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ECOLOGY OF TERRESTRIAL ARTHROPODS ON THE TOKELAU ATOLLS

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## ECOLOGY OF TERRESTRIAL ARTHROPODS ON THE TOKELAU ATOLLS

by Alden D. Hinckley<sup>1/</sup>

The Tokelaus are a chain of three atolls, south of the Phoenix Group and north of the Samoas. Distances (in statute miles) from Apia, Western Samoa, are approximately 300 to Fakaofu, 330 to Nukunono, and 400 to Atafu. Annual rainfall for each atoll is usually in excess of 100 inches but they have experienced long dry spells. Hurricanes occasionally pass through the group and several motus of Nukunono atoll were swept by waves in the storm of January 29 and 30, 1966.

During 1967, while I was employed as Ecologist on the United Nations - South Pacific Commission Coconut Rhinoceros Beetle Project, I spent 40 days in the Tokelaus. I went north from Apia on one of the last R.N.Z.A.F. Sunderland flights and returned aboard the "Aoniū", a Tongan copra boat. I visited Fakaofu on January 16-17 and February 25, Atafu on January 17-18 and February 24, and stayed on Nukunono from January 18 through February 23. Although my primary objective was to assess the Rhinoceros Beetle situation on Nukunono, I had time to make many other ecological observations.

For their help and hospitality, I would like to thank: Mr. Lloyd Weber, District Officer of the N.Z. Tokelau Administration; Father Mauga and the Marist Sisters; Mr. Morgan Williams of the "Tokrat" Project; all the people of the Tokelaus, especially my assistants Juliano and Sefo. I am also grateful for the determinations made by specialists associated with the British Museum and by Dr. Ernest Reese, University of Hawaii.

### FAUNAL DIVERSITY

The only previous publication devoted primarily to Tokelau arthropods is one by Dale (1959) based on brief visits to each atoll in September, 1958. Laird's excellent 1956 monograph on Pacific Island mosquito ecology includes some Tokelau records and he subsequently used the atolls for pathological and chemical control experiments. Other surveys of terrestrial faunas on atolls include Gressitt (1952) on Kayangel in the Palau group, Niering (1963) on Kapingamarangi, a Polynesian outlier south of Ponape, Moul (1954) on Onotoa in the Gilberts, and Van Zwaluwenburg (1955) on Canton, in the Phoenix group. Perhaps the most complete study was made on Arno in

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the Marshalls by Usinger and LaRivers (1953). Gressitt (1954) estimated that the Arno fauna might include 500 species of terrestrial arthropods, some 300 having been collected by Usinger and LaRivers. Other estimates by Gressitt (1954) were 1,100 species for Kayangel and 170 for Onotoa. Van Zwaluwenburg (1955) recorded nearly 100 insects and 15 other arthropods from Canton.

In this paper, 177 species of Tokelau arthropods in 103 families (150 insects in 83 families) are listed in Table I. Most of these are probably common to all 3 atolls, the only definite exception being the Coconut Rhinoceros Beetle, Oryctes rhinoceros, so far confined to Nukunono. Other possible exceptions would be the millipede on Atafu and Aedes vexans on Fakaofu. I would guess that the total arthropod fauna on Nukunono is close to 400 (300 insects). The day I left, I was still finding species I had not seen before. I did not collect any bird or rat ectoparasites and I missed many arachnids. In terms of faunal diversity, it seems that Nukunono stands somewhere between Arno and Onotoa. It is certainly richer than Canton, only 450 miles to the north.

#### SPECIES ESTABLISHMENT, EXTINCTION AND DISPLACEMENT

Books by Elton (1958) and, more recently, MacArthur and Wilson (1967) have raised important questions about successful and unsuccessful colonization. As Laird (1956) showed, Anopheles almost certainly could become established on high islands in the Fiji and Samoa groups. Similarly, there are many "open niches" on atolls.

