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**SYSTEMATICS AND ECOLOGY OF THE LAND
CRABS (DECAPODA: COENOBITIDAE, GRAPSIDAE
AND GECARCINIDAE) OF THE TOKELAU ISLANDS,
CENTRAL PACIFIC**

by J.C. Yaldwyn and Kasimierz Wodzicki

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ABSTRACT

The Tokelau Islands consist of three atolls (Atafu, Nukunonu and Fakaofu) approximately 500 km north of Western Samoa. Their numerous islets are formed mainly of coral sand and rubble with no standing freshwater. Sixty-one plant species have been recorded, 13 of these being introduced and 10 being adventives. There are three vegetation zones, the beach, the beach-crest, and the interior coconut/fern zone with the physiognomy of a humid tropical forest. Marine invertebrates have not been studied. One hundred and fifty insect species in 83 families have been recorded with most being widely distributed South Pacific species including several introduced agricultural pests, e.g. Rhinoceros Beetle. Some marine fishes have been listed and 7 species of lizards are known from the group. Twenty-six bird species (15 sea birds, 8 shore birds and 3 land birds) are known but none are endemic races. Domestic pigs, cats, man and the Polynesian Rat (*Rattus exulans*) are the only mammals. *R. exulans* is an economic pest as it causes considerable damage to the coconut crop and assists in the spread of filariasis.

Ten species of "land crabs" are identified from the Tokelaus, 4 being terrestrial hermit crabs of the anomuran family Coenobitidae (3 *Coenobita* spp. and *Birgus latro*) and 6 being terrestrial crabs of the brachyuran families Grapsidae (2 *Geograpsus* spp., a *Metopograpsus* and a *Sesarma*) and Gecarcinidae (2 *Cardisoma* spp.). Eight of these species have been recorded before from the Tokelaus under one name or another but two, *Geograpsus grayi* and *Metopograpsus thukuhar*, are new records for this group of atolls. The total of 10 land crab species

¹ National Museum of New Zealand, Wellington, New Zealand.

² Zoology Department, Victoria University of Wellington, New Zealand.

from the Tokelaus can be compared numerically with 15 species on one atoll (Arno) in the Marshall Islands, 9 on one atoll (Kapingamarangi) in the Carolines and 7 from one atoll (Raroia) in the Tuamotus. All the land crab species from the Tokelaus (except for *Sesarma ?gardineri* known elsewhere only from New Guinea and southern Micronesia) are wide-ranging Indopacific forms known from at least the western Indian Ocean to the eastern central Pacific.

Fourteen different crab names in the Tokelau language are recorded and identified. Vernacular names for common land crabs such as *uga* (*Coenobita brevimana*), *ugauga* (*Birgus latro*), *paikea* (*Cardisoma rotundum*) and *kalamihi* (*Geograpsus crinipes*) are used with minor modifications for similar species in Samoa, Niue and the Cook Islands. A traditional story about the *kaviki* (the shore crab, *Ocypode ceratophthalma*) recorded by Dr. Judith Huntsman of the University of Auckland, is given in translation.

All land crab species on the Tokelaus are nocturnal scavengers. Population counts of *Coenobita brevimana* and *C. perlata* together, *Birgus latro*, *Cardisoma rotundum*, *C. carnifex*, and *Geograpsus crinipes* give a combined density of about 560 crabs per 5000 sq. m. This figure can be compared to approximately the same land crab density figure on Kapingamarangi Atoll in the Carolines (Niering, 1956) but is in dramatic contrast to counts of approximately 30,000 *Cardisoma planatus* per 5000 sq. m on Clipperton Atoll in the eastern tropical Pacific (Ehrhardt, 1968).

The numerous land crabs on the Tokelaus have an indirect effect on rat control programs and a direct effect on *R. exulans* themselves. Crabs interfere with rat traps and poison baits, eating both warfarin and zinc phosphide. The effect of the anticoagulant warfarin on crabs is unknown, but quadrat counts show that crabs are severely affected by zinc phosphide. The slight risk to humans of secondary poisoning from eating affected crabs can be virtually eliminated by banning crab collecting in poisoned areas for periods after poison baiting, and by putting poison baits in aluminium tubes of a diameter small enough to exclude large and sought-after species such as *Birgus latro* and the two *Cardisoma* spp. Large land crabs presumably prey on young rats, thereby forcing rats to nest above ground level, and compete with rats for at least one of their important foods, the coconut meat available in man-opened and abandoned nuts.

INTRODUCTION

There is no comprehensive information on the systematic status and biology of "land crabs" (both terrestrial hermit crabs and terrestrial true crabs) on islands in the central and south Pacific. Holthuis (1953) in his enumeration of crustacean species from coral atolls in the Marianas, Marshalls, Gilberts and Tuamotu Islands lists, but does not comment on, seventeen species of land crab in the families

Coenobitidae (land hermit crabs), Grapsidae and Gecarcinidae (true crabs). Niering (1956: 16-18) recorded nine land crab species of these families from Kapingamarangi Atoll in the Carolines and gives a general, but vivid, description of their habits. An extensive summary of the published information on the general ecology of land crabs on Pacific atolls is given in the excellent review of atoll environment by H.J. Wiens (1962: 432-439).

One of us (K.W.) visited the atolls of the Tokelau group on four separate occasions (November 1966 - February 1967 and April - June 1968, Nukunonu Atoll; July - September 1971, Fakaofu Atoll; December 1972 - February 1973, Atafu Atoll) working on the problem of rat damage to coconuts (Wodzicki, 1968a, 1968b, 1969a, 1970, 1972a, 1972b, 1973a, 1973b, 1973c; Mosby and Wodzicki, 1972; Mosby, Wodzicki and Shorland, 1974; Mosby, Wodzicki and Thompson, 1973). During his early visits he made incidental collections of land crabs and was surprised at both the systematic variety and the abundance of these animals. On the suggestion of J.C.Y., he made a special collection of land crabs during his last trip concentrating on obtaining a coverage of the different species present, particularly those with "specific" Tokelauan names. The 1972/73 visit to Atafu Atoll produced a list of seven different land crab species and these have already been recorded in a preliminary report on this visit (Wodzicki, 1973c).

K.W. had previously recorded that land crabs seriously interfere with snap and live-trapping of rats on the Tokelaus (Wodzicki, 1968a: 56) and then added details of interference with ground-placed poison baits (1973c: 21,29). As the coconut crab (*Birgus latro*) and to a lesser extent other land crabs are a part of the Tokelauan diet, he was aware that the use of acute poisons in rat control, such as zinc phosphide, might create the danger of secondary poisoning of humans. During a concurrent survey (Wodzicki, 1969b) of rat ecology and damage on Niue Island, an isolated raised atoll south-east of Samoa, K.W. made similar collections of land crabs and these will be the subject of a future study.

The purpose of the present paper is to provide a detailed account of the systematic status and local names of the ten land crabs on the Tokelau Islands, to comment on their ecology and significance in these atolls, and to discuss the local problem of rat-crab relationships.

ENVIRONMENT AND NATURAL HISTORY

Situation and Climate

The Tokelau (or Union) Islands consist of three atolls, named from west to east Atafu, Nukunonu (sometimes misspelt "Nukunono", see Wodzicki and Laird, 1970: 247) and Fakaofu. Their eighteenth and nineteenth century European names, not now used, are Duke of York,

Duke of Clarence and Bowditch Islands respectively. The Tokelaus are bounded by latitudes 8°S and 10°S and by longitudes 171°W and 173°W. The atolls are approximately 500 km to the north of Western Samoa; Nukunonu is about 90 km south and east of Atafu and Fakaofu is about 65 km east of Nukunonu. They are typical atolls, each being surrounded by a coral reef with an inner lagoon. The numerous islets (or motus) of each atoll vary in number and size but do not rise more than 3 to 5 metres above sea level. The total land area of the Tokelaus is about 11.5 sq.km and the areas of the three atolls are approximately as follows (revised 1975 figures, N.Z. Ministry of Foreign Affairs):

	Total land area (sq. km)	Area largest islet (sq. km)	Area of lagoon (sq. km)
Atafu (fig. 1)	3	1.5	19
Nukunonu (fig. 2)	4.5	1.5	109
Fakaofu (fig. 3)	4	1	59

The mean annual temperature is about 28°C, with July or August being the coolest months and April or May the warmest. The rainfall is heavy but inconsistent and a daily precipitation of 8 cm or more can be expected at any time of the year. The highest mean annual rainfall is 2829 mm at Fakaofu for the years 1958-74. The islands lie in the zone of the south-easterly trade winds but from November to February north-easterly and northerly winds predominate (Kennedy, 1966). The Tokelaus are within the hurricane belt and severe tropical storms occur irregularly. Further details of daily temperatures and annual rainfall provided by the New Zealand Meteorological Service (J.D. Coulter, *in litt.*) are given in tables I and II.

People

The Tokelau atolls are in a border area between Micronesia and Polynesia, and are inhabited by about 1600 Polynesians. Although the islanders retain linguistic and cultural ties with Samoa, Tokelauan culture is of composite origin including elements from both eastern and western Polynesia (Macgregor, 1937). It is distinctly moulded by the atoll environment. The population has shown a significant decline over recent years due to emigration to New Zealand (fore-shadowed by Doumenge, 1966, and documented by Hooper and Huntsman, 1973). The islands are within the political boundaries of New Zealand and the Tokelauans are New Zealand citizens (Annual Report, 1974; Kennedy, 1966). Nearby Swains Island (or Olosenga), regarded by some authors as geographically part of the Tokelau group (see Krauss, 1970) is about 200 km south of Fakaofu and about 300 km north of Samoa. It is United States territory and is excluded from the present study. Bibliographies of the Tokelau Islands and of Swains Island have been compiled by Krauss (1969, 1970).

Table I Surface temperature in the Tokelau Islands ($^{\circ}\text{C}$)

	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Mean</u>
ATAFU (1929-1941)													
Mean daily maximum	30.0	30.0	30.5	30.5	30.5	30.0	29.5	30.0	30.0	30.0	30.0	30.0	30.0
Mean daily minimum	26.0	25.5	26.0	26.0	26.0	26.5	26.0	26.0	26.0	26.0	26.0	26.0	26.0
Daily mean	28.0	28.0	28.5	28.5	28.5	28.5	28.0	28.0	28.5	28.0	28.0	28.0	28.5
ATAFU (1969-1974) ¹													
Mean daily maximum	31.0	31.1	31.3	31.3	31.2	30.7	30.7	30.5	31.0	31.6	31.8	31.3	31.1
Mean daily minimum	25.1	25.5	25.7	25.9	26.1	26.2	25.3	25.2	25.6	25.5	25.8	25.4	25.6
Daily mean	28.1	28.3	28.5	28.6	28.7	28.5	28.0	27.0	28.4	28.6	28.8	28.3	28.4
FAKAOFO (1969-1974) ²													
Mean daily maximum	30.8	31.2	31.3	31.5	30.9	30.3	29.8	29.8	30.2	30.9	31.1	31.1	30.7
Mean daily minimum	25.0	25.1	25.3	25.8	25.9	25.9	25.4	25.4	25.4	25.3	25.7	25.5	25.5
Daily mean	27.9	28.2	28.3	28.7	28.4	28.1	27.6	27.6	27.8	28.1	28.4	28.3	28.1
NUKUNONU (1969-1974) ³													
Mean daily maximum	29.8	30.1	30.7	31.4	31.4	31.5	31.2	30.9	30.9	30.9	30.8	30.3	30.8
Mean daily minimum	23.3	24.1	23.7	24.1	24.1	24.2	24.3	24.1	24.2	24.2	24.7	24.6	24.1
Daily Mean	26.6	27.1	27.3	27.8	27.8	27.9	27.7	27.5	27.6	27.6	27.7	27.4	27.5

¹ Actual period 1969, 1971-1972, 1974

² Actual period 1969-1972, 1974

³ Actual period 1969-1972, 1974

Table II Mean rainfall in the Tokelau Islands (mm)

	<u>Period of record</u>	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Year</u>
ATAFU	1929-1953	294	343	269	211	195	223	241	213	185	267	236	360	2911
	1958-59, 1971, 1974	398	154	218	140	179	142	187	193	203	219	133	386	2552
FAKAOFO	1958-60, 1970-74	383	305	200	125	196	193	236	175	206	284	201	325	2829
NUKUNONU	1958-60, 1971-71, 1974	352	235	221	169	133	157	208	195	217	267	158	379	2691

Soils and Vegetation

The islets of the three atolls are, with a few local exceptions, composed entirely of decaying organic matter, coral sand and rubble. There is no natural standing freshwater and the islanders use sub-surface sources and roof catchment systems.

The plant cover of the islets has not been greatly modified by man and despite centuries of human intrusion, and the ubiquitous introduction of the coconut palm, the vegetation of the Tokelaus still remains in a state of natural equilibrium.

The relative paucity of plant species (61, of which 13 are introduced cultivated plants and 10 are adventives) is another important characteristic of the vegetation of the Tokelau atolls (Parham, 1971). It is appropriate to consider the vegetation of each atoll islet as a single unit, a comparatively simple ecosystem, composed of three main zones: (1) the lower beach or foreshore of sand with more stable areas of coral rubble or beachrock; (2) the beach-crest, and (3) the interior strip on relatively flat stable coral sand. The characteristics and the principal plants of these three zones have been described by Parham (1971: 587-593, figs 4-8) in some detail and can be summarised here. The narrow foreshore zone of either the ocean or lagoon side of the islet is "practically devoid of vegetation" probably due to the unstable nature of this unprotected beach area. A creeping sand-binder, a grass and sedge occasionally occur as pioneers on recently-modified beaches. The beach-crest zone, as the name indicates, stands about 3 to 5m above the high tide level and may extend 10 to 20 m inland. There are four distinct plant associations including the *Messerschmidia argentea* facies which is characteristically seen on exposed sea-side frontages. Other distinctive shrubs and trees found in this zone are the windbreak-forming *Scaevola taccada*, the tall straggling shrub *Pemphis acidula*, the screwpine *Pandanus* (probably *P. tectorius*) and the tree *Guettarda speciosa*.

The interior strip or central zone of the islets is typically occupied by a dense coconut/fern (*Cocos nucifera*/*Asplenium nidus*) forest with a closed 20 m or more high canopy formed by coconut palms with an understory of other trees including *Cordia subcordata*, *Pisonia grandis*, *Guettarda* and *Pandanus* spp. The luxuriant character is enhanced by low shrubs and a dominant crowded ground cover of ferns, including *Nephrolepis hirsutula*, *Phymatodes scolopendria* and *Psilotum nudum* in addition to *Asplenium*, as well as mosses, lichens and fungi. This plant association has the general physiognomy of a humid tropical forest.

Human existence on the Tokelaus is still largely based on fishing and coconuts. All vegetated islets of any significant size carry coconuts planted by man. The eastern islets of each atoll carry more coconut palms to the ground area than the western and southern islets,

and are reputed to provide larger returns of copra per comparative area. Other introduced cultivated plants are only found on the village motu of each atoll which in all three cases is a western islet. These cultivated introductions are mainly used for food or as ornamental plants. The interior forest zone of certain eastern islets and areas such as Olopuka, Natama, Te Ahaga and Lauualalava on Atafu Atoll (see fig. 1), Long Motu on Nukunonu Atoll (fig. 2), and Fenualoa and Lefu on Fakaofu Atoll (fig. 3) appears to be denser and more luxuriant than the forest zone of western and southern islets. This luxuriance in plant growth may have some connection with the predominance of easterly trade winds. Observations by K.W. and reports from local inhabitants would indicate that coconut crabs (*Birgus latro*), and possibly other land crabs, are significantly more abundant on these uninhabited eastern islets.

