emman) could be confiscated by the leroij. If so, all of his bwij was evicted and another bwij put on the land. The evictees would move to the domain of another iroij, as in the case of land alienation of the iroij'(s) bwij. This land was passed on through the bwij of the new occupants and was then classified as kotleb.

The offenders: leroij'(s) mate and the woman involved, were either killed, beaten, or had their land confiscated, any of the three; however, they had no choice of punishment.

The leroij sometimes ordered her husband's death and sometimes her rival as well but usually had them beaten. The most usual punishment was confiscation of land. If the iroij'(s) wife was of iroij "blood", she could sleep with another man and not be subject to punishment by the iroij. He could only "get revenge" by sleeping with another woman or he might merely scold his wife. "Both iroij and leroij have the same power so they cannot punish each other."

Conversely, if an iroij offends his (leroij) wife, she may obtain revenge by sleeping with another man. This method of "paying back", as it is called, is often practiced today by Marshallese of all classes. The leroij'(s) kajur lover could not be punished according to custom and neither could the kajur sex partner of the iroij. An iroij who had sexual relations with the wife of another iroij from the same area could not be punished.

The wife, if a commoner (lijela) could be thrown out after being beaten but her land was not confiscated. If a leroij was offended against by another leroij, the same thing applied as in the case of the two iroij. Informant laughingly told of an iroij who slept with the lijela (commoner wife of an iroij lablab). When the cuckold found out about it, he became angry but did not do anything about it. "A kajur would have been killed." This incident occured shortly before World War II. However, for example, if an iroij from the Rālik Chain came to Radak and trespassed sexually on a Radak iroij'(s) wife, war would ensue. This almost precipitated a war on Majuro more than one hundred years ago.

A bwirak (lesser iroij) who slept with a lijela would have his land confiscated but not killed; presumably because he was a member of the royal class. The land confiscated by a leroij from her rival could be given to the husband of the adultress. This was only done occasionally, and this land was passed down through the man's bwij. Land of this type was called mweien tiriamo (goods of sorrow). The land of a man who slept with the lijela (commoner wife of an iroij) was never given to his wife but was kept by the iroij.

Kaamnak--(not a land title; verb) "to put someone on the land, house, etc. Similar to kotleb land; it may be any type of land. It has often been land given by one iroij to another, e.g., Jebrik Lokotwerak, iroij lablab of one-half of Majuro Atoll during Japanese times, gave an island on Majuro Atoll to Litokwa, an iroij from Ebon Atoll in the Rālik Chain. Litokwa had promised to kaamnak land to Jebrik in return. He did not keep his promise, however, so Jebrik took the land back. This type of land is used by the iroij recipient, and after his death, it reverts to the iroij donor.

Kotra land, iroij personal land, has been given as kaamnak. Kaamnak provided the iroij with a place to stay when they visited outside their own atolls, e.g., Toemeiñ iroij of northern Radak, had land of this type in Jaluit Atoll in the Rālik chain during the Japanese times.

While the iroij is away from his kaamnak land, the money share from the land is given to the original iroij. Food is given to any of the recipient iroij'(s) workers who may be on the land, e.g., workers of iroij Loemein on his kaamnak land on Jabor, Jaluit Atoll.

The usufruct rights in kaamnak may be transferred to a third party, e.g., during the Japanese period, iroij Jebrik Lotokwerak of Majuro gave Jable, a piece of land on Majuro, to iroij erik Lañlan of Majuro as kaamnak. The latter had a boat made by a half-caste, Joachim de Brum, and turned this land over to him for his use in payment for the boat. He predeceased his half-caste friend, and the land reverted to the original donor.

Workers of this type of land will remain on the land, make ekkan, and give the copra share to the new iroij when he is there. This individual will inform the original iroij who will reply "keep it" (money and ekkan), i.e. temporary tenure is recognized by everyone involved.

CONCLUSION

The Marshallese system of land tenure has been modified in certain respects due to the acculturative influence of the bearers of western culture. Warfare has been eliminated from the pattern of culture and consequently land ownership does not fluctuate as radically as in the days of inter-clan and familial strife.

With the introduction of foreign administrative authorities and foreign concepts, the authority of the royal (iroij) class has progressively become weaker. However, as was stated initially, the system of inheritance and usufruct has been retained albeit modified in regard usufruct and is operating today with no overt indications of overall disintegration and with all indications of continuance. Whether further acculturation and exposure to the concepts of the American socio-economic system will cause a breakdown of the present Marshallese system of land tenure remains to be seen.

It is strongly recommended that the program of returning the former Japanese government lands to the former Marshallese owners and the payment of claims against the United States government for occupation and damage to land be expedited. It is further recommended that the land shall never be allowed to pass into non-Marshallese hands.

This is the explicit desire of the Marshallese people and was presented in a joint, unanimous resolution in the meeting of the second "Marshallese Congress" in August of this year. As such, it deserves the most serious consideration by the powers that be.

This is particularly important in view of the steady increase in population due to the superior facilities offered by the American medical program which has almost entirely eradicated venereal and other diseases that have prevented large population increase in the past.