The Rhinoceros Beetle is a case in point. Well established on Cocos-Keeling atoll in the Indian Ocean and such Pacific high islands as Babelthuap, Palau, and Upolu, W. Samoa, the beetle has invaded 2 more atolls, Kayangel, 20 miles north of Babelthuap, and Nukunono, 330 miles north of Upolu. The colonizations apparently occurred about 1946 on Kayangel (Gressitt, 1952) and during 1964 on Nukunono. The behavior, adaptability and durability of the beetle make it a successful colonist. Adults fly at night, are attracted to light, and may land on cargo at a wharf or aboard a ship. The gravid female can survive long confinement in a hold and fly ashore to lay a clutch of 20-30 eggs in a rotten log, thus establishing the first cohort of a new species on the atoll. On Nukunono, Oryctes was, at first, found only on the village motu but the hurricane of January 1966 created a large supply of dead logs and the population increased ten-fold by January 1967, spreading to every large motu except Tokelau, the one farthest away from Nukunono village.

Many other colonizations have been successful in the Tokelaus. In Table I, those names marked with an asterisk are agricultural pests or "tramp species" which may have been introduced by man, including the original waves of Polynesian migrants. On the high islands of Fiji, Tonga, and Samoa, there are many other species which could presumably become established in the Tokelaus. The limited agriculture of the

Tokelaus is thus threatened by such pests as the Coconut Spike Moth, Tirathaba trichogramma (Meyrick); the Cluster Caterpillar, Spodoptera (ex Prodenia) litura (F.) which feeds on Alocasia and many other plants; the Scab Moth, Nacoleia octasema (Meyrick) which attacks Musa and Pandanus fruits; as well as many polyphagous scales and mealybugs. Of course, the establishment of many beneficial or economically neutral species is also possible.

Since there are so few records of earlier collections from the Tokelaus, it is not possible to say with certainty that species have died out or been displaced. However, the Tokelauans report that the Monarch Butterfly, Danaus plexippus (L.), has been established intermittently on Nukunono and Fakaofu, feeding on oleander (probably adults visiting flowers). It also seems likely that the dragonfly, Pantala flavescens (F.), dies out during prolonged dry periods on Nukunono, although it may persist in the deep wells of Atafu. This pattern of repeated establishment and extinction is common on arid, much-disturbed Canton (Van Zwaluwenburg, 1955).

Usinger and LaRivers (1953) reported an interesting displacement among the lygaeid bugs, Nysius spp., in the Marshalls and it is possible that similar events may have occurred in the Tokelaus or may occur some time in the future. However, so many niches are open or underutilized that the rate of establishment will exceed the rate of extinction (cf. MacArthur and Wilson, 1967), despite the small land area of the atolls, less than 2 sq. mi. for Nukunono and less than 1 sq. mi. for each of the others.

The sphinx moths of the Tokelaus provide a good example of 5 self-established species living in "peaceful co-existence". On Nukunono atoll, it was apparent that they seldom competed for adult or larval food, primarily because behavioral differences minimized niche overlap.

Sphingids of Nukunono Atoll:

	<u>Agrius</u> (Herse)	<u>Apocalypsis</u> (Hippotion)	<u>Cephanodes</u>	<u>Chromis</u>	<u>Macroglossum</u>
DISTRIBUTION	Nukunono motu	Tokelau motu	most motus	most motus	most motus
ABUNDANCE	rare	uncommon	very common	common	common
ADULT Flies	night	day	day	night	day
frequents flowers of	?Ipomoea	Pemphis	Morinda Pemphis ?Scaevola	?Morinda	Morinda
LARVA feeds on	Ipomoea	?Ipomoea ?Pisonia	Gardenia Guettarda ?Morinda	Morinda	Morinda

## COMMUNITY ANALYSIS

Usinger and LaRivers (1953) attempted to classify the arthropod communities of Arno. Their system, reproduced as Appendix D in Wiens (1962), must be modified for application to the Tokelaus. They described communities associated with the Strand, Inner Beach, Open Woodland, Canopy Woodland, and Human habitations. For Nukunono, 5 plant habitats, each supporting characteristic arthropod populations, could be distinguished. These were: Inner Beach Shrubs, Village Gardens, Grass and Sedge, Coconut Groves, and Canopy Woodland. The first and last correspond roughly to those so designated by Usinger and LaRivers but the Tokelau coconut groves, with a palm density above 100 per acre, cannot be described as an Open Woodland. Only the mission plantation on Nukunono motu approaches this condition.

Detailed records of trophic relationships are presented in Table II but these, and other observations, can also be considered on a broader community basis:

Inner Beach Shrubs

These have been well described by Gressitt (1954), Fosberg (1960), and Wiens (1962). In the Tokelaus, Pemphis is most common on otherwise barren lagoon-side flats. Scaevola and Messerschmidia (Tournefortia) occur above the high water mark on both lagoon and ocean beaches. Uncultivated Pandanus also occurs in this zone.