In addition to coconut palms, two other plants in the coconut/fern forest zone are of especial importance to the Tokelauans. The *kanava* (*Cordia subcordata*) is the only timber tree used for canoe hulls on these atolls and the *lau mea* fern (*Asplenium nidus*) is extensively used as a green vegetable (K.W., personal observation; Parham, 1971: 603-604).

Invertebrate Animals

There is a rich fauna of corals and other marine invertebrates around the Tokelau Islands, not yet studied. Reef and lagoon crabs, and other crustaceans are well represented. Small collections of marine crabs made by K.W. are in the National Museum of New Zealand and Tokelauan names of a few species are recorded below. Hinds (1971) in a report to the South Pacific Commission mentions the presence of the Crown-of-Thorns starfish at these islands and discusses van Pel's observations (1958) on the possibility of transplanting pearl oysters and trochus shells to the lagoons. Although a recent issue of Tokelau Islands stamps features selected corals (September 1973) there is no published record of the actual occurrence of these forms in the area. A stamp issue featuring named cowrie shells (November 1974) is, however, based on species recorded from one of the atolls (Ingam, 1940).

The terrestrial invertebrates of the Tokelaus have been the subjects of several studies. Laird (1956) recorded some freshwater protozoans, Hoyt (in Wodzicki, 1968a) listed an unidentified earthworm, Laird (1956) listed several unidentified entomostracan crustaceans, while Dale (1959) identified three widely distributed isopods. Land crabs are listed by Laird (*Sesarma* sp. only), Hoyt, Hinckley (1969) and Wodzicki (see below). Insects have been treated in some detail by Dale (1959), Hoyt (in Wodzicki, 1968a) and Hinckley (1969). The latter records a total of 150 insects in 83 families most being widely distributed South Pacific species including several introduced agricultural pests. The most important of these introductions is obviously the Rhinoceros Beetle (*Oryctes rhinoceros*) accidentally brought in from Western Samoa and still well established on Nukunonu Atoll in spite of a planned programme of eradication sponsored by the

United Nations Development Program/South Pacific Commission Rhinoceros Beetle Control Project. Arachnids have been recorded by Marples (1955), who found 13 spiders all known from Samoa, Hoyt (in Wodzicki, 1968a), who added two mites and a scorpion, and by Hinckley (1969) who listed further mites. Centipedes and millipedes have been listed by Hoyt and by Hinckley. Additional collections of terrestrial arthropods made on the Tokelau atolls by K.W. are in the Entomology Department of the National Museum of New Zealand, but have not as yet been studied.

Three terrestrial molluscs, all known from other Pacific islands, are recorded by Dale (1959). Finally the Tokelau Islands were selected as the site of a WHO supported research project on the control of mosquitos as carriers of filariasis and the results of this project have been reviewed by Laird (1966).

The geographic relationship of the Tokelau Island terrestrial invertebrates can be summarized in the words of Hoyt (in Wodzicki, 1968a) "It is doubtful if any of the species of land inhabiting invertebrates are endemic to the Tokelaus and probably a few of the species come and go from time to time. In general most of the insects (and spiders) appear to have come from Samoa, although many are widely distributed throughout the South Pacific." In contrast to the Central Pacific atolls of Canton (Phoenix Group), Palmyra (Line Islands) and Johnston, which have faunas mainly derived from Hawaii, "the Tokelaus have obtained most of their fauna from the south and much of it from Samoa."

Vertebrate Animals

There is a rich and varied lagoon and offshore fauna of marine fishes still undocumented and fishing remains the mainstay of the Tokelauan way of life. Van Pel (1958) and Hinds (1971) give lists of many edible fishes taken by local fishermen. A stamp issue featuring named reef fishes was issued in November, 1975.

Seven species of Pacific Island lizards (4 skinks and 3 geckos) have been recorded from the Tokelaus (Wodzicki, 1968a: 69; Whitaker, 1970). The commonest species is the blue-tailed skink, *Emoia cyanura*, found practically everywhere within coconut plantations and near human habitation. Four marine turtles have been identified from local reports (Wodzicki, 1968a: 67) and it appears that the Green Turtle (*Chelonia mydas*) nests on some of the islets of the group but is subjected to considerable human predation.

A recent survey (Wodzicki and Laird, 1970) revealed a relatively rich avifauna of at least 26 species (15 sea birds, 8 shore birds and 3 land birds). Of these, seven sea birds and one land bird (the Pacific Pigeon, *Ducula pacifica*) are known to breed on the Tokelaus and the populations of these eight species are at present on the decline as they are being taken for food by the islanders. All 26 bird species are known widely on other Pacific islands and no endemic

races have been described from the Tokelaus. Most have been recorded from nearby central Pacific island groups such as the Gilbert and Ellice Islands and the Samoan Archipelago. All but one of the shore birds and two of the land birds (a duck, ? *Anas super-ciliosa*, and the Long-tailed Cuckoo, *Urodynamis taitensis*) are migratory which demonstrates the importance of these atolls as mid-Pacific stepping stones.

Apart from domestic pigs, which are retained in enclosures or on small islets, cats (almost entirely kept as pets, rarely feral), and man, the Polynesian Rat (*Rattus exulans*) is the only other mammal found in the Tokelau Islands (Kirkpatrick, 1966; Wodzicki, 1972b). Fortunately no other rodents are found on these atolls but the Polynesian Rat inflicts considerable damage to coconuts, thereby affecting both the local food supply and copra production (Wodzicki, 1968a, 1972a). Rat damage is restricted to immature green coconuts on the palm (Laird, 1963) and rats do not attack unopened nuts on the ground (Wodzicki, 1972a: 311). The Polynesian Rat gnaws a small pit or an opening in the fibrous exterior of the green nut near the peduncle. A few days later the damaged nut drops to the ground and lies unused until eventual disintegration. These damaged nuts provide ideal habitats for the larvae of the diurnal mosquito (*Aedes polynesiensis*), carrier of filariasis (caused by the nematode *Wucheria bancrofti*), which breed in either the water-filled, rat-gnawed pits or in the decaying interior of the nuts (Laird, 1963, 1966).

MATERIAL AND METHODS

All specimens in the "Material examined" lists given below were collected by K.W. unless otherwise stated. All examined material is in the collection of the National Museum of New Zealand. Measurements of both hermit crabs and true crabs are middorsal carapace lengths in millimetres.

SYSTEMATICS OF THE LAND CRABS

CRUSTACEA

Order DECAPODA

ANOMURA

Family COENOBITIDAE

Coenobita Latreille, 1825

Coenobita Latreille, 1825: 276. Alcock, 1905: 139-141 (key to Indian supp.), 192-193 (world checklist). Fize and Serène, 1955: 2-7 (key to South East Asian spp.). Gordan, 1956: 311-312 (bibliography 1905-1954).

Three species of terrestrial hermit crabs were found on the Tokelau Islands. These can be recognized as belonging to the characteristic terrestrial hermit crab genus *Coenobita* by their

habitat, by their shell-bearing habit, and by the compressed eye stalks with the cornea both terminal and lateral. Their generic identity can be confirmed by the twisted, asymmetrical abdomen bearing uropods but lacking paired pleopods and by the peduncle of the antennule (antenna 1) being as long as, or longer than, the carapace and ending abruptly (i.e. lacking a flagellum). All three are typically nocturnal species and can be specifically identified using the key given by Alcock (1905; translated into French by Fize and Serène, 1955).

Coenobita brevimana Dana, 1852
(Tokelau name - *uga*)

- Coenobita clypeata* Latreille, 1826: 277. [Not *C. clypeatus* Herbst, 1791 = *C. diogenes* of various authors, from the West Indies.]
Coenobita clypeata; Dana, 1852: 473; 1855: pl.30 fig. 4a.
Coenobita clypeata var. *brevimana* Dana, 1852: 473; 1855: pl.30 fig. 4b.
Coenobita clypeatus; Alcock, 1905: 142, pl.15 figs. 1, 1a.
Coenobita brevimanus; Rathbun, 1910: 314 (synonymy with *C. clypeata* Latreille).
Coenobita hilgendorfi Terao, 1913: 388 (replacement name for *C. clypeata* Latreille used by some authors).
Coenobita brevimanus; Holthuis, 1953: 36.
Coenobita clypeata; Fize and Serène, 1955: 7, figs. 1 A-C, pl.1 fig. 1

Material examined:

Atafu Atoll

- 7 Feb. 1973, Nauta, 1 male 27mm, 2 females 25mm (1 ovigerous).
 14 Feb. 1973, Te Hepu, 1 damaged male, 3 females 25-28mm.
 19 Feb. 1973, Vao islet, 2 males 19-20mm, 25 females 20-29 mm.
 (collected with *C. perlata*).

Fakaofu Atoll

- 1 Aug. - 19 Sept. 1970, 4 males 19-44mm.

Remarks:

This characteristic purplish species can be readily identified as "*C. clypeata* Latreille" from Alcock's 1905 key by the reduced antennal scale not being fused with the 2nd segment of the antennal peduncle, by the slightly (rather than "strongly") compressed eyestalks, and by the presence of a "bunch of hairs" on the inner surface of the right palm only.

The form of the large (left) hand in the larger specimens from Fakaofu and Nautua is as shown in Fize and Serène, 1955: fig. 1B. The lower border is long and relatively straight. The lower border of the large hand in the smaller specimens from Fakaofu and in the Atafu collections of 14 and 19 February differs from that shown by Fize and Serène in being relatively short and more convex in outline (cf. the characters given for Dana's so-called variety *brevimana* by Fize and Serène, 1955: 11).

We have not followed Fize and Serène (1955) in their use of the name "*C. clypeata* Latreille" for this species. Rathbun (1910) accepted that the name "*C. clypeata*" was pre-occupied by *C. clypeata* Herbst, 1791, used for a West Indian species of this genus. She applied the name *C. brevimana* Dana, originally used for a variety of *C. clypeata* Latreille, to this well known Indopacific species and was followed in this usage by Edmondson (1923) and Holthuis (1953). The name *C. hilgendorfi* Terao, 1913, has been used by some authors for this species, e.g. Forest (1954).

The mollusc shells used by this species and retained with the above collections belong to three genera. The commonest was *Turbo* (*Marmarostoma*) *argyrostoma*, and the other two were *Mancinella armigera* and *Casmaria ponderosa*.

Colour notes:

Carapace, hands and legs purplish in life and colour retained in alcohol.

Distribution:

Widely distributed in the Indopacific ranging from the East African coast and Madagascar through the Indian Ocean and the Indonesian Archipelago to the Marshall Islands (Holthuis 1953), Ellice Islands (Whitelegge, 1897), Line Islands (Edmondson, 1923), Tahiti and the Tuamotu Archipelago (Holthuis, 1953; Forest, 1954). This species was first recorded from the Tokelau Islands by Hinckley (1969), and later (under the name *C. clypeata*) by Wodzicki (1973c).

Coenobita perlata H. Milne Edwards, 1837
(Tokelau name - *uga kaifala*)

Coenobita perlata H. Milne Edwards, 1837: 242.

Coenobita perlatus; Alcock, 1905: 145, pl.XIV figs 2, 2a.

Coenobita perlatus; Holthuis, 1953: 37.

Coenobita perlata; Fize and Serène, 1955: 24, figs 3C, 4A-C; pl.1
fig. 2.

Material examined:

Atafu Atoll

31 Dec. 1972, Motu-ite-Fala, 1 female 31mm.

16 Jan. 1973, Nautua, 1 female 29mm.

26 Jan. 1973, Olopuka, 1 male 28mm.

10 Feb. 1973, 1 male 26mm.

19 Feb. 1973, Vao islet, 1 male 21mm (collected with *C. brevimana*).

Fakaofu Atoll

1 Aug. - 19 Sept. 1970, 3 males 8-30mm.

Remarks:

The striking red colouring allows immediate visual recognition of this species in its natural habitat. It can be readily identified as *C. perlata* from Alcock's 1905 key by having the reduced antennal scale fused with the 2nd segment of the antennal peduncle, by the strongly compressed eyestalks, by the presence of a "brush of hairs" on the inner surface of both palms, by the presence of an oblique stridulating row of laminar teeth on the upper part of the outer surface of the left palm, and by having the outer surface of the propodus of the 3rd left leg (2nd walking leg) convex and not sharply separated from the anterior surface. In mature males the coxa of the 5th right leg is produced into a long curved tube (the vas deferens), considerably longer than the short vas deferens tube of the left coxa.

Specimens of this species were taken in shells of the mollusc *Turbo (Marmarostoma) argyrostoma*.

Colour notes:

As mentioned above, the characteristic colour of the carapace and legs of this species is red, varying in the specimens examined from a pale to a vivid red. The juvenile specimen with a carapace length of 8mm was creamy-white in general colour with red bands on the wrists of chelae and walking legs.

Distribution:

Widely distributed in the Indopacific ranging from the Red Sea and Madagascar through the Indian Ocean and the Indonesian Archipelago to the Marshall Islands (Holthuis, 1953), Samoa and the Tuamotu Archipelago (Holthuis, 1953; Forest, 1954). This species was first recorded from the Tokelau Islands by Hinckley (1969), and later by Wodzicki (1973c).

Coenobita rugosa H. Milne Edwards, 1837

Coenobita rugosa H. Milne Edwards, 1837: 241.

Coenobita rugosus; Alcock, 1905: 143, pl.XIV figs. 3, 3a.

Coenobita rugosus; Barnard, 1950: 469, fig. 86.

Coenobita rugosa; Holthuis, 1953: 40.

Coenobita rugosa: Fize and Serène, 1955: 12, figs. 2A-C, 3A; pl.1
figs. 3, 5, 7-10.

Material examined:

Atafu Atoll

5 Dec. 1972-20 Feb. 1973, 2 males 9-12mm, 2 females 7.5-9.5mm.

Remarks:

These small specimens were identified as this species from Alcock's 1905 key by having the reduced antennal scale fused with the 2nd segment of the antennal peduncle, by the strongly compressed eyestalks, by the presence of a "brush of hairs" on the inner surface of both palms, by the presence of an oblique stridulating row of lamina teeth on the upper part of the outer surface of the left palm, and by having the outer surface of the propodus of the 3rd left leg flat and separated from the anterior surface by a well defined crest. In mature males the coxa of the 5th right leg is produced into a curved vas deferens tube but this is only slightly longer than the vas deferens tube of the left coxa.

Colour note:

The colour of these small specimens was creamy-white with light, orange-brown marks on hands and walking legs.

Distribution

Widely distributed in the Indopacific ranging from Natal and East Africa (Barnard, 1950), through the Indian Ocean and the Indonesian Archipelago to the Marshall and Gilbert Islands (Holthuis, 1953), Ellis Islands (Whitelegge, 1897), Line Islands (Edmondson, 1923), Tahiti and the Tuamotu Archipelago (Holthuis, 1953; Forest, 1954); apparently recorded from the west coast of the Americas (Barnard, 1950). This species was first recorded from the Tokelau Islands by Wodzicki (1968a).