There is no serious population pressure at the present time, but the time may come when it will become necessary to utilize every piece of land to the maximum extent as in the Southern Gilberts. This eventually should be anticipated and prepared for.

ADDENDUM

A possible future trend was seen only this week in the request of an alab on Jarej Island, Majuro Atoll (adjacent to the Administrative Center) to collect cash rentals from various individuals whose bwij lands are in other areas and who have built retail stores and bakeries on this individual's bwij land.

GLOSSARY

A brief resume of terminology used in connection with land rights follows:

Ailiñ.....	atoll
Ajri.....	literally "child"; as used in reference to a person living and working on his father's land.
Alab.....	the senior member of the bwij; the head man or woman of a wāto or group of wāto(s).
Bolē.....	divination by means of stones (counted out in series).
Burij.....	land (noun).
Bwij.....	literally "navel"; the extended family group or lineage; used to refer to the maternal lineage primarily but is also used to refer to the paternal lineage, e.g., "that is my father's bwij land." Bwij is sometimes used as a synonym for jowi (clan).
Bwij eo elot.....	means that the bwij has become extinct; all the lineal descendants of the founder of the bwij have died.
Bwirak.....	title of lesser royalty; libwirak--feminine.
Dri jerbal.....	literally "work people"; everyone who works on the land with the exception of the alab. This is a comparatively new term that came into usage with the introduction of a cash economy with copra as its base. The people who have the indisputable rights in a particular piece of land are those who might possibly become alab through their matrilineal lineage. The ajri or children of the male alab form another category and yet another consists of those individuals who are real outsiders, being neither paternal nor maternal relatives but who have been allowed to work on the land.
Ekkan.....	tribute paid to the iroij: food, mats, etc.

Emo..... forbidden, tabu.

Ene..... island.

Eonene..... the main island.

Iroij emman..... commoner husband of a leroij.

Iroij elap or iroij lablab..... king or paramount chief; the alab of the senior royal bwij; leroij--queen or chiefess.

Iroij erik..... literally "little chief"; secondary chief; used in the Radak chain only.

Jikin..... place (noun); referring to a piece of land.

Jikin kwellok..... place of assembly; village

Jikin jemeir..... land of paternal relatives; 3rd person plural.

Jikin jineir..... land of maternal relatives; 3rd person plural.

Jowi..... clan, matrilineal and strictly exogamous with one exception: jirikrik, "because there are so many jirikrik".

Kajur..... commoner.

Kōkajiriri..... adopted child; literally: "to rock and fondle in one's arms", i.e., to "look out" for a child.

Lijela..... commoner wife of an iroij.

Mañoren..... maternal nephews or nieces.

Mañoren lōboren..... eldest female mañoren (the most important because her children will eventually become alab).

Nukin..... relatives, paternal and maternal.

Radak..... eastern chain of atolls and islands: Bokak, Bikar, Wutrōk, Ailuk, Wotje, Erikub, Maloelap, Aur, Majuro, Arno, Mille, Tōke, Likiep, Narikrik, Jemo Island, and Mejij Island.

Rālik..... western chain of atolls and islands: Roñlap, Wotto, Lae, Ujae, Kuajlen (Kwajalein), Ellip Island, Namu, AiliñLaplap, Jaluit, Namrik, Ebon, Kili Island, Ujilañ, Ailiñinae, Roñrik, Enewetak, Bikini, and Jabwot Island.

Rārōk..... islands (ene ko) or wāto(s) (wāto ko) used for making copra but not regularly inhabited; also used to describe waste land, full of coral boulders and sand left by a typhoon; area of poor soil. Usually the S. or S.E. portion of an atoll. Called aeañ when on N. or N.W. and liklal when in the western portion.

Rukorea (Rālik), Mileba (Radak). maternal uncle.

Dialectical differences in terminology (Rālik and Radak chains) are noted where existent in this paper.

Diacritical marks: ā—as in back, sack; ō—approximately as "u" in murder; ñ—"ng" as in sing, king, etc.

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APPENDIX

MODIFICATION OF THE LAND TENURE SYSTEM ON UJILAÑ BY THE DISPLACED ENEWETAK PEOPLE

When the former inhabitants of Enewetak were re-located on Ujilañ, the naval authorities allocated one-half of the atoll to each of the iroij lablab Johanes and Abream, following the pattern that prevailed on Enewetak.

In 1949 each iroij then divided the land allocated to him, among his people. Each individual (from the youngest child to the oldest adult) received a plot of land some of which support less than ten coconut trees. The alab does not receive a share of the dri jerbal copra nor (as previously stated) does the iroij.

As may be seen, this new pattern of allocating individual land holdings is a drastic modification of the traditional Marshallese land tenure system. Whether this change was brought about by acculturation from the neighboring Ponape District within which Ujilañ was incorporated administratively during the Japanese period, or whether it was a result of suggestions by American administrative authorities is not clear at the present time, due to lack of detailed information. Further investigation is needed here.

MARSHALLS