Although no insects were recorded from Pemphis on Arno (Usinger and LaRivers, 1953), the noctuid semi-looper, Achaea, fed on it throughout the Tokelaus. Its populations may approach the "one-stage" condition. On the wave-washed clump of Pemphis next to the Fakaofu hospital, empty cocoons predominated but on the Tokelau motu of Nukunono, abundant larvae were defoliating the shrubs and on the village motu of Atafu, adults appeared to be the most common stage. Other insects feeding on Pemphis included a mealybug, Planococcus, and a small, unidentified caterpillar. As on Jaluit (vide Wiens, 1962, p. 447), a green lacewing, Chrysopa, was common near Pemphis. Flowers of Pemphis were frequented by such insects as the moth, Piletocera, and the bee, Megachile, which also visited other strand shrubs.

Scaevola supported not only the butterfly, Precis, and the dipterous leafminer, Ophiomyia, but also 2 sucking insects, the planthopper, Ugyops, and the polyphagous Aphis gossypii. The latter was attended by the equally ubiquitous ant, Pheidole megacephala, and preyed on by Coelophora. Many small wasps and flies were found on Scaevola leaves, possibly attracted by honeydew. They included the eurytomid, Eudecatoma sp., the scelionid, Macrotelia sp., the ceratopogonids, Dasyhelea spp., and the scatopsid, Scatopse sp. Also associated with Scaevola were adult derbids, Lamenia and Swezeyia, but adults in this family feed on the underside of many different kinds of leaves.

Messerschmidia made a small but colorful contribution to the strand community by nourishing larvae of the arctiid moth, Utethesia.

The inflorescences of Pandanus contained Docidothrips as well as mealybugs and caterpillars of Pyroderces. Birgus and other land crabs sheltered amidst the prop roots of Pandanus. Another crab was found with Aedes in broken, water-filled Pandanus stems.

#### Village Gardens

On each atoll, almost all the houses and gardens are, by tradition, confined to one motu. The gardens, with Alocasia, Musa, and some vegetables, are usually planted in pits filled with coconut husks and other debris. Near habitations, there are also some ornamentals such as Crinum, Gardenia, Polyscias and Nerium (oleander). In the village area, there are usually few coconut palms and a dense grove of breadfruit trees but the hurricane waves killed many breadfruit trees on Nukunono and scoured out the garden pits, although these had been partially restored at the time of my visit. West of the mission on Nukunono motu there is a plantation of a Pandanus variety especially good for fiber work.

This Pandanus showed feeding marks of Oryctes and the phasmatid, Graeffea. In the dead breadfruit wood, grubs of Oryctes and Dihammus were common. The Dihammus adults were conspicuous, resting on the leaves of many different plants but, as Dale (1959) noted, they did no damage. Damage by Oryctes adults to village palms was severe, 41% of the young fronds having been cut by beetle feeding in the growing tips. At the time of the survey, the beetle population on Nukunono motu and adjacent Motusaga was estimated to be 1,325.

Aphids were common in the gardens, Aphis gossypii on Alocasia and Pentalonia on Musa. The pits in which these plants were grown supported large numbers of roaches. Eggs of these were presumably parasitized by Evania and other stages eaten by the centiped, Scolopendra.

Gardenia bushes near the Nukunono hospital provided many trophic records. Aphis gossypii and Planococcus citri were sucking buds and leaves; sooty mold was growing on the honeydew; a psocid, Ectopsocus sp., was feeding on the mold; Pheidole was consuming both the honeydew and the psocids; and dipterous predators were also active, a syrphid attacking the aphid and a cecidomyiid attacking the mealybug. Other predators were present, Aleurodothrips, and the mite, Typhlodromus, but their roles were not clear.

#### Grass and Sedge

This association was the most restricted, being observed in a few unshaded areas such as the Nukunono mission and the church foundation at Fakaofu. Despite their limited extent, these patches of sparse grass and slightly denser sedge provided some interesting sweep net catches.