Birgus Leach, 1815

Birgus Leach, 1815: 337. Alcock, 1905: 148.

The genus *Birgus* is monospecific. The general appearance and habits of the distinctive Robber or Coconut Crab, *B. latro*, are well known from numerous general accounts and illustrations that have been published in the semi-popular literature on Indopacific animals. The place of this large land "crab" in the general ecology of coral atolls has been summarized by Wiens (1962: 432-434).

Birgus latro (Linnaeus, 1767)
(Tokelau name - *ugauga*)

Cancer latro Linnaeus, 1767 (not "1758" as given by Gordan, 1956): 1049.
Birgus latro; Henderson, 1888: 50 (synonymy).
Birgus latro; Alcock, 1905: 150, pl.XVI fig. 1.
Birgus latro; Reyne, 1939: 283 (habits and distribution).
Birgus latro; Gordan, 1956: 304 (bibliography 1905-1954).

Material examined:

Atafu Atoll

8 Jan. 1973, Nautua, 2 females 62-74mm.

Fakaofo Atoll

1 Aug. - 19 Sept. 1970, 1 male 33mm.

Remarks:

Although many specimens of this large and readily identified land crab were seen by K.W. during his visits to the Tokelau Islands only three small specimens were brought back for the systematic collections. Larger specimens were collected during rat poisoning trials on Atafu in 1973 and have been used for chemical analysis.

Distribution:

Widely distributed on islands in the Indian Ocean; not recorded from the Malaysian-western Indonesian area, but ranging from the eastern Indonesian Islands and the Philippines, through northern New Guinea, to the Marshall Islands (Holthuis, 1953), Ellis Islands (Whitelegge, 1897), Niue Island (Yaldwyn, 1970), Line Islands (Edmondson, 1923), Tahiti and the Tuamotu Archipelago (Holthuis, 1953; Forest, 1954). Recorded from Swains Island just to the south of the three atolls of the Tokelau group by Dana (1852: 474; 1875). Dana visited Swains Island during the United States Exploring Expedition 1838-42 and recorded that "Great numbers of Birgi (large Crustacea) were burrowing over the island, some of which were six inches in breadth" (Dana, 1875: 160). First recorded from the Tokelau Islands by Wodzicki (1968a) and Hoyt (in Wodzicki, 1968a), and later by Hinckley (1969).

BRACHYURA

Family GRAPSIDAE

Subfamily GRAPSINAE

Geograpsus Stimpson, 1858

Geograpsus Stimpson, 1858: 101. Rathbun, 1918: 231 (American and eastern Pacific sp.). Tesch, 1918: 74 (Indo-West Pacific spp.). Banerjee, 1960: 157 (key to Indo-West Pacific spp.).

Two species of the land crab genus *Geograpsus* were collected on the Tokelau Islands. These can be readily recognised in the field as belonging to this distinctively terrestrial grapsid genus by the obvious toothed plate on the chelipeds. This feature is a prominent, plate-like expansion of the inner distal margin of the merus (arm). It is found in some other members of the subfamily Grapsinae, such as the intertidal genera *Grapsus* and *Pachygrapsus*, the semi-terrestrial and distinctively-shaped genus *Metopograpsus* (see below) and the

temperate genus *Leptograpsus*. The generic identity of the Tokelau material dealt with here can be confirmed by the following features: the carapace is quadrate and dorsally flattened with the front (the interorbital margin) wider than either orbit but less than half the carapace width; the pterygostomial region of the carapace (on either side of the mouth-field) is neither reticulated nor "hairy"; the fingers of the chelae are distally acute and not spoon-shaped, and there is an opening into the gill chamber fringed with setae between the bases of the 3rd and 4th legs (see Barnard, 1950: 9, 76, 111).

Both species of *Geograpsus* recorded here can be specifically identified using the key given by Banerjee (1960).

Geograpsus crinipes (Dana, 1851)
(Tokelau name - *kalamihi*)

Grapsus crinipes Dana, 1851: 249.

Grapsus crinipes Dana, 1852: 341, pl. XXI fig. 6.

Geograpsus crinipes; Alcock, 1900: 396 (synonymy).

Geograpsus crinipes; Edmondson, 1959: 162, fig. 4a.

Geograpsus crinipes; Banerjee, 1960: 163, figs. 1e, 3q, 3r, 4a-c.

Material examined:

Atafu Atoll

8 Jan. 1973, Nautua, 1 male 48mm.

4 Feb. 1973, from house in Atafu village, 1 male 40.5mm.

14 Feb. 1973, Kokoloa, 1 female 30mm.

May 1976, coll. P.C. Cotton, 2 females 23.5-31mm.

Nukunonu Atoll

26 Dec. 1966, Teahua Motu, 1 female 41mm.

8 Feb. 1967, Avelau, Long Motu, 1 female 38mm.

26 May, 1968, 1 male 45.5mm.

Fakaofu Atoll

1 Aug. - 19 Sept. 1970, Fenualoa, 1 female 38mm.

1 Aug. - 19 Sept. 1970, 3 females 26-45mm.

Remarks:

This was the commoner of the two species of *Geograpsus* found on the Tokelau Islands. It can be identified as the relatively light-coloured, large species *G. crinipes*, from Banerjee's key (1960: 158). It has the lateral margins of the carapace parallel and not converging posteriorly, keeled throughout their lengths; the cardiac and intestinal regions of the carapace have a series of transverse irregular striae; the suborbital border between the external orbital angle and notch is dentate; the upper border of the buccal cavern is straight; the sternite of the chelipeds is not pubescent, and the lower margins of the meri of the walking legs are only very weakly dentate distally.

Although most of the twelve specimens available showed no trace of pubescence on the sternite of the chelipeds, two large females had some faint low pubescence on the anterior part of this sternite. Even the smallest specimens, two females from Fakaofu and a female from Atafu, all with immature triangular abdomens (carapace lengths 26, 27 and 23.5mm respectively), show the characteristic features of this species as listed above, including the fully keeled lateral margins of the carapace (cf. the small females identified below as *Geograpsus grayi*).

Colour notes:

Three more or less different colour patterns were recorded in the preserved material. These differences could not be related to sex or size. Pale coloured individuals were straw or creamy-orange above and paler below. Intermediate coloured individuals were pale to dark grey above, often with darker or more orange frontal and gastric regions, and paler below. A dark individual had a dark brown carapace with the chelipeds, walking legs and sternites paler but with brown patches.

Distribution:

Widely distributed in the Indopacific ranging from the Red Sea, through islands in the Indian Ocean and the Indonesian Archipelago to the Marshall Islands (Holthuis, 1953), Ellis Islands (Whitelegge, 1897), Line Islands (Edmondson, 1923), Hawaiian Islands (Edmondson, 1959), Tahiti and the Tuamotu Archipelago (Holthuis, 1953), extending to Easter Island in the eastern Pacific (Garth, 1973). The species was first recorded from the Tokelau Islands by Wodzicki (1973c), though the "*Geograpsus grayi*" records from the Tokelaus given by Hinkley (1969) probably refer to this common species of *Geograpsus*.

Geograpsus grayi (H. Milne Edwards, 1853)

Grapsus grayi H. Milne Edwards, 1853: 170.

Geograpsus grayi; Alcock, 1900: 395 (synonymy).

Geograpsus grayi; Banerjee, 1960: 159, figs. 1f, 3n-p.

Material examined:

Nukunonu Atoll

Nov. 1966 - Feb. 1967, 1 female 24mm.

Fakaofu Atoll

1 Aug. - 19 Sept. 1970, 1 female 19mm.

Remarks:

Two small female specimens of *Geograpsus* from the Tokelaus with unkeeled posterolateral margins on the carapace are tentatively identified as *G. grayi*. Following Banerjee's key (1960) they have the lateral margins of the carapace more or less parallel (*but not*

noticeably converging posteriorly) and keeled anterolaterally but not keeled posterolaterally; the epistome is poorly developed; the suborbital border between the external orbital angle and notch is very slightly dentate, and the sternite of the chelipeds bears a distinct irregular patch of pubescence. Though the underlined features do not agree with Banerjee's key to *G. grayi*, the unkeeled posterolateral carapace margin and the pubescence on the sternite separate these small specimens from the other species of *Geograpsus*.

The two females identified by us as *G. grayi* have rounded abdomens of the mature type at carapace lengths of 19 and 24mm. The Fakaofu specimen of *G. grayi* was collected in the same period and on the same atoll as the smallest available specimens of *G. crinipes*, two females of 26 and 27mm. These female *G. crinipes* at that larger size have abdomens in the immature (triangular) abdominal stage as described above. We consider this to be additional evidence that two species of *Geograpsus* are present on the Tokelau Islands. Mature male specimens of this second species would be needed to confirm this tentative specific identification.

Colour notes:

The Nukunonu female after preservation was pale creamy-orange above and below, while the Fakaofu female was dark brown on the anterior part of the carapace and pale brown on the posterior part of the carapace, the chelipeds, walking legs and sternites. The hands of the latter specimen were slightly iridescent on the outer surface.

Distribution:

Widely distributed in the Indopacific ranging from the Red Sea area, through islands in the Indian Ocean and the Indonesian Archipelago to the Marshall Islands (Holthuis, 1953), Wake Island and Fiji (Banerjee, 1960), Niue Island (Sendler, 1923; Yaldwyn, 1970), Cook Islands (Sendler, 1923), Tahiti and the Tuamotu Archipelago (Holthuis, 1953). This is probably a new record for the Tokelau Islands as the "*Geograpsus grayi*" records from these atolls given in Hinckley (1969) are considered by us to refer to the commoner species *G. crinipes*.

Metopograpsus H. Milne Edwards, 1853

Metopograpsus H. Milne Edwards, 1853: 164. Tweedie, 1949: 466 (key to spp.). Banerjee, 1960: 172 (key to spp.).

The species of the genus *Metopograpsus* are not generally regarded as typical "land crabs" as the few references to habitat published usually record them from mangrove swamps or intertidal sand flats (e.g. Macnae and Kalk, 1962: 27; Macnae, 1966: 80; McNeill, 1968: 80). One species of the genus was collected for K.W. on Atafu Atoll by Dr. Iuta Tiniealu during work on rat control and forwarded to us with a

collection of land crabs.

Metopograpsus as a genus is characterized as follows: the carapace is quadrangular with the posterior margin narrower than the anterior margin; the front (i.e. the anterior margin between the orbits) is wider than half the carapace width; weak striations are present laterally, but absent medially, on the dorsal surface of the carapace; the anterolateral surfaces of the carapace on each side of the mouth field (the pterygostomial regions) are smooth rather than reticulate; and the third maxillipeds lack an oblique setose ridge on their outer surfaces (see Barnard, 1950).

The species of *Metopograpsus* from Atafu was readily identified as *M. thukuhar* using the key given by Banerjee (1960).

Metopograpsus thukuhar (Owen, 1839)
(Tokelau name - *lala*)

Grapsus thukuhar Owen, 1839: 80, pl.24 fig. 3.

Metopograpsus thukuhar; Tesch, 1918: 80 (synonymy).

Metopograpsus thukuhar; Banerjee, 1960: 186, figs. 6f, 6g.

Metopograpsus thukuar (sic) Forest and Guinot, 1961: 155, figs. 162, 167.

Metopograpsus thukuhar; Crosnier, 1965: 25, figs. 20-22, 27.

Material examined:

Atafu Atoll

Dec. 1973, coll. Iuta Tinielu, 2 males 15-18mm, 2 females 13-15mm.

Remarks:

Dr. Tinielu sent a small collection of crabs from Atafu to K.W. in December 1973 in answer to a request for "land crabs". This consisted of two species of *Cardisoma*, a species of *Sesarma* and the four specimens of *Metopograpsus* listed above. He commented (*in litt.* 14 Dec. 1973) on the latter as follows "The lala are darkish in colour small in size."

From Banerjee's key the following features were found to be diagnostic for *M. thukuhar*: no tooth on lateral margin of carapace posterior to external orbital angle; free edges of postfrontal lobes rounded and blunt, postfrontal region with ridges and markings (cf. Crosnier, 1965: fig. 21); suborbital tooth blunt and not keeled from tip to base (cf. Crosnier, 1965: fig. 27); base of antenna thickly pubescent; no "pubescent areas" on anterior surface of propodi of 1st to 3rd walking legs, no "linear fringe" of setae on upper margin of propodus of 4th walking leg; male abdomen with 6th segment (penultimate) slightly longer than 5th; male 1st pleopod with terminal chisel-like chitinous projection (i.e. chitinous projection not T-shaped or apically concave, see Forest and Guinot, 1961: fig. 162; Crosnier, 1965: fig. 20), and female oviducal aperture partly obstructed with a blunt lobe rather than a chitinous projection (cf. Forest and Guinot, 1961: fig. 167).

Distribution:

Widely distributed in the Indopacific ranging from the east coast of Africa and Madagascar, through islands in the Indian Ocean and the Indonesian Archipelago to Japan, Australia, Fiji and Samoa (Banerjee, 1960), Hawaii (Edmondson, 1959; Banerjee, 1960) and Tahiti (Forest and Guinot, 1961). This is the first record of this species from the Tokelau Islands.

Subfamily SESARMINAE

Sesarma Say, 1817

Sesarma Say, 1817: 76. Tesch, 1917: 128 (synonymic list of spp.), 234 (key to Indopacific spp.). Crosnier, 1965: 46 (key to subgenera). Serène and Soh, 1970: 387 (generic and subgeneric subdivision of *Sesarma* s.l.).

Members of the tropical and subtropical genus *Sesarma* s.l. are commonly referred to as "marsh crabs" and most species are recorded as living in mangrove swamps, mud flats or saline marshes. Even in the absence of mangroves and true marshes (cf. Parham, 1971: 592), a species of *Sesarma* s.l. occurs on the Tokelau Islands. This is regarded by us as a "land crab" as all specimens taken were collected on kanava trees (*Cordia subcordata*) or coconut palms at a distance from the beach. This *Sesarma* has already been recorded from the Tokelau Islands by Laird (1955, 1956). His specimen was taken with mosquito larvae from a "rot-hole" in a puka tree (*Hernandia peltata*) on "Motusanga" (Motuhaga), Nukunonu in June 1953.

There are over one hundred species of *Sesarma* s.l. in the Indopacific area (Serène and Soh, 1970). This multiplicity of species has made classification difficult both at the specific and generic level. Recently the genus *Sesarma* in its wide sense has been broken up into a number of new genera and subgenera by Serène and Soh (1970) as a step towards the ultimate revision of this whole group of allied species. The Tokelau *Sesarma* belongs to the new genus *Labuanium* as defined in this reclassification. In our essentially faunal study we will take a conservative systematic view and use *Labuanium* Serène and Soh, 1970, in a subgeneric sense.

Sesarma (Labuanium) ? gardineri Borradaile, 1900
(Tokelau name - *ataata o hiliao*)

Fig. 4

References to *S. gardineri*:

- Sesarma gardineri* Borradaile, 1900: 593, pl. XLIII fig. 8.
Sesarma gardineri; Nobili, 1905: 497.
Sesarma gardineri; Tesch, 1917: 194 (in synonymy of *S. rotundatum* Hess, 1865).