Aiolopus, the only grasshopper observed during the survey, was collected in this habitat. So also were the leafhoppers, Balclutha, Deltocephalus and Exitanus, the planthopper, Corbulo, the lygaeid,

Pachybrachius, the mirid, Trigonotylus, and the thrips, Haplothrips. Presumably the leafminer, Phytomyza (collected by Dale), and the Lawn Armyworm, Spodoptera, would be found here, too.

Many of the flies swept from grass and sedge were apparently "just resting", although some may have been feeding on pollen, etc. They included Allotrichoma, Dasyhelea, Drapetis, Drosophila, Lamprolonchea, Limonia, Musca, and Trypaneoides.

### Coconut Groves

As indicated above, these are generally quite dense. Nut harvesting is intermittent and many non-bearing volunteers struggle to survive amidst the understory of Guettarda and Morinda. Ground cover, such as it is, consists of clumps of ferns, Asplenium and ?Nephrolepis. Also found in some coconut groves are trees such as Calophyllum inophyllum, Cordia subcordata, and Hernandia sonora, as well as the shrubby Ficus tinctoria. These conditions prevail over most of the uninhabited motus in the Tokelaus.

On the coconut palms, the most common phytophage was the Flat Moth, Agonoxena, but neither it nor the Stick Insect, Graeffea, reach damaging levels in the Tokelaus, although the latter can be devastating in the Gilberts. The only coconut pests important enough to merit control efforts were the Rhinoceros Beetle, Oryctes, and the Polynesian Rat, Rattus exulans (Peale). Various flies frequented the coconut inflorescences and Pyroderces larvae fed on the male flowers. Water catchment holes ("tungu") carved in palm bases, together with old, rat-chewed nuts, were major sources of Aedes in the groves.

The very numerous Morinda shrubs had the widest range of associated insects. Aphis gossypii on leaves and Pinnaspis on fruits were commonly attended by Pheidole and other ants which may have also obtained nourishment from flowers and extrafloral nectaries. The syrphid, Xanthogramma, preyed on the aphid and an aphelinid parasitized the scale. Morinda fruits were punctured by the pentatomid, Pegala, and its flowers were visited by flies such as Cadrema, Dacus, Drosophila, Homoneura, Pseudorichardia, and Trypaneoides. The nectar was also used by sphinx moths and the larvae of 2 species, Chromis erotus and Macroglossum hirundo, chewed large sections from Morinda leaf edges.

Caterpillars common on Guettarda were the hornworm, Cephanodes, and the leafroller, Chloauges. Some leaves of the few Ficus shrubs on Nukunono motu had been chewed and 2 larvae, presumably those of Euploea lewenii, were collected from Ficus on Fakanava motu. Callopietria and Piletocera moths were often seen flying over ferns, and larvae of the former may have chewed young leaves on Asplenium.

In coconut and other logs, not only Oryctes grubs but also the tenebrionid, Amarygmus, 3 species of termites, and 4 species of mites, were found. However, millipeds were found only on Atafu, possibly

because the ground is slightly higher and some soil has developed. Isopods, crabs, centipeds, earwigs, and small beetles were seen under logs.

### Canopy Woodland

This association, which may resemble the original vegetation of the Tokelaus, has the same lower strata as the coconut groves: i.e., ferns, then Morinda and Guettarda. Sida and other shrubs may also be present. However, the upper canopy is formed by various combinations of Cordia, Guettarda, and Pisonia. Breadfruit may be planted in these areas but there are few other agricultural incursions. In this respect it differs from the canopy on Arno where giant breadfruit trees were dominant (Usinger and LaRivers 1953). On Nukunono atoll, the canopy woodland is found in the center of Tokelau motu, the south end of the long motu, and the west end of Nukunono motu.

Many of the Morinda and Guettarda insects found in coconut groves also occurred under canopy woodland. The leafroller, Eucosma sp., on Cordia is another species which occurred in both communities. Perhaps Hypolimnas, a colorful nymphalid with great variation in patterns, was the most conspicuous insect found in the canopy woodland. Its caterpillars and chrysalides were common on Sida in the central part of Tokelau motu. The gryllid, Anaxipha, and the derbid, Lamenia, were also collected on Sida.

Many fairy terns and noddies nest in the canopy. Their ectoparasites, and arthropods found in their guano, would represent other important components in the woodland community of the Tokelaus.

### SUMMARY

During January and February 1967, an ecological survey of the Tokelau atolls showed that at least 160 species of terrestrial arthropods were present. They are listed, together with earlier records, in Table I. Their observed food relationships are summarized in Table II.

The faunal diversity of the Tokelaus is discussed and it is concluded that Nukunono has fewer species than Arno in the Marshalls but more than Onotoa in the Gilberts. It is also concluded that the Tokelau atolls have many functional niches open or partially open, and that further accidental colonizations by high island species are quite probable.

The arthropods of the Tokelaus are also analyzed by their community relationships. For this purpose, 5 communities are recognized: Inner Beach Shrubs; Village Gardens; Grass and Sedge; Coconut Groves; Canopy Woodland.



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Table I. TERRESTRIAL ARTHROPODS IN THE TOKELAUS

\* Possibly introduced by man.

A - Atafu  
 N - Nukunono  
 F - Fakaofu

CRUSTACEA

## ISOPODA

## Armadillidae

\*Melanesillo hebridarium (Verhoeff) ..... Dale (1959)

## Ligiidae

\*Ligia vitiensis Dana ..... "

## Rhyscotidae

\*Rhyscotoides parallelus (Budde-Lund) ..... "

## DECAPODA

## Coenobitidae

Birgus Latro (L.) ..... A N FCoenobita brevimanus Dana ..... N

<u>C. perlatus</u> H. Milne Edwards .....	N
Grapsidae	
<u>Geograpsus grayi</u> (H. Milne Edwards) .....	A N F
Gen. & sp. indet. ....	N
<u>CHILOPODA</u>	
SCOLOPENDROMORPHA	
Scolopendridae	
<u>Cryptops</u> sp. ....	N
<u>Otostigmus</u> sp. ....	N F
* <u>Scolopendra morsitans</u> L. ....	A N F
GEOPHILOMORPHA	
Mecistocephalidae	
<u>Mecistocephalus</u> sp. ....	N
<u>DIPLOPODA</u>	
JULIFORMIA	
Spirobolidae	
*? <u>Spirostrophus naresii</u> (Pocock) .....	A
<u>ARACHNIDA</u>	
CHELONETHIDA	
Indet. ....	N
SCORPIONIDA	
Buthidae	
* <u>Isometrus maculatus</u> (DeGeer) .....	A N F
ACARINA	
Ascidae	
<u>Proctolaelaps</u> sp. ....	N
Epilohmanniidae	
<u>Epilohmannia cylindrica</u> (Berlese) .....	N
Hermannidae	
<u>Phyllhermania</u> sp. nr. <u>foliata</u> Hammer .....	N
Phytoseiidae	
<u>Typhlodromus caudatus</u> Berlese .....	N
Rhodacariidae	
<u>Olgamasine</u> sp. ....	N
Uropodidae	
? <u>Fuscuropoda</u> sp. ....	N
ARANEIDA	
Argiopidae	
<u>Araneus theisi</u> (Walck.) .....	A N F
Eusparassidae	
* <u>Heteropoda venatoria</u> (L.) .....	N
Pholcidae	
<u>Smeringopus elongatus</u> Vinson .....	N

Salticidae		
* <u>Ascyrtus pterygodes</u> (L. Koch) .....	A N F	
<u>Bavia aericeps</u> Simon .....	N	
<u>Flacilla</u> sp. ....	A	

INSECTA

COLLEMBOLA		
Entomobryidae		
<u>Seira</u> (or <u>Drepanocyrtus</u> ) sp. ....	N (Laird, 1956)	
THYSANURA		
Lepismatidae		
Gen. & sp. indet. ....	N	
ODONATA		
Libellulidae		
<u>Pantala flavescens</u> (F.) .....	A (Laird, 1956) N	
ORTHOPTERA		
Acrididae		
<u>Aiolopus dubius</u> (Willemsen) .....	N	
Blattidae (s.l.)		
* <u>Blatella notulata</u> (Stål) .....	N	
* <u>Cutilia nitida</u> (Brunner) .....	N	
* <u>C. soror</u> (Brunner) .....	N	
* <u>Periplaneta americana</u> (L.) .....	N	
* <u>P. australasiae</u> (F.) .....	N	
* <u>Pycnoscelus surinamensis</u> (L.) .....	N	
Gryllidae		
<u>Anaxipha</u> sp. ....	N	
* <u>Gryllodes sigillatus</u> (Walker) .....	N	
? <u>Ornebius novarae</u> (Saussure) .....	N	
Phasmatidae		
* <u>Graeffea crouani</u> (LeGuillou) .....	A N F	
Tettigoniidae		
<u>Phisis pallida</u> (Walker) .....	N F	
ISOPTERA		
Kalotermitidae		
* <u>Glyptotermes xantholabrum</u> (Hill) .....	N F	
* <u>Incisitermes repandus</u> (Hill) .....	N F	
Rhinotermitidae		
* <u>Prorhinotermes inopinatus</u> Silvestri .....	N	
DERMAPTERA		
Chelisoichidae		
* <u>Chelisoches morio</u> (F.) .....	N	
PSOCOPTERA		
Ectopsocidae		
<u>Ectopsocus</u> sp. ....	N	