Material examined:

Atafu Atoll

16 Jan. 1973, Nautua, 1 male 28mm.
 Dec. 1973, coll. Iuta Tiniehu, 3 males 26-28mm.
 May 1976, coll. P.C. Cotton, 1 female 33.5mm.

Nukunonu Atoll

18 Feb. 1967, 1 male 30mm.

Remarks:

This relatively uncommon, pinkish orange, tree-climbing crab is readily recognizable as a species of *Sesarma* s.l. by its lateral carapace margins being nearly straight rather than strongly convex, by the distinctly reticulate nature of the pterygostomial region, by the front of the carapace being bent downwards almost at right angles to the dorsal surface of the carapace with strong postfrontal lobes at this angle, by the basal segment of the antenna being in communication with (i.e. not excluded from) the orbit, and by the absence of teeth on the posterior edge of the walking leg meri (cf. Barnard, 1950; Crosnier, 1965). In Tesch's (1917: 235) or Crosnier's (1965: 47) subdivision of the genus the Tokelau species would be placed in the subgenus *Sesarma* as it has two teeth on the lateral border of the carapace behind the external orbital angle, and the upper border of the hand has only one or two simple longitudinal ridges (and no pectinated crest).

In Tesch's key (1917: 238) to the Indopacific species of *Sesarma*, subgenus *Sesarma*, the Tokelau material can not be identified as *S. rotundatum* Hess in couplet 46 as the sides of the carapace are posteriorly divergent and not regularly convex, nor as *S. trapezoidea* Guérin in couplet 49 as the upper border of the male movable finger is not "regularly and transversely milled".

Using Serène and Soh's (1970) key to genera and subgenera of the *Sesarma* complex the Tokelau species has the following diagnostic features (in addition to those listed above): basal segment of antennule somewhat swollen and about as broad as long, walking legs long with anterior and posterior borders of meri subparallel for most of segment, breadth of front just a little shorter (regarded as "subequal" for the key) than breadth of posterior border of carapace, postfrontal lobes strongly ridged anteriorly, carapace lateral border slightly diverging posteriorly and almost concave, walking leg dactyls about half length of propodi, male abdomen relatively narrow and elongate. Thus it can be placed in *Labuanium* though the lateral borders of the carapace are not "slightly convex". Serène and Soh list eight Indopacific species in their *Labuanium* group. Serène (*in litt.*, 10 June 1975) considers that the species of this group are probably all palm-tree dwellers.

Following correspondence and discussions with Dr. Serène in 1975-76 on the identity of this *Sesarma* species, we now regard it as conspecific with the species recorded as the "red tree-crab" and described from Funafuti (in the Ellice Islands) and Rotuma (north-west of Fiji) as *Sesarma gardineri* by Borradaile in 1900. *S. gardineri* has been synonymized with *S. rotundatum* Hess by Rathbun (1907: 33) and Tesch (1917), consequently it was not listed as a separate species under *Labuanium* by Serène and Soh in 1970.

Using an unpublished key to the species of *Labuanium* provided for us by Serène, the Tokelau specimens are identified as "*L. gardineri*" from the following characters: frontal margin of carapace with a weak median concavity, anterior margin of postfrontal lobes not strongly crested and armed with blunt (rather than sharp) tubercles, lateral border of carapace diverging somewhat from behind external orbital angle and nearly straight rather than medially convex, inner surface of male palm with scattered granules arranged neither in vertical nor in transverse rows, upper borders of male palm with a finely granulate longitudinal line, upper border of male free finger (cheliped dactyl) with irregular longitudinal row of 13-15 acute conical tubercles, lower border of fixed finger with acute tubercles, walking leg dactyls about half length of propodi and thickly tomentose on both borders. As the status of *S. gardineri* vis-a-vis *S. rotundatum* is not at all clear we have followed Serène's advice and used this specific name with a question mark. It would appear that the nearly straight (though diverging) lateral carapace margins and the walking leg dactyls being at least half the length of the propodus may serve to distinguish Borradaile's species from *S. rotundatum* with its medially convex carapace margins and walking leg dactyls less than half propodi. *S. rotundatum* was originally described from Sydney in eastern Australia but this temperate locality is probably incorrect as the species has not been recorded from Australia since. The correct nomenclature and relationship of these oceanic island, tree-climbing *Sesarma* must await a complete revision of the whole group.

Note on arboreal habits:

This *Sesarma* was seen only on overgrown eastern islets, such as Nautua and Te Ahaga, of Atafu Atoll (see fig. 1) by K.W. in 1973. It was observed on rainy days running on coconut trunks or on kanava branches and sometimes on the ground. Laird took his specimen (1955) on a puka tree at Nukunonu, and Holthuis (1953: 33) recorded what was probably the same *Sesarma* from a "hole in live coconut trunk" on Ujae Atoll in the Marshalls.

Colour notes:

As mentioned above this crab on the Tokelau was recorded as being "pinkish orange in life". Borradaile's specimens (1900) were described as "red", while Holthuis (1953) noted that his specimen from Ujae was "orange-gray".

Distribution:

Sesarma gardineri has been recorded in the Indopacific from New Guinea, the Ellice Islands, Rotuma and the Tokelaus. It was first recorded from the Tokelau Islands by Laird (1955, 1956) and later by Wodzicki (1973c).

S. rotundatum has been recorded from the Nicobar Islands in the Indian Ocean, Java, New Guinea, Duke of York Island near New Britain, the Caroline and Marshall Islands in Micronesia, Samoa and Hawaii (Tesch, 1917).

The Duke of York Island between New Britain and New Ireland, recorded as a locality for *S. rotundatum* by Miers (see Tesch, 1917), is not the same as the older European name (Duke of York Island) for Atafu Atoll in the Tokelaus.

Family GECARCINIDAE

The typical land crab family Gecarcinidae is represented on the Tokelau Islands by two species. These crabs on the Tokelaus are easily recognised in the field by their distinctive shape, appearance and colour. They have a deep, transversely oval body with the lateral borders tumid and strongly arched owing to the expanded gill chambers. The anterior margin, including the wide orbits is considerably more than half the greatest width of the carapace, the eyes are large, and the general colour of these crabs is usually dark. Mature males of one of the species occurring on the Tokelaus (*Cardisoma carnifex*) can be very large and have one cheliped conspicuously enlarged.

Türkay (1974: 224) gives a useful key to the genera of gecarcinid land crabs found in the Indopacific area. This key is given here in translation for the convenience of Pacific research workers. (In both keys used here the references, e.g. 1(2), are alternatives. Where there is no agreement with 1, refer to 2. Where the agreement is with 2, then proceed to the next number, i.e. 3, etc.).

Key to gecarcinid land crab genera in Asia and Oceania

- 1(2) Pterygostomial regions without "hairs" - *Gecarcoidea* H. Milne Edwards, 1837
(2 spp. in Asia and Oceania).
- 2(1) Pterygostomial regions with a thick tomentum of "hairs".
- 3(4) A suborbital crest present beneath the lower margin of the orbit at the same level as the upper margin of the mouth field - *Epigrapsus* Heller, 1862
(2 spp. in Asia and Oceania)
- 4(3) No suborbital crest present - *Cardisoma* Latreille, 1828
(4 spp. in Asia and Oceania)

The wide anterior margin of the carapace (frontorbital border), the setose patches on the anterolateral surface of the carapace on each side of the mouth field (the pterygostomial regions) and the lack of a suborbital crest place both Tokelauan gecarcinid species in the genus *Cardisoma* (see Alcock, 1900; Türkay, 1974).

Cardisoma Latreille, 1828

Cardisoma Latreille, 1825-28: 685 [pp.345-832 were published in 1828].
Bright and Hogue, 1972: 16 (synopsis of world spp.; list of arthropod burrow associates). Türkay, 1974: 224 (key to Asian and Pacific spp.).

Cardiosoma (sic) Alcock, 1900: 444 (synonymy).

Indopacific land crabs of this genus can be identified from Türkay's up-to-date key to the four species found in this area. This key, somewhat modified by us, is also given here in translation.

Key to the species of *Cardisoma* in Asia and Oceania

- 1(2) Tomentose area on pterygostomial region longer (i.e. higher) than width at base. Corneous endpiece of male 1st pleopod asymmetrical; suture on lateral side of endpiece (Türkay, 1973a: fig. 4a-b; 1974: fig. 3). Female genital opening with lateral margin strongly produced (thickened and expanded), median margin distinctly produced but to a lesser extent than the lateral margin (Türkay, 1973a: figs. 2, 11) -

C. carnifex (Herbst, 1796)

(Indopacific from East African coast to the Tuamotu Archipelago).

- 2(1) Tomentose area on pterygostomial region together with that on exopod of 3rd maxilliped about as long as width at base. Corneous endpiece of male 1st pleopod symmetrical; suture on median side of endpiece. Female genital opening with lateral margin distinctly produced, but median not produced at all and hardly noticeable.

- 3(4) Distance between external orbital tooth and epibranchial tooth (first lateral tooth) on margin of carapace equal to or less than one third width of orbit. Under surface of corneous endpiece of male 1st pleopod not visible from "above" (Türkay, 1974: fig. 2). Expanded lateral margin of female genital opening extending out from sternum and leaning over aperture towards midline in ventral view (Türkay, 1974: fig. 13) -

C. hirtipes Dana, 1851

(Indopacific from Bay of Bengal to Hawaii).

- 4(3) Distance between external orbital tooth and epibranchial tooth equal to or greater than half width of orbit. Under surface of corneous endpiece of male 1st pleopod visible from "above".

Expanded lateral margin of female genital opening extending out from sternum parallel to line of sight and not leaning towards midline in ventral view (Türkay, 1974: fig. 10, *C. longipes*; 1973a: fig. 12, *C. rotundum*).

- 5(6) Surface of carapace granulated over much of its area and with a distinctly granulated postfrontal crest. The 4th pereopod (3rd walking leg) is twice or more than twice width of carapace. Corneous endpiece of male 1st pleopod distally pointed, a little longer than width at base (Türkay, 1974: fig. 4a-b) -

C. longipes (A. Milne Edwards, 1867)
(Indopacific, known only from New Caledonia, Ocean Island in the Gilberts, Kandavu Island in Fiji, Niue, and Makatea in the Tuamotus)

- 6(5) Surface of carapace granulated only on hepatic regions, no postfrontal crest present. The 4th pereopod is a little longer than width of carapace but never approaching twice width. Corneous endpiece of male 1st pleopod distally broad and blunt, not as long as width at base (Türkay, 1974: fig. 1) -

C. rotundum (Quoy and Gaimard, 1824)
(Indopacific from Indian Ocean to Hawaii).

Cardisoma carnifex (Herbst, 1796)
(Tokelau name - *tupa*)
Fig. 5

Cancer carnifex Herbst, 1796: 163, pl.41 fig. 1.
Cardisoma obesum Dana, 1852: 375, pl.24 fig. 1.
Cardisoma carnifex; Boone, 1934: 187, pls 97, 98.
Cardisoma carnifex; Miyaki, 1939: 188, 220, pl.15(5) fig. 2.
Cardisoma carnifex; Türkay, 1973a: 89, figs. 2,4,9-11.
Cardisoma carnifex; Türkay, 1973b: 108, figs. 7-8.
Cardisoma urvillei; Türkay, 1973c: 969, fig.b, pl.1 figs 1-2
(=*C. carnifex*).
Cardisoma carnifex; Türkay, 1974: 224-229, figs. 3,11 (synonymy; distribution map).

Material examined:

Atafu Atoll

8 Jan. 1973, Nautua, 1 male 68mm (det. M. Türkay).
14 Feb. 1973, Te Hepu, 1 female 60.5mm (det. M. Turkey).
Dec. 1973, coll. Iuta Tinielu, 1 female 64mm.

Fakaofu Atoll

1 Aug. - 19 Sept. 1970, 1 male 73mm.

Remarks:

Though not the commoner of the two *Cardisoma* species found on the Tokelaus, *C. carnifex* can usually be recognised in the field by the greater size they can reach (cf. *C. rotundum*, carapace length up to at least 55mm) and by the gross disparity in size in the male chelipeds. This asymmetry increases with increase in size of the male crab. The Nautua male collected on 8 January 1973 with a carapace length of 68mm had the propodus (palm and fixed finger) of the enlarged chela measuring 80.5mm while that of the small chela measured 54.5mm. On the other hand the Fakaofu male of 1970 with a carapace length of 73mm had the propodus of the enlarged chela measuring 99mm while that of the small chela measured 62mm. Females have unequally sized chelipeds but do not have this asymmetry developed to the same extent as in mature males.

Following Türkay's key (as given here) to the species of *Cardisoma*, these specimens have the tomentose area on the pterygostomial region considerably longer than wide at the base, the corneous tip of the male 1st pleopod asymmetrical, the female genital opening with its lateral margin strongly thickened and expanded into a round protuberance, and with its medial margin thickened into a low rim of uniform height. Thus this material is clearly referable to *Cardisoma carnifex*.

Miyake (1939: 189) in discussing the species of *Cardisoma* present in the Micronesian area listed a series of differences between *C. carnifex* and *C. hirtipes*, but did not include *C. rotundum* in his discussion. Our specimens from the Tokelaus show the features listed by Miyake as characteristic of *C. carnifex*. These are as follows: 1, the epibranchial tooth on the anterolateral margin of the carapace is placed very close to the external orbital angle; 2, the width of the orbit is greater than the width of the front; 3, the lateral margin of the carapace bulges outwards prominently behind the epibranchial tooth; 4, the granulated ridge marking the anterolateral border of the carapace extends posteriorly behind the level of the gastroducardiac suture; 5, the postfrontal lobes of the carapace are reasonably distinct but are rounded anteriorly, other carapace regions are not clearly delineated; 6, the width of the tomentose area of each pterygostomial region is equal to half the width of the buccal cavity (note: Miyake compares the width of both tomentose pterygostomial areas to the full width of the buccal cavity); 7, the lower orbital border meets the lateral orbital border at a right angle, and 8, the meri of the walking legs carry setae at the distal end of the anterior margin only (note: Miyake uses the term "posterior margin" of merus, but a reading of Alcock, 1900: 446, indicates that "distal end of merus" was probably what Miyake intended).

In addition we note (following Edmondson, 1962: 25) that *C. carnifex* does not have, behind the level of the posterior end of the granulated anterolateral ridge of the carapace, the 3 to 5 short curved striae running obliquely over the branchial margin onto the upper surface of the carapace so characteristic of the other species

of *Cardisoma* (compare figs. 5 and 6).

Colour notes:

Two of our specimens were dull, dark reddish-brown in general colour with some paler mottling. Another specimen was somewhat shiny (with a micropunctate carapace surface) and dark reddish-brown in colour with a broad, transverse, very dark, crescent-shaped mark at the gastrocadiac suture on the carapace. The largest male, in contrast, was orange-yellow, with the hands and ventral surface dirty white in colour, and the setae on the propodi and carpi of the walking legs jet black and very obvious.