## THYSANOPTERA

## Phlaeothripidae

Aleurodothrips fasciapennis (Franklin) ..... NHaplothrips gowdeyi (Franklin) ..... F

## Thripidae

Docidothrips sp. .... N

## HEMIPTERA

## Aphididae

\*Aphis gossypii Glover ..... A N F\*Pentalonia nigronervosa Coquillet ..... A N F

## Cicadellidae

Balclutha incisa Matsumura (= Nesosteles tutuilana  
Osborn) ..... NDeltocephalus sp. nr. hospes Kirkaldy ..... FExitanus capicola (Stål) ..... N

## Coccidae

\*Coccus hesperidum L. .... N

## Delphacidae

Corbulo dodona Fennah ..... N FUgyops oromedon Fennah ..... A N F

## Derbidae

Lamenia caliginea Stål ..... A NSwezeyia lyricen Kirkaldy (?= S. maurellei Muir  
in Dale 1959) ... N

## Diaspididae

\*Pinnaspis strachani (Cooley) ..... A N F

## Gerridae

Halobates kelleni Herring ..... N

## Lygaeidae

Pachybrachius pacificus (Stål) ..... N

## Miridae

Trigonotylus dohertyi Distant ..... N

## Pentatomidae

Glaucias sp. .... NPegala biguttula Hagl. ..... A N

## Pseudococcidae

\*Dysmicoccus brevipes (Cockerell) ..... A\*Planococcus citri (Risso) ..... N F\*Pseudococcus sp. (in Dale, 1959) ..... A N F

## Reduviidae

Gen. &amp; sp. indet. .... N

## NEUROPTERA

## Chrysopidae

Chrysopa basalis Walker ..... A N F

## LEPIDOPTERA

## Agonoxenidae

Agonoxena argaula Meyrick ..... A N F

## Arctiidae

Utetheisa pulchelloides Hampson ..... A N F

Cosmopterigidae	
<u>Batrachedra</u> sp. ? <u>psilopa</u> Meyrick .....	N
? <u>Labdia</u> sp. ....	N
<u>Pyroderces</u> <u>paradotis</u> Meyrick .....	N
<u>Trissodoris</u> <u>honorariella</u> Walsingham .....	N
Geometridae	
<u>Chloroclystis</u> sp. ....	A
Lyonetiidae	
<u>Commodica</u> sp. ? <u>lucinda</u> Meyrick .....	N
<u>Decadarchis</u> sp. ? <u>carpophthora</u> Meyrick ..	N
Noctuidae	
<u>Archaea</u> <u>janata</u> L. ....	A N F
<u>Callopietria</u> <u>nauticorum</u> Tams .....	N
<u>Spodoptera</u> <u>acronyctoides</u> Guenee .....	N
<u>Tiridata</u> <u>samoana</u> Butler .....	N
Nymphalidae (s.l.)	
<u>Euploea</u> <u>lewenii</u> Feld. ....	N
<u>Hypolimnas</u> <u>bolina</u> L. ....	N F
<u>Precis</u> <u>villida</u> F. ....	A N F
Pyralidae (s.l.)	
<u>Cadra</u> (or <u>Ephestia</u> ) <u>cautella</u> (Walker) ...	A (Dale, 1959) N
<u>Chloauges</u> <u>woodfordii</u> Butler .....	A N F
<u>Piletocera</u> <u>signiferalis</u> Wlgrn. ....	A N F
Sphingidae	
<u>Agrius</u> (or <u>Herse</u> ) <u>convolvuli</u> (L.) .....	N
<u>Apocalypsis</u> (or <u>Hippotion</u> ) <u>velox</u> (F.) ...	A N
<u>Cephonodes</u> <u>armatus</u> Rothschild and Jordan .....	A N F
<u>Chromis</u> <u>erotus</u> eras Boisduval .....	N
<u>Macroglossum</u> <u>hirundo</u> <u>samoanum</u> R. & J. ...	N F
Tortricidae	
<u>Eucosma</u> sp. ....	N
DIPTERA	
Agromyzidae	
<u>Ophiomyia</u> <u>cornuta</u> Meijere .....	A N F
* <u>Phytomyza</u> <u>apicata</u> Malloch .....	N (Dale, 1959)
Asilidae	
<u>Despoticus</u> sp. nr. <u>simmondsi</u> Bezzi .....	N
Cecidomyiidae	
Gen. & sp. indet. ....	N
Ceratopogonidae	
<u>Dasyhelea</u> spp. ....	N
Chironomidae	
? <u>Orthosmittia</u> sp. ....	N
Chloropidae	
<u>Cadrema</u> <u>bilineata</u> Meijere .....	N (Dale, 1959)
<u>C.</u> <u>pallida</u> Loew .....	N
Culicidae	
* <u>Aedes</u> <u>polynesiensis</u> Marks .....	A N F
* <u>A.</u> <u>vexans</u> <u>nocturnus</u> (Theobald) .....	F (Laird, pers. com., 1968)