Distribution:

Widely distributed to the Indopacific ranging from the east coast of Africa and Madagascar, through islands in the Indian Ocean, the east coast of India and the Indonesian Archipelago to the Ryukyu Islands, Gilbert Islands (Holthuis, 1953; Türkay, 1974), Ellis Islands (Türkay, 1974), Line Islands (Edmondson, 1962), Samoa (Türkay, 1974), Cook Islands (Edmondson, 1962; Türkay, 1974), Tahiti and the Tuamotu Archipelago (Holthuis, 1953; Türkay, 1974). This species was first recorded from the Tokelau Islands by Hoyt (in Wodzicki, 1968a), with later records by Wodzicki (1973c) and Türkay (1974).

A review of the natural history and utilization by man of *Cardisoma carnifex* in the Indopacific is given by Guinot (1967).

Cardisoma rotundum (Quoy and Gaimard, 1825)

(Tokelau name - *paikea, tupa*)

Fig. 6

Thelphusa rotunda Quoy and Gaimard, 1825: 527, pl.77 fig. 1.

Cardiosoma (sic) *hirtipes* Alcock, 1900: 447 (part only, *C. rotundum* is included under *C. hirtipes*).

Discoplax pagenstecheri Sandler, 1923: 24, pl.20 (also numbered 5) fig. 2.

Cardisoma hirtipes; Edmondson, 1962: 23 (part).

Cardisoma rotundum; Türkay, 1973a: 92, figs. 5, 12-14.

Cardisoma frontalis; Türkay, 1973c: 971, fig. 1a, pl.1 figs. 3-4 (= *C. rotundum*).

Cardisoma rotundum; Turkey, 1974: 234, figs. 1, 14 (synonymy; distribution map).

Material examined:

Atafu Atoll

21 Jan. 1973, from house in Atafu village, 1 female 31mm (det. M. Türkay).

14 Feb. 1973, Te Hepu, 1 female 51.5mm (det. M. Türkay).

Aug. 1973, coll. Iuta Tinielu, 3 males 44-51mm, 3 females 48-51mm (det. M. Türkay).

Dec. 1973, coll. Iuta Tinielu, 2 males 34-46.5mm.

Nukunonu Atoll

- 29 Nov. 1966, Long Motu, 1 male 47mm.
 23 Dec. 1966, Motuakea, 2 males 50-51mm.
 26 Dec. 1966, Teahua Motu, 1 male 47mm, 1 female 47.5mm.
 Dec. 1966, Village Motu, 3 males 41-50mm, 3 females 39-45.5mm.
 8 Jan. 1967, Lalo, Long Motu, 2 males 34-47mm.
 7 Feb. 1967, Avelau, Long Motu, 1 ovigerous female 55mm.
 April-June 1968, 2 males 34-37mm.

Fakaofu Atoll

- 1 Aug. - 19 Sept. 1970, Fenualoa, 1 male 36.5mm, 2 females 41-54mm.
 1 Aug. - 19 Sept. 1970, 1 male 48mm, 1 female 48mm.

Remarks:

C. rotundum appears to be more common on the Tokelau Islands than the larger *C. carnifex* (31 specimens of *C. rotundum* in the present collections compared with only four *C. carnifex*). *C. rotundum* is not only the smaller of the two species but has symmetrically-sized chelipeds both in males and in females.

The specimens listed above can be identified from Türkay's key to the species of *Cardisoma* (as given here) by having the tomentose area on the pterygostomial region about as long as wide at the base; the distance between the external orbital tooth and the epibranchial tooth greater than one third and usually greater than one half the width of the orbit; the postfrontal lobes distinct but not developed into a crest; the surface of the carapace granulated only on the hepatic regions, and the 4th pereopod longer than the width of the carapace but never twice as long. In addition the corneous tip of the male 1st pleopod is symmetrical, broad and blunt, while the female genital opening has its lateral margin strongly thickened and expanded out from the sternum, but not leaning over the aperture towards the midline, and does not have its medial margin produced at all. This combination of features firmly identifies the smaller Tokelau *Cardisoma* as *C. rotundum*.

For many years *C. rotundum* has been confused with, and often included in the synonymy of, the virtually sympatric species *C. hirtipes*. Türkay (1973a, 1974) showed clearly that two species were involved, separated them in his key and provided a short table (1974: 233) of additional differences between these two similar forms. Our specimens from the Tokelaus have the features tabulated as characteristic of *C. rotundum* by Türkay but show somewhat greater variability than Türkay allowed for. Thus the distance between the epibranchial tooth and the external orbital tooth in our material is sometimes *less than half* the width of the orbit, but always greater than one third of this width. (Note: one specimen from Nukunonu had a second, less developed, epibranchial tooth on one margin of the carapace). Türkay describes the central part of the epistome in

C. hirtipes as granulate and that of *C. rotundum* as smooth. However, some specimens in our material of *C. rotundum* have a very few tubercles on the central part of the epistome (but never as many as shown in material of *C. hirtipes* available to us from other areas) and all have an obvious row of tubercles along the ventral edge of the epistome. The subdistal tooth on the meri of the walking legs of our specimens is indeed not noticeable ("nicht wahrnehmbar") as described by Türkay.

As discussed above under *C. carnifex*, Miyake (1939: 189) listed a series of differences between that species and *C. hirtipes* (presumably including specimens of *C. rotundum*). Difference number 6 indicates that the combined width of the tomentose areas of both pterygostomial regions is much greater than the width of the buccal cavity. In our material of *C. rotundum* the width of the tomentose area on each pterygostomial region is subequal to the width of the buccal cavity as well as being subequal to the length of the tomentose area itself.

Finally we must mention an extremely useful preliminary distinguishing feature which we used in the initial separation of *C. rotundum* from *C. carnifex* in our Tokelau collections. This was the presence or absence of a series of short curved striae running obliquely over the branchial margin onto the dorsal surface of the carapace behind the level of the posterior end of the granulated anterolateral carapace ridge. As mentioned by Edmondson (1962: 25) these striae are absent (or hardly developed) in *C. carnifex*, but present in *C. rotundum* (3 to 5 in our material) and in the two other species of this genus (*C. hirtipes* and *C. longipes*).

Colour:

There was considerable variation in the colour patterns seen in the preserved material available of this species from the Tokelau Islands. The colour patterns recorded could be grouped into four different categories.

1. The commonest pattern (19 specimens) observed was varying degrees of dark purplish-black, usually with some purple mottling on the walking legs and occasionally purple mottling on the posterior part of the carapace. Hands were distinctly paler, sometimes purple dorsally, the sternum was pale. Many of these specimens had the margins of the movable sutures in the chelipeds and walking legs (particularly the carpomeral suture) distinctly and obviously reddish in colour.
2. A less common pattern (5 specimens) varied from pale to dark purplish-brown with purple mottling on the carapace and walking legs. Hands distinctly pale, sometimes tinged with orange. The dactyls (claws) of the walking legs in one specimen were of a contrasting pinkish-orange.

3. An equally common pattern (5 specimens) varied from pale orange-yellow to a darker orange-brown with in some cases dark markings on the carapace or reddish mottling on the walking legs. As in the other patterns described the hands were distinctly paler.
4. Two specimens only were somewhat different from category 3 above. These were pale tan in colour over the dorsal surface of the carapace and limbs with pale grey hands and a pale sternum.

No relationship could be found linking these colour differences with the sex, age, or atoll distribution of these crabs.

Distribution

Widely distributed in the Indopacific (but less widely than *C. carnifex*) ranging from islands in the Indian Ocean to the Ryukyu Islands, Marshall Islands (Holthuis, 1953; Türkay, 1974), Ellis Islands (Türkay, 1974), Cook Islands (Türkay, 1974) and Tikahau in the Tuamotu Archipelago (Türkay, 1974). Türkay (1974) records a specimen from Hawaii, but Edmondson had concluded in 1962 (p.25), with the Bishop Museum collections in front of him, that there was "no record to justify the inclusion of any member of the genus *Cardisoma* among the Hawaiian fauna at the present time."

C. rotundum was first recorded from the Tokelau Islands by Wodzicki (1968a: 68), with later records by Wodzicki (1973c) and Türkay (1974).

TOKELAU NAMES FOR LAND CRABS

Introductory Remarks

Other than a short vocabulary (Boardman, 1969) and a preliminary dictionary (Kilifi and Webster, n.d.), there are no published dictionaries of the Tokelau language and no official lists of animal and plant names are available. Tokelau names for plants are listed in Macgregor (1937) and in Parham (1971), the latter based on collections made by K.W. on Nukunonu in 1966-67 and in 1968. Some crab names are listed in Wodzicki (1973c) and a complete list of bird names are given by Wodzicki and Laird (1970). The Tokelau vocabulary has many cognates with that of Samoa. The orthography used and pronunciation of consonants are discussed in Macgregor (1937) and more recently in Sharples (1970, 1976).

The land crab names, and the names of some crabs collected in the lagoon, given here were acquired in the field by K.W. from Tokelauans as the crabs were actually collected. They have been checked with two social anthropologists at the University of Auckland - Dr. Antony Hooper and Dr. Judith W. Huntsman. Our thanks go to

these two scientists for their continued help over the years with matters Tokelauan. Additional comments on crabs were provided by Dr. Hooper (*in litt.*, 3 September 1973) from notes made by him on Fakaofu. These have been freely quoted here. The following comments (based on Wodzicki and Laird, 1970: 250) incorporate information provided by Dr. Huntsman (*in litt.*, 16 September 1977) and explain the orthography adopted in this paper for Tokelau vernacular names. There is an "official" orthography of Tokelauan, and linguistic analysis of the language has been undertaken by Dr. Peter Sharples (1976). In Tokelauan, as in other Polynesian languages, vowel length is phonemic. The phonemically distinct long vowels are indicated by macrons, *f* is a voiceless bilabial fricative and *h* is a glottal fricative which occurs palatised before back vowels. Following Samoan, the sound *ng* as in the English "sing" is rendered by the letter *g*. The Tokelau sound unit (or phoneme) written as *h* is the reflex of the Samoan phoneme written as *s*, and the Tokelau phoneme written as *k* is the reflex of the Samoan glottal stop written as ' (c.f. *kalamih*i and 'alamisi in table III).

Alphabetical List of Crab Names recorded from the Tokelau Islands

Ataata o hiliao, the name applied on Atafu to the small, orange, long-legged "marsh crab" (*Sesarma ? gardineri*) known for its habit of climbing trees.

Kaifala, see *uga kaifala*

*Kalamih*i, used for the land crab *Geograpsus crinipes*. These are described by Hooper as living inland, under stones and other debris, they are not known to dig their own burrows. They are eaten but are reputed to cause constipation.

Kamakama, name recorded by Hooper for a two-inch wide (about 5 cms) edible, grey or mottled crab found on rocks close to the lagoon edge. Probably a species of *Grapsus*.

Kaviki, used for the marine ghost crab (*Ocypode ceratophthalma*) of the sandy beaches. Dr. Hooper records that these large white or pale brown crabs reach up to about 5 cms in width and dig holes down into the sand mainly on the ocean side of the islets. These burrows do not appear to reach water level. *Kaviki* are used in local medicines and a tale about this crab recorded and translated by Dr. Huntsman is given in a later section.

On Fakaofu, Hooper reports that three kinds of *kaviki* are recognised. The *kaviki mataloloa* with "long legs", the *kaviki pukupuku* with "short legs" and a third kind known to some as *uliuli taigole* which are "small and black" and are found in soft muddy sand. [It would appear that the latter two names would not refer to species of *Ocypode*.]

Lala, used for the crab *Metopograpsus thukuhar* on Atafu. Presumably equivalent to the name *paikea lala* recorded by Hooper (see below under *paikea*).

Paikea, used on all three atolls for the smaller of the two *Cardisoma* species, *C. rotundum*, though sometimes the name *tupa*, usually applied to the larger *C. carnifex*, is used as a general name for both species of *Cardisoma*.

Dr. Hooper records that on Fakaofu there was always some confusion when Tokelauans were talking about the different kinds of *paikea*. Some informants distinguished more colour varieties than others. There appeared to be three main kinds:

(a) The *paikea* which are normally eaten. These are brown in colour and up to about 5 cms in width. Specimens from the village islet tend to be more yellow in colour and are called *paikea hehega*. They burrow or shelter under rocks or other ground debris. In addition to their use as human food they are also collected for feeding to pigs. [These are variously coloured forms of *Cardisoma rotundum*, see our discussion under this species in the "Systematics" section.]

(b) The "black" *paikea*. Sometimes called *paikea uli* (*uli* meaning "black") or *paikea lala*; these are found under rocks and are usually not eaten. [Probably these are *Metopograpsus thukuhar* already discussed under the name *lala*.]

(c) The "red" *paikea*. These are described as red in colour, about 2.5 cms in width and having long legs. They are called *paikea fala* and are described as living on *fala* trees (*Pandanus* spp.) or in rain water-filled *tugu*, which are natural or man-made water storage holes in palms or other trees (see Wodzicki, 1968a: fig.10). They are not eaten. [Presumably these are *Sesarma ? gardineri*, already listed under the name *ataata o hiliao* as recorded on Atafu.]

Paka, according to Hooper used as a general name for "sea crabs" as distinct from land crabs. There are several different kinds recognised by their differing colour and size.

Tapako, the name supplied to K.W. for a small swimming crab, *Portunus* sp., taken in the lagoon at Natama islet, Atafu.

Tapolalau, used for specimens of the common marine Indopacific box crab, *Calappa hepatica*, taken in the lagoon at Olopuka, Atafu.

Tupa, used for both species of *Cardisoma*, but usually applied to the larger species with asymmetrically-sized chelae, *C. carnifex*. Dr. Hooper describes these as living in burrows on Fakaofu and taken as food. He also records the interesting observation that "they come up out of their holes in hurricanes."

Uga, used as a general name for land hermit crabs of the genus *Coenobita*. One of us (K.W.) recorded the unqualified name

uga in wide use on Atafu for the purplish species *Coenobita brevimana*, while the name *uga kaifala* was applied to the red species *C. perlata*.

Dr. Hooper recorded the names *uga uli* and *uga fala* in use on Fakaofu for the purple and red species of *Coenobita* respectively.

Uga kaifala, used for the red species *Coenobita perlata* on Atafu.

Ugauga, used on all three atolls for the coconut crab, *Birgus latro*, though colour variations occur.

Comparative List of Crab Names from Samoa, Niue and the Cook Islands

It was felt that a comparative table of vernacular names for the land crabs, and some of the obvious shore crabs, as used in the Tokelau Islands, Samoa, Niue Island and the Cook Islands would be of general interest to those working on ecology and environmental studies in this area of the South Pacific. Some knowledge of local names is the key to working in the Pacific on large and edible animals.

The Samoan crab names in table III were obtained from the extensive list of vernacular names published with their systematic identifications in Kramer (1903: 412-413). These names have been checked with the most recent Samoan dictionary (Milner, 1966). In Samoan the sound *ng* (as in the English "sing") is represented by the letter *g*. The unaspirated voiceless glottal stop is written as an inverted comma ('). We thank Mrs. Seni Neich of Wellington for help in the interpretation of the Samoan crab names.

The Niuean crab names were obtained on Niue Island by J.C.Y. in 1971 and 1972. The orthography used is that adopted in the standard Niuean dictionary (McEwen, 1970). Unlike in written Tokelauan and Samoan the sound *ng* in Niuean is written in McEwen as *ng*, although *g* will be found in older texts. The syllable written as *te* is pronounced *se* in Niuean (thus *tautea* = *tausea*).

The Cook Island crab names were obtained from the only dictionary of Cook Island Maori known to us (Savage, 1962). The sound *ng* is written as *ng* in this dictionary of the Rarotongan dialect. Some additional crab names were supplied by Mr. R. Powell of Rarotonga (*in litt.* October 1976) through Mr. J.M. Campbell of the Plant Diseases Division, D.S.I.R., Auckland. The latter names are indicated by an asterisk in table III, and not all of these appear in Savage (1962). Powell informs us that the coconut crab is called *unga ono* on Rarotonga (cf. *unga* - '*onu* for an unspecified land crab in Savage, 1962), *kavo* on the northern atoll of Penrhyn. He also records that coloured forms of *unga* (*Coenobita* spp.) are referred to as *teatea* (white), *muramura* (red), and *kerekere* (black).

We have not attempted to search for and list crab names from other Polynesian island groups. However, we note in passing that Whitelegge (1897) records the following names from Funafuti Atoll in the Ellice Islands (about 890 km west of Atafu): *ounga ouri* for *Coenobita clypeata* (= *C. brevimana*), *ounga koula* for *Coenobita olivieri* (possibly *C. spinosa*, see Fize and Serène, 1955: 5), and *keibea* for *Cardisoma "hirtipes"* (presumably *C. rotundum*, see Turkay, 1974); and that Tinker (1965, supported by Pukui and Elbert, 1957) records the Hawaiian names '*ohiki* for *Ocypode ceratophthalme* and '*a'ama* for *Grapsus grapsus*. Churchward's Tongan dictionary (1959) gives *paka* as a general name for crabs, '*unga* for hermit crabs, and the names *kalamihi*, *kamakama*, *keviki*, *tafolā*, *teitei*, *tupa*, *tupaolelangi*, '*ū'ū* (all similar to names in table III) are listed among other unidentified crab names.

A Traditional Story of the Kaviki or Ghost Crab

Dr. Judith W. Huntsman recorded the following tale on Nukunonu Atoll and has kindly allowed us to include her translation here.

This is the story of Kaviki, a beauty of the Tokelau Group

This story is about the kinds of creatures that crawl on the ground and live there. The creatures like *ugauga* (coconut crab), *tupa* (large land crab), *paikea* (medium sized land crab), *Kalamihi* (greyish small land crab), *kaviki* (sand crab) etc. and all their various kinds of judging on their colour.

Now *Kaviki* lives in the village. (The kind of *kaviki* that has its eyes placed at the very top of its head and lives in the sand, where it buries itself). He makes up his mind one day that he will go and wander around the world to look for a wife. *Kaviki* is very handsome. The news of his beauty spreads far and wide.

Kaviki now goes to where he wants to go. He goes towards inland, to the bush; and when he gets to the bush the women *kalamihi*, the kind that are greyish, call like this:

"*Kaviki*, you are so beautiful. *Kaviki*, you are so handsome."

Kaviki replies to them: "What are your feelings." The woman *kalamihi* calls him: "Come here and we will be wed." *Kaviki* answers her: "Ach! Who do you think admires you, you hairy-legged, greyish-skinned creature." So the woman *kalamihi* is shamed.

Kaviki goes on, he goes to Alofi [western side of Nukunonu]. When he goes there, the women *paikea* (the white *paikea*) of this place call: "How beautiful *Kaviki* is." *Kaviki* replies: "What do you feel [meaning: is it true what you say]; *Kaviki* is a chief's son. He is very handsome and very beautiful."

Table III Comparative list of crab names from the Tokelau Islands, Samoa, Niue and the Cook

Islands	Tokelau	Samoa	Niuean	Cook Island
Scientific name	name	name	name	name
Land crabs:				
<i>Coenobita</i> spp. (dark coloured)	uga	uga	ungamea	unga
<i>Coenobita</i> sp. (reddish)	uga kaifala	?	ungafala	unga muramura
<i>Birgus latro</i>	ugauga	ūū	unga	(unga-kaveu (unga ono*
<i>Geograpsus crinipes</i>	kalamihi	'alamisi	tautea	?
<i>Geograpsus grayi</i>	—	?	kalahimu	?
<i>Metopograpsus thukuhar</i>	lala	?	—	?
<i>Cardisoma carnifex</i>	tupa	tupa	—	tupa
<i>Cardisoma rotundum</i>	tupa, paikea	pa'atea	—	?
<i>Cardisoma longipes</i>	—	—	kalavi	—
Shore crabs:				
<i>Ocypode ceratophthalma</i>	kaviki	av'i	—	papaka*
<i>Grapsus</i> spp.	kamakama	'ama'ama	kamakama	?
<i>Calappa</i> spp.	tapolalau	tāpola	?	pakapaka*
General name for crabs	paka (sea crabs)	pa'a	paka (edible sea crabs)	papaka*

Legend to tabe III

— indicates species not present or, in the case of *G. grayi* on Tokelaus, species not named.

? name not available to us.

* name from Mr. R. Powell, Rarotonga.

A woman *paikea* calls: "Come here and we will be wed." *Kaviki* replies to her: "Ach! Who would admire you, greyish-skinned, skinny-legged creature." That woman *paikea* is also shamed.

He goes on to another place. When he arrives there the women *ugauga*, (the kind that is black) call to him: "Look! How beautiful *Kaviki* is." *Kaviki* replies: "What again are your feelings? *Kaviki* is handsome, *Kaviki* is beautiful?" The black woman *ugauga* says to him: "Come here and we will be wed." *Kaviki* answers her: "Ach! Who admires you, you are dark black!" He insults her like this and the black woman *ugauga* is shamed.

Kaviki keeps on going and he comes to Tokelau [north east corner of Nukunonu atoll]. The women *ugauga* of this place see *Kaviki* approaching and call out: "Look! *Kaviki* is very beautiful and very handsome!" *Kaviki* again replies: "What are your feelings? *Kaviki* is very beautiful!" The red woman *ugauga* crab calls to *Kaviki*: "Come here and we will be wed." *Kaviki* answers her. "Ach! Who wants you, fat-legged thing!" So this red woman *ugauga* is shamed.

Kaviki carries it on like this. He goes around until all the islets of the atoll are covered in his walk. Down he goes and goes and he arrives at Lalō and Nataulagā [eastern side of Nukunonu atoll]. The large *tupa* of this place call: "Look! *Kaviki* is beautiful! He is very handsome." *Kaviki* replies: "What are your feelings? *Kaviki* is beautiful? He is handsome?" The woman *tupa* calls out: "Come here and we will be wed." *Kaviki* replies: "Ach! Who admires you? Long-legged thing, and skinny and hairy creature!" So the woman *tupa* is also shamed.

But look now, all the kinds of creatures like this; the coconut crabs, the large land crabs, the medium sized land crabs, the small greyish land crabs etc. all come down and follow him persistently to find out where he will get a wife for himself. They come down and wait for him at Tepuka [islet on south western side of Nukunonu]. They all gather together in this place, and wait until *Kaviki* arrives as he is going round the islets of Atumotu [southern side of Nukunonu].

Now *Kaviki* comes down, he arrives at the point and the women of that place, the *kaviki toga* (the southern *kaviki*) call out: "Look! *Kaviki* is very beautiful! He is very handsome!" *Kaviki* answers them: "But what are your feelings? *Kaviki* is very beautiful? *Kaviki* is very handsome?" The southern woman *kaviki* says to him: "Come here and we will be wed." *Kaviki* replies: "Ach! Who admires you ugly people."

This is the exact place where *Kaviki* gets *kaviki toga* (southern *kaviki*). *Kaviki* is now chased away from there. The women mock him. The women call him names to shame him and he calls back to shame them. All the different kinds of *ugauga*, *paikea*, *tupa*, *kalamihi* etc. shout out: "Look here *Kaviki*! Who do you think wants you? The skinny-legged thing with your eyes sticking up on the very top of your head."

Unfortunately *Kaviki* is ashamed. The women again shout at him: "You there, your eyes sticking out at the very top."

Kaviki stands up, and runs fast. He runs away because he is ashamed. All the different kinds of women chase him. He runs away and climbs up a pandanus tree. The very pandanus tree on which *kaviki toga* is. That is the *kaviki* whom *Kaviki*, the son of a chief, loves. The kind of *kaviki* which are red, and are found on the pandanus tree. They are also on coconut trees and inside the *tugu* [holes in coconut trees to collect rainwater]. So the greyish *kaviki* and the red *kaviki* now live on the pandanus. They are wed.

So ends the story of *Kaviki*.

(Comment by J.C.Y. and K.W.: we wonder if the *kaviki toga* of the story are equivalent to the tree-climbing *ataata o hiliao* of Atafu?).

NOTES ON THE ECOLOGY OF THE LAND CRABS

Introductory Remarks

Eighty years ago Charles Hedley summarized so dramatically the place of land crabs in the atoll ecosystem that any discussion on this subject could start no better than with his actual words - "The dominant note in the life of a coral atoll, as expressed by the Funafuti [Ellice Islands] fauna, struck me as the abundance and ubiquity of Crustacea. The Avifauna were but sea fowl, the indigenous Mammalia but rats, the Reptilia only a stray scink and gecko, while insects and land mollusca...were barely represented. Into the vacant places swarmed Crustacea. Not an inch of the atoll world is secure from them. The *Coenobita* wander across from shore to shore and dispute any stray edibles with the rats..." (Hedley in Whitelegge, 1897: 127-128).

The effect of land crabs on atoll life is discussed by Wiens (1962: 432-439) and can be briefly stated as follows: land crabs are nocturnal scavengers eating any available organic material such as dead animals, coconut meat, and other vegetable matter such as twigs, leaves and fruit; they play a major role in the incorporation of organic matter into the soil and their burrowing activity aids in soil aeration. Where burrowing is not practical because of the lack of soil, land crabs shelter under piles of coconut husks, amongst tree roots, in cavities in coral rubble, or in crevassed coral limestone.

Observations in the Tokelaus

On the Tokelau atolls burrowing by land crabs was not obvious except in a few sandy bays on the lagoon side of the islets. Land crabs were not observed during daylight, except when freshly opened coconuts were discarded on the ground. These would usually attract some *Coenobita* during the day but would be covered with land crabs

(mainly *Coenobita*, but including *Geograpsus*, *Cardisoma* and *Birgus*) at night. All the land crabs recorded on the Tokelaus were observed living on the ground although some species were good climbers. *Birgus latro* was often observed at night feeding on rat baits nailed to palm trunks up to two metres above ground, but was not observed climbing to the crowns of palms. The common *Coenobita brevimana* also climbed to rat baits, while *Sesarma ? gardineri* was often seen running along coconut or kanava trunks.

Land Crab Numbers

To obtain some idea of the relative effect of land crabs on the ecosystem of the Tokelaus, K.W. decided to make a preliminary estimate of their numbers during field work on Atafu Atoll in 1972-73. As part of his project on rat ecology and control he had established 14 quadrats on a representative series of islets on various sides of the Atafu lagoon (Wodzicki, 1973c). Each quadrat was a 50 metre square with a total of 2500 square metres. A two to three metre wide strip around each quadrat was cleared of ground vegetation. Five of these quadrats on properties showing severe rat damage to coconuts were selected on three different islets for estimating crab numbers. All five quadrats were situated in coconut/fern forest on the following properties: Laualalava (containing 102 coconut palms and 25 other trees), Te Ahaga (115 palms, 8 other trees), Nautua (117 palms, 8 other trees), Olopuka (132 palms, 23 other trees), and Fenualoa (100 palms, 22 other trees) — see fig. 1. At each quadrat on various dates (see table IV) eleven baits of halved mature coconuts were spaced around the cleared strip at about 12-metre intervals between 1700 and 1800 hours. After about two hours the quadrats were revisited by a team of three people carrying bright lights and all crabs found on or in the vicinity of each bait were identified and counted. In two quadrats, Laualalava and Te Ahaga, it was possible to repeat the baiting and counts on later dates (14 days later at the former and 6, 7, 1 and 1 day later at the latter). In these two quadrats the crabs found on each date were individually marked with a spot of paint of a different colour for each visit.

The result of these nocturnal land crab counts are listed in table IV and can be summarized as follows. The hermit crabs of the genus *Coenobita* are, as expected, the most numerous land crab species on Atafu Atoll with a total of 1266 individuals (i.e. about 96%) out of 1319 different land crabs counted in all five quadrats. The other species in decreasing numerical significance are *Birgus latro* (37), *Cardisoma rotundum* (11), *Geograpsus crinipes* (4) and *C. carnifex* (1). At the two quadrats where counts were repeated on later dates, it was found that there was a much larger *Coenobita* population than that indicated at the first count in each quadrat. Thus 84 *Coenobita* were counted at Te Ahaga on the first night, but the total number of different individuals seen had risen to 383 after the fourth count 15 days later. Similarly, at Laualalava there were 333 *Coenobita* counted on the first night, but the total number of different individuals after the second count 14 days later was 551. The coloured marking at these

Table IV. Numbers of land crabs in five quadrats on Atafu Atoll, January - February 1973.

Quadrat	Date of count	<i>Coenobita</i> spp. No. of No. (& %) of crabs unmarked at crabs baits		<i>Birgus latro</i> No. of No. (& %) of crabs unmarked at crabs baits		<i>Cardisoma rotundum</i> No. of crabs at baits	<i>Cardisoma carnifex</i> No. of crabs at baits	<i>Geograpsus crinipes</i> No. of crabs at baits	Total No. of crabs seen on each visit	Total No. of different crabs seen at quadrat
Lauaalalava	25-1-73	333	-	0	-	0	1	1	335	
	8-2-73	234	218 (93%)	1	-	3	0	1*	239	558
Te Ahaga	23-1-73	84	-	3	-	0	0	0	87	
	29-1-73	109	91 (83%)	13	11 (85%)	0	0	0	122	
	5-2-73	107	89 (83%)	8	7 (86%)	1	0	0	116	
	6-2-73	141	91 (65%)	3	1 (33%)	4*	0	2	150	
	7-2-73**	35	28 (80%)	0	-	1*	0	0	36	413
Nautua	5-2-73	208	-	3	-	0	0	0	211	211
Olopuka***	12-2-73	5	-	5	-	2	0	0	12	12
Fenualoa	2-2-73	119	-	6	-	0	0	0	125	125

Legend to table IV

* Unmarked crabs, not seen at previous count.

** Count made at 1000 hours, i.e. in daylight.

*** Area poisoned with zinc phosphide on 22-1-73 (i.e. 21 days before count).

two quadrats was done on the mollusc shell of the *Coenobita* and on the carapace of the other species. No attempt was made at these subsequent counts, and in the assessment of numbers, to allow for shell change in the hermit crabs or moult in the other crabs. The marking and recapture figures at the Laualalava and Te Ahaga quadrats suggest either very large populations or considerable mobility of land crabs, especially the *Coenobita* populations. Although *Coenobita* are usually nocturnal as indicated by the large numbers seen at night, a count taken at Te Ahaga on the morning of 7 February 1973 showed that 35 *Coenobita* (i.e. a quarter as many as counted the night before) were still feeding on what little remained of the baits at 10 a.m.