Dolichopodidae	
<u>Chrysosoma complicatum</u> Beck .....	N
Gen. nr. <u>Liparomyia</u> sp. ....	N (Dale, 1959)
Drosophilidae	
* <u>Drosophila errans</u> Malloch .....	F
<u>Drosophila</u> sp. ....	N
Empididae	
<u>Drapetis</u> sp. ....	F
Ephydridae	
<u>Allotrichoma</u> sp. ....	F
Lauxaniidae	
<u>Homoneura acrostichalis</u> Meijere .....	N
<u>H. sp. ? hawaiiensis</u> Malloch .....	N
<u>Trypaneoides</u> sp. nr. <u>carniventris</u> Bezzi .	N
Lonchaeidae	
<u>Lamprolonchaea aurea</u> Macq. ....	N F
Muscidae	
<u>Hardyia</u> sp. nr. <u>australis</u> Malloch .....	A (Dale, 1959)
* <u>Musca domestica</u> L. ....	A N F
* <u>M. sorbens</u> Wied. ....	A N F
Otitidae	
* <u>Scholastes bimaculatus</u> Hendel .....	A (Dale, 1959) N
Platystomatidae	
<u>Pseudorichardia flavitarsis</u> Macq. ....	N
Sarcophagidae	
* <u>Sarcophaga misera</u> Walker (= <u>S. dux</u> Thoms.) .....	N
Scatopsidae	
<u>Scatopse</u> sp. ....	N
Syrphidae	
<u>Xanthogramma scutellare</u> F. ....	N
Tephritidae	
<u>Dacus passiflorae</u> Froggatt .....	A (Dale, 1959) N
Tipulidae	
<u>Limonia</u> spp. ....	N
<u>L. subsaltens</u> Alexander .....	N
<u>Styryngomyia</u> sp. ....	N
Ulidiidae	
<u>Euxesta semifasciata</u> Malloch .....	F
COLEOPTERA	
Anthicidae	
* <u>Anthicus</u> sp. ? <u>oceanicus</u> Laferte .....	A (Dale, 1959)
Anthrribidae	
Gen. & sp. indet. ....	N
Cleridae	
* <u>Necrobia rufipes</u> (Deg.) .....	F (Dale, 1959)
Coccinellidae	
<u>Coccinella repanda</u> Thnb. ....	A (Dale, 1959)
<u>Coelophora inaequalis</u> (F.) .....	N
Cucujidae	
* <u>Oryzaephilus mercator</u> (Fauv.) .....	N