These population counts can be compared to those given by Niering (1956: 17) and Ehrhardt (1968) for land crab numbers on Kapingamarangi Atoll in the Caroline Islands and on Clipperton Atoll in the eastern tropical Pacific off southern Mexico. Niering's figures are the only counts we have found of land crab populations on an Indopacific atoll. He recorded a total of 526 hermit crabs, true crabs and coconut crabs in a 40,560 square foot strip transect by counting individual land crabs found under surface vegetation and debris, and adding the number of crab holes seen. Niering's count was presumably made in daylight. K.W.'s highest total count for an Atafu quadrat of 2500 square metres was 558 land crabs at Laualalava. Making an arbitrary assumption that K.W.'s baits were attracting land crabs from an area twice that of the quadrat around which the baits were placed, his highest count gave a figure of about 560 crabs per 5000 square metres in the Tokelaus. Niering's figure is of the same order being about 530 crabs in an area of 4500 odd square metres in the Carolines.

Ehrhardt set out to make a census of the gecarcinid land crab *Gecarcinus planatus* on isolated Clipperton Atoll, which has a land area of 1763 square kilometres. He did a synchronized series of counts of adult crabs in selected sectors at 1800 hours (one hour after observed crab emergence) and arrived at a density for the different sectors ranging from 1.4 crabs to 12.6 crabs per square metre, with an estimated average of 6 crabs per square metre over the whole land surface of the Atoll. This average gives a total population of about 11.5 million land crabs on Clipperton Island. The average figure of 6 crabs per square metre on Clipperton gives a total of 30,000 land crabs in an area of 5000 square metres compared with 560 on Atafu and somewhat more than 530 on Kapingamarangi.

Crab-Rat Relationships

It has been reported from other Pacific Atolls that land crabs seriously interfere with rat trapping (Storer, 1962: 46,57) and poison baiting (Smith, 1969: 56,70). Similar interference on the Tokelaus has been described by Wodzicki (1968a, 1973c). As the coconut crab, *Birgus latro*, and to a smaller extent the other land crabs are a part of the diet of the Tokelauans, it has been thought that the use of acute poisons, such as zinc phosphide, in rat control may create a danger of secondary poisoning in humans. In addition, it has been

suggested that under certain atoll conditions predatory land crabs may have a direct effect on rat population.

In the Tokelau atolls snap trapping for the Polynesian Rat (*Rattus exulans*) was considerably handicapped by the dense populations of land crabs of all types and also to a lesser degree by lizards. The degree of interference is best illustrated by examples from trapping on various islets on Nukunonu (Wodzicki, 1968a: 56). It was found, when trap lines were visited every two hours, that during daylight interference was mainly due to lizards. From dusk onwards increasing numbers of land crabs began to appear, usually before most of the rats began to move. Thus when the rats appeared on the scene a large percentage of the traps were no longer available as crabs had already taken the bait or been caught. During one night's trapping on a low lying part of Long Motu with a high crab population and numerous rats present a grid of 50 ground-laid traps caught six crabs and had 42 traps sprung with the bait taken, but not a single rat was caught. On Atafu (Wodzicki, 1973c: 21) serious crab interference also occurred with traps nailed at about 1.8 metres above ground level on coconut palms. *Coenobita* spp. and *Birgus* were the observed culprits.

Wodzicki (1973c: 21) found that land crabs on Atafu also ate both zinc phosphide baits and anticoagulant warfarin baits laid for rats. He found *Coenobita* spp. regularly inside aluminium tubes (70-80mm in diameter) containing grated coconut with 2.5% zinc phosphide and these land crabs were without doubt responsible for the disappearance of many of the poison baits. Partly or fully grown *Birgus latro* was too large to enter the poison tubes, but indentations made by the claws of *Birgus* on both ends of several tubes showed that these large land crabs had tried to reach the baits inside. From later crab baiting in areas poisoned with zinc phosphide on Atafu, it is clear that this poison adversely affects (presumably "kills") *Coenobita* spp. (see table IV, Olopuka quadrat).

Warfarin cake baits on Atafu were also greedily eaten by *Coenobita* spp. and *Birgus*, particularly when this bait was laid on the ground. These land crabs were also seen taking rat cake nailed at about 1.8 metres above ground level on coconut palms, and on one occasion a dozen *Coenobita* and one *Birgus* were observed around a single bait on a palm trunk. No information was obtained on the affect of this anticoagulant on land crabs on Atafu.

To guard against the possibility of secondary poisoning of humans during zinc phosphide baiting for rats, the *Fono Toeaina* (Council of Elders) on Atafu ban visits to, and the collecting of land crabs on, properties poisoned for a fortnight after the laying of such baits (Wodzicki, 1973c: 22). In the Olopuka quadrat trial, zinc phosphide in grated coconut was presented (as described above) in aluminium tubes which prevented the entry of *Birgus latro* and *Cardisoma* spp. Only 5 *Coenobita* were counted at crab baiting 21 days later compared with counts ranging from 84 to 333 per visit on unpoisoned quadrats (see table IV). The counts of *Birgus* and *Cardisoma*, however, were

approximately the same as the counts made in the unpoisoned quadrats. Thus, as zinc phosphide affects *Coenobita* spp., it probably affects other land crabs, however, the use of poison tubes prevents the larger (and more sought after by the islanders) *Birugs* and *Cardisoma* spp. from having access to this poison. If such precautions are taken there should be little or no risk to the Tokelau people of secondary poisoning from zinc phosphide during future rat control programs. Smith (1969: 67-68) conducted zinc phosphide poisoning trials on caged land crabs and ShipRats (*R. rattus*) in the Gilbert Ialands and was able to demonstrate that land crabs appear to have "a considerable resistance to zinc phosphide". He could not secondarily poison rats with zinc phosphide-fed crabs. He concluded that the "risk of any secondary poisoning to human beings would appear to be negligible".

We assume that the ubiquitous presence of land crabs on the Tokelau atolls probably affects the Polynesian Rat population in two ways. The large species, particularly *Birgus latro*, presumably prey on rats, especially on young in the nest, while the movement of swarms of land crabs of all sizes may force rats to take up an arboreal existence. These assumptions are undirectly supported by the fact that no rat nests were found at ground level by K.W. during his four visits to the Tokelau Islands. The only rat nests seen were in the tops of coconut palms and, in one case, in the hollow top of a one-metre high palm stump. Presumably crabs also compete, to a certain extent, with rats for available coconuts split open by islanders and abandoned (compare Hedley's comments at the beginning of the section on "Ecology"). As already described, such opened coconuts on the ground attract large numbers of land crabs at night and the presence of these crabs could interfere with rats feeding on this coconut meat. Mosby, Wodzicki and Thompson (1973) demonstrate that the coconut meat forms an important part of the rat diet on the Tokelaus. *Rattus exulans* is presumably too small to attack crabs, except in their juvenile stages, and this assumption is supported by the almost complete lack of crustacean remains in the 312 rat stomachs from all three Tokelau atolls analysed by Mosby *et al.*

Predation

The two main predators of land crabs in the Tokelaus are man and pigs. As stated above in the list of Tokelau crab names, most of the larger land crabs are actively collected and eaten by the islanders. Thus *ugauga* (*Birgus latro*), *tupa* (*Cardisom carnifex*), *paikea* (*C. rotundum*), *kalamihi* (*Geograspus crinipes*) to a lesser extent, and presumably the larger *uga* (*Coenobita* spp.) are all food items for man. On Atafu Atoll edible land crabs are known to be more abundant on the eastern islets as already mentioned. K.W. was informed that certain of these eastern islets were reserved for crab collecting and were left undisturbed for periods of time to allow larger harvests of *Birgus* and other species to be made at spaced intervals.

Pigs on Pacific islands are notorious eaters of land crabs. Although pigs are kept on the Tokelaus in enclosures or on small islets, Dr. Hooper has reported that *paikea* in particular are collected specifically for

feeding to penned pigs. Occasional escapee pigs are known to have reached isolated areas and to have survived, presumably partly on land crabs, for considerable periods.

SUMMARY

As each section above has been followed by a separate discussion, the main findings brought out by the present contribution can be summarized as follows:

1. Ten species of "land crabs" are recorded from the Tokelau Islands. They belong to six genera placed in three families. Four of these species are terrestrial hermit crabs (*Anomura*) and six are terrestrial true crabs (*Brachyura*). These ten species are listed here with their most commonly used Tokelauan names.

Coenobitidae

Coenobita brevimana Dana, 1852 *uga*
Coenobita perlata H. Milne Edwards, 1837 *uga kaifala*
Coenobita rugosa H. Milne Edwards, 1837
Birgus latro (Linnaeus, 1767) *ugauga*

Grapsidae

Geograpsus crinipes (Dana, 1851) *kalamihi*
Geograpsus grayi (H. Milne Edwards, 1853)
Metopograpsus thukuhar (Owen, 1839) *lala*
Sesarma ? gardineri Borradaile, 1900 *ataata o hiliao*

Gecarcinidae

Cardisoma carnifex (Herbst, 1796) *tupa*
Cardisoma rotundum (Quoy and Gaimard, 1825) *paikea*

Eight of these species have already been recorded from the Tokelau Islands but two, *Geograpsus grayi* and *Metopograpsus thukuhar*, are new records for this group of atolls.

2. The number of land crab species on the Tokelau Islands (10) can be compared with Holthuis's (1953) figure of 15 land crab species on Arno Atoll in the Marshall Islands, and 11 species on Ujae Atoll in the same Micronesian group. Holthuis gives a combined total of 16 land crab species for the Marshall Islands in the western central Pacific and seven for Raroia Atoll in the Tuamotu Archipelago, eastern Polynesia. Another recent record for Micronesia is Niering's (1956) figure of nine land crab species on Kapingamarangi Atoll in the Caroline Islands.
3. All the land crab species recorded from the Tokelau Islands, except for the poorly known *Sesarma ? gardineri*, are widely

distributed species in the Indopacific known from the East African coast or the Indian Ocean islands eastwards to the Society Islands or the Tuamotu Archipelago. *S. ? gardineri* is at present known with certainty only from New Guinea, southern Micronesia and the Tokelaus.

4. Quadrat counts and relative numbers in collections indicate that *Coenobita brevimana*, *Birgus latro*, *Cardisoma rotundum* and *Geograpsus crinipes* are the most numerous species (in decreasing order of abundance) on the Tokelau Islands.
5. Fourteen different crab names in the Tokelau language are listed and their identity discussed. The most abundant species as listed immediately above, are called *uga*, *ugauga*, *paikea* and *kalamihi*. These names and some others listed are used with minor modifications for similar species in Samoa, Niue and the Cook Islands.
6. All the land crab species in the Tokelau Islands are nocturnal scavengers. Population counts on Atafu Atoll in the Tokelaus give a density of about 560 land crabs per 5000 square metres, and this can be compared with approximately the same figure given for land crab density on Kapingamarangi Atoll in the Caroline Islands by Niering (1956). This is in dramatic contrast to a figure of approximately 30,000 land crabs per 5000 square metres obtained by Ehrhardt (1968) on Clipperton Atoll off southern Mexico in the eastern tropical Pacific.
7. The presence of numerous land crabs on the Tokelau Islands has an indirect effect on rat control programs and (presumably) a direct effect on rats themselves. Land crabs interfere with snap traps, both ground laid and fixed to trees, and with poison baits. Both warfarin and zinc phosphide baits are eaten by these crustaceans. The effect of the anticoagulant land crabs in the Tokelaus is unknown, but it is clear from poison trials in quadrats that crab numbers were severely affected by the acute poison zinc phosphide. The very slight risk of secondary poisoning of humans can be virtually eliminated by following recommended precautions.

Land crabs directly affect Polynesian Rats in two different ways. Large species can presumably prey on rats, especially young, thus forcing rats to nest above ground level, mainly in coconut palms. Land crabs also compete with rats for the coconut meat available in nuts opened by Tokelauans and abandoned.

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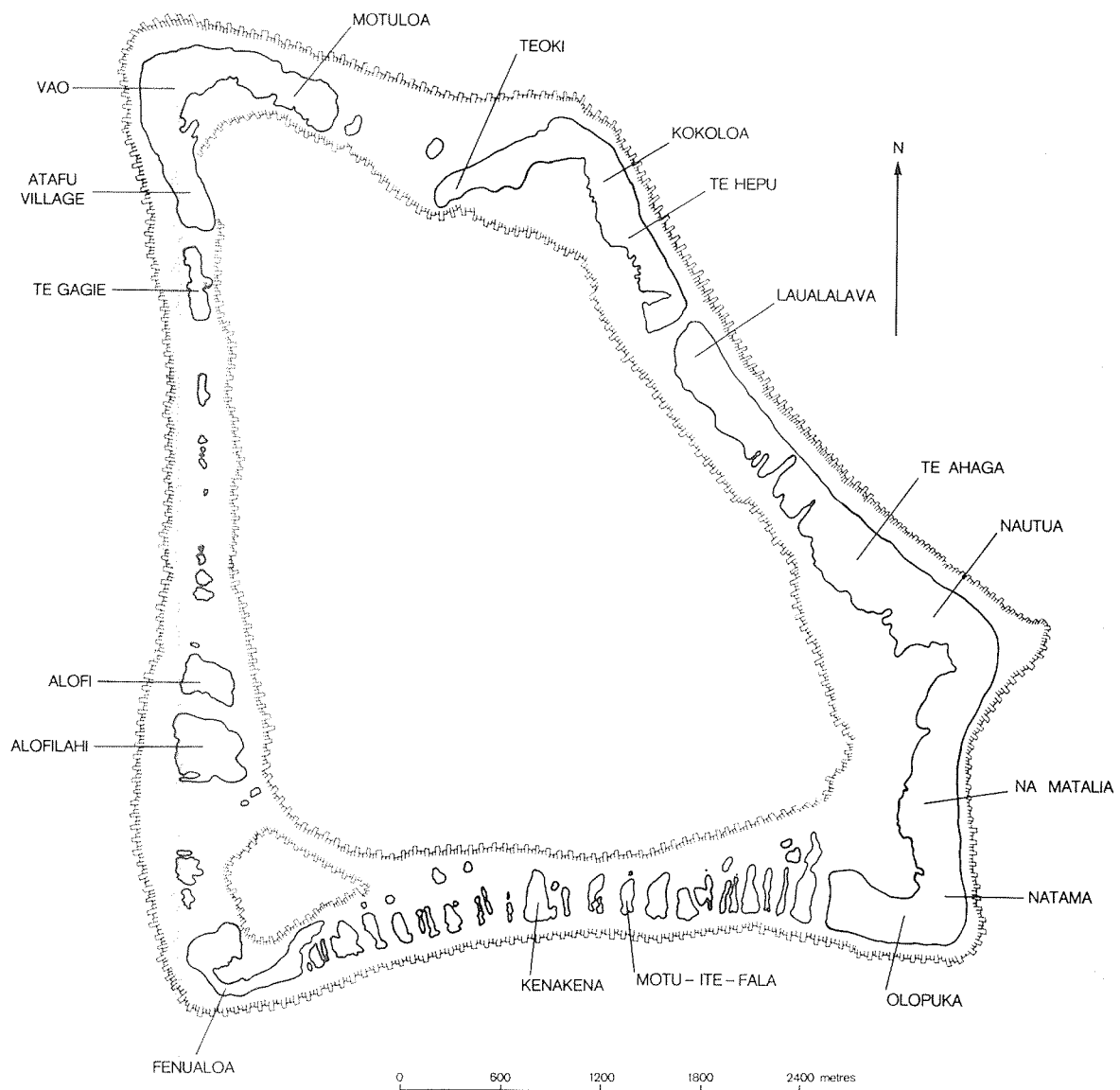


Fig. 1. Map of Atafu Atoll, based on N. Z. Lands and Survey Department Aerial Plan No. 1036/7A (1974)

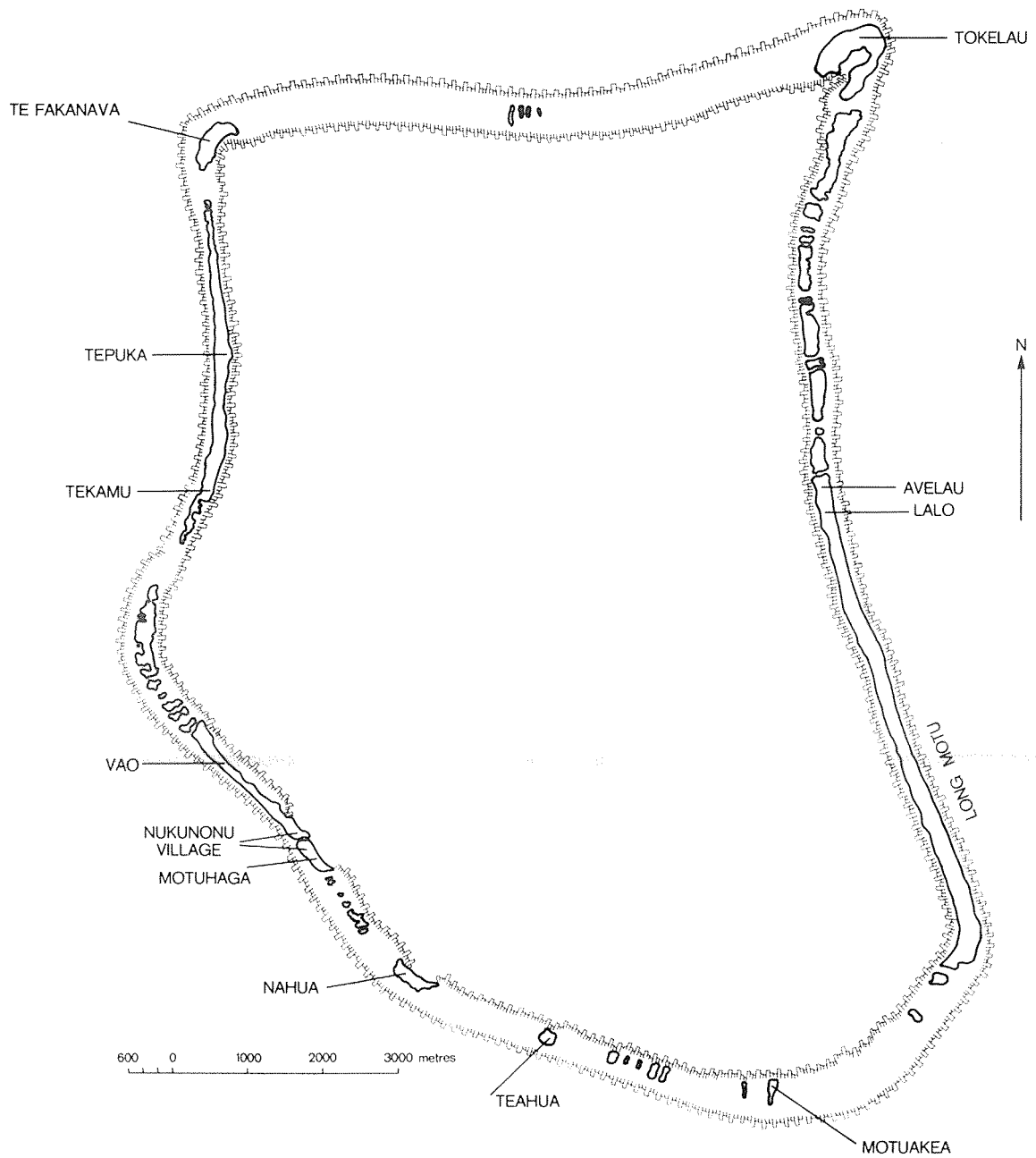


Fig. 2. Map of Nukunonu Atoll, based on N. Z. Lands and Survey Department Aerial Plan No. 1036/7B sheets 1 and 2 (1974).

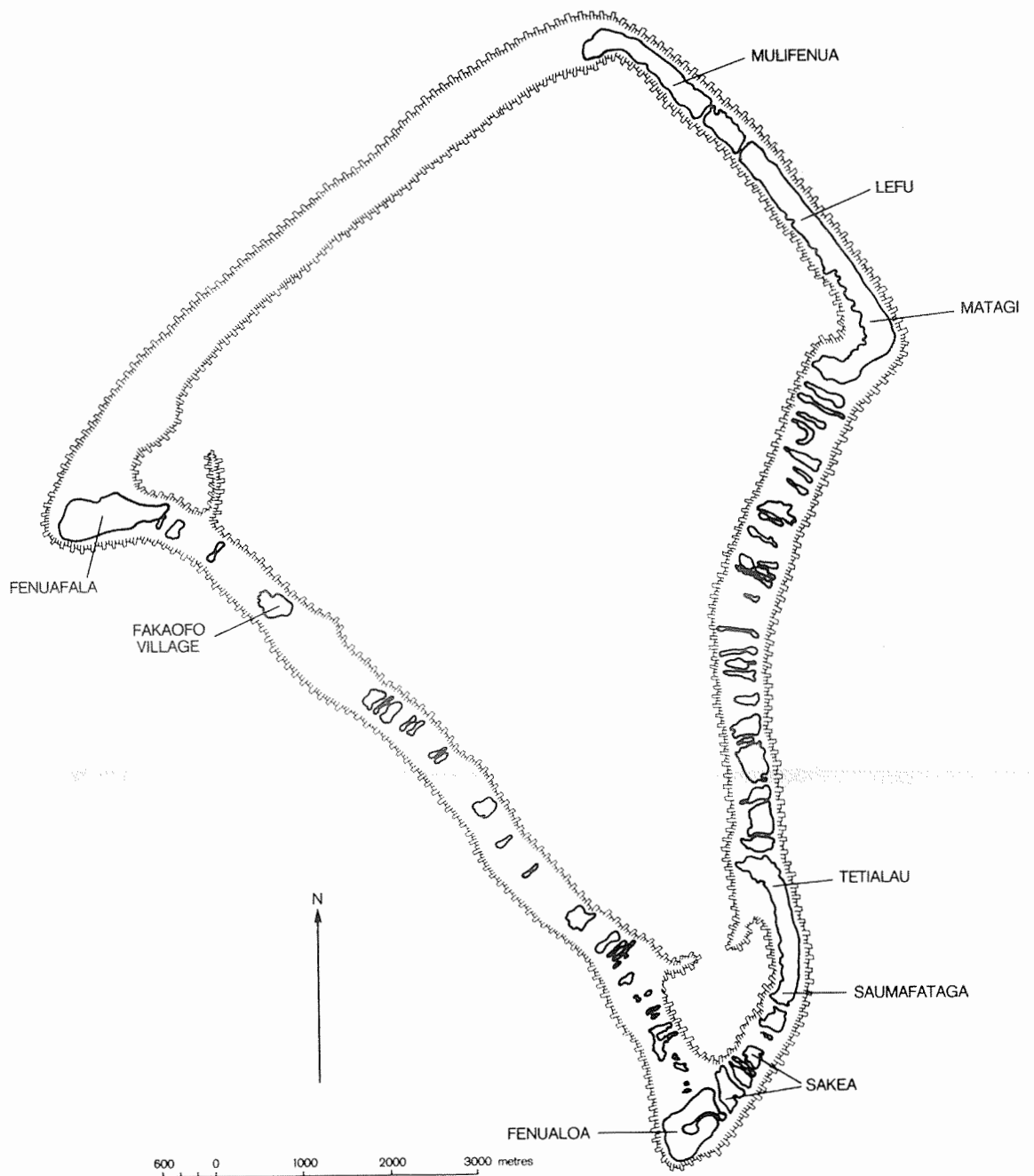


Fig. 3. Map of Fakaofu Atoll, based on N. Z. Lands and Survey Department Aerial Plan No. 1036/7C (1974).

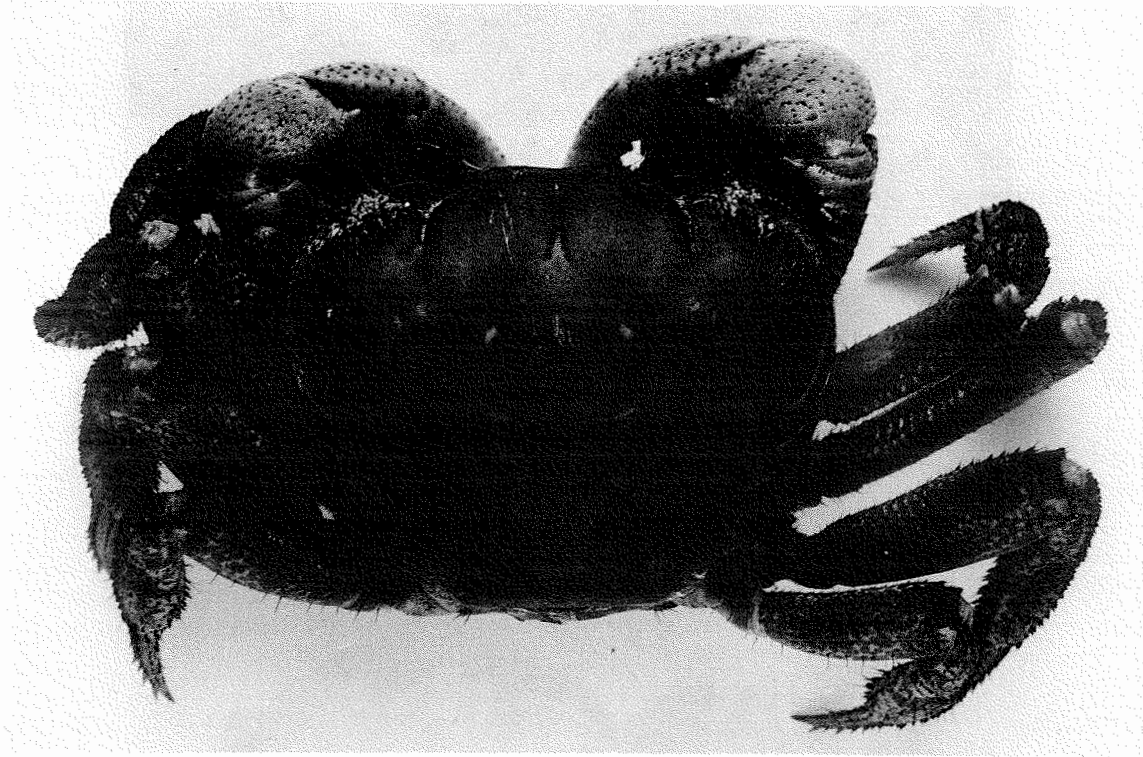


Fig. 6. *Cardisoma rotundum*. Dorsal view of male, carapace length 41.5 mm from Village Motu, Mukunonu.
(Photo T.R. Ulyatt)

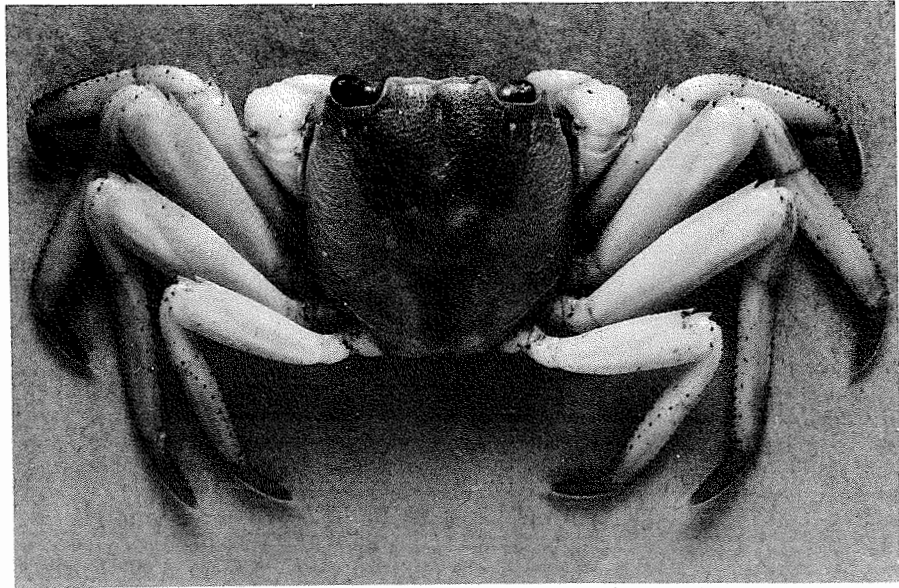


Fig. 4. *Sesarma (Labuanium) ?gardineri*. Dorsal view of male, carapace length 28 mm from Nautua, Atafu.
(Photo T.R. Ulyatt, National Museum of N.Z.)

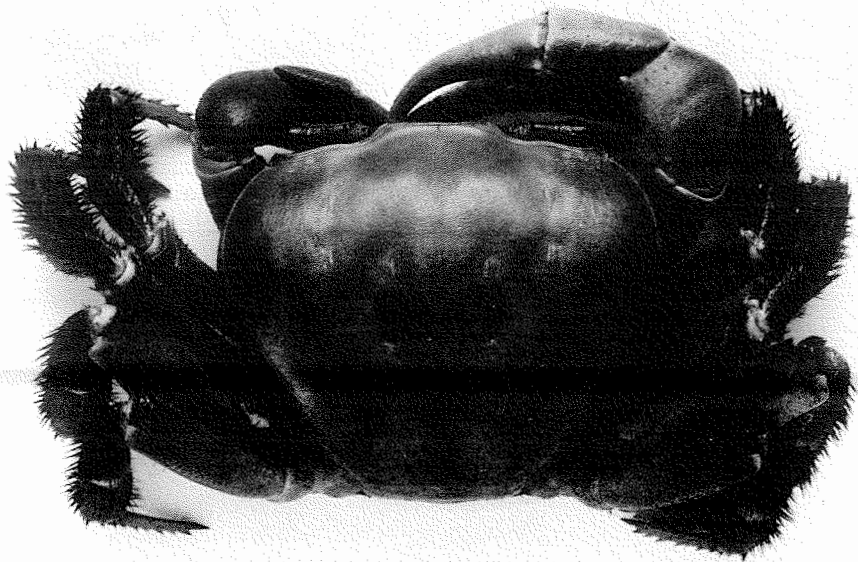


Fig. 5. *Cardisoma carnifex*. Dorsal view of female, carapace length 64 mm from Atafu.
(Photo R.R. Ulyatt)