Dynastidae		
* <u>Oryctes rhinoceros</u> (L.) .....	N (only)	
Hydrophilidae		
<u>Dactylosternum subsquatratum</u> Fairm. ....	F	
Lamiidae		
* <u>Dihammus fasciatus</u> (Montr.) .....	A N F	
* <u>Opsis nutator</u> (F.) .....	A N	
* <u>Sybra</u> sp. ....	A (Dale, 1959)	
Nitidulidae		
* <u>Carpophilus dimidiatus</u> (F.) .....	A (Dale, 1959) F	
* <u>C. maculatus</u> Murr. ....	A (Dale, 1959) F	
Oedemeridae		
<u>Ananca bicolor</u> (Fairm.) .....	N	
<u>A. decolor</u> (Fairm.) .....	N	
<u>Pselaphanca lateritia</u> (Fairm.) .....	N	
<u>Sessinia livida</u> (F.) .....	A N F	
Scolytidae		
* <u>Xyleborus affinis</u> Eichh. ....	N	
Tenebrionidae		
* <u>Amarygmus hydrophiloides</u> Fairm. ....	N F	
* <u>Tribolium castaneum</u> (Herbst) .....	N	
HYMENOPTERA		
Aphelinidae		
Gen. & sp. indet. ....	N	
Chalcidae		
<u>Brachymeria</u> sp. ....	N	
Eucharitidae		
<u>Chalcura</u> sp. ....	A	
Eulophidae		
<u>Hemiptarsenus</u> sp. ....	N	
Gen. nr. <u>Stenomesus</u> sp. ....	N	
Eurytomidae		
<u>Eudecatoma</u> sp. ....	N	
Evaniidae		
* <u>Evania punctaticeps</u> Kieffer .....	N	
Formicidae		
* <u>Anoplolepis longipes</u> (Jerdon) .....	N F	
* <u>Camponotus inconspicuus</u> Mayr var. <u>samoensis</u> <u>Santschi</u> (? syn. of <u>C. chloroticus</u> Emery, see Wilson & Taylor, 1967) ....	N	
* <u>Cardiocondyla</u> sp. ....	N	
* <u>Monomorium floricola</u> (Jerdon) .....	F (Wilson & Taylor, 1967)	
<u>Odontomachus simillimus</u> Fr. Smith (= " <u>haematoda</u> L.") .....	N F	
* <u>Paratrechina bourbonica</u> (Forel) .....	N	
* <u>P. longicornis</u> (Latreille) .....	F(W.&T.,1967)	
* <u>P. vaga</u> (Forel) .....	F(W.&T.,1967)	
<u>Pheidole fervens</u> Fr. Smith .....	F(W.&T.,1967)	
* <u>P. megacephala</u> (F.) .....	A N (Dale, 1959)	
<u>P. oceanica</u> Mayr .....	F(W.&T.,1967)	
* <u>Tapinoma melanocephalum</u> (F.) .....	N F	
<u>Technomyrmex albipes</u> (Fr. Smith) .....	F(W.&T.,1967)	

* <u>Tetramorium guineense</u> (F.) .....	F(W.&T.,1967)
* <u>T. simillimum</u> (Fr. Smith) .....	F(W.&T.,1967)

Note: The species recorded from Fakaofu (F) by Wilson and Taylor (1967) were collected by E. H. Bryan, Jr. in 1924 and some, especially in Paratrechina and Pheidole, may have been displaced since then.

Megachilidae		
<u>Megachile diligens buxtoni</u> Perk. and Chees. ....	A N F	
Scelionidae		
<u>Macroteleia</u> sp. ....	N	
Sphegidae		
* <u>Pison hospes</u> Sm. ....	N	
* <u>P. iridipenne</u> Sm. ....	N	
Vespidae		
<u>Parodynerus bicinctus</u> F. ....	A N	
* <u>Polistes</u> sp. ....	? F	

Table II. TROPHIC RELATIONSHIPS OF TOKELAU ARTHROPODS

A. PHYTOPHAGOUS

Hosts:	Scientific name	Family	English or Tokelau name
1.	<u>Alocasia</u> sp. <u>Aphis gossypii</u> <u>Pseudococcus</u> sp. (Dale, 1959)	Araceae	Ta'amu
2.	<u>Artocarpus altilis</u> <u>Pseudococcus</u> sp. (Dale, 1959)	Moraceae	Breadfruit
3.	<u>Asplenium nidus</u> <u>?Calliopistria nauticorum</u>	Polypodiaceae	Lau Mea
4.	<u>Cocos nucifera</u> <u>Agonoxena argaula</u> Diaspid scale <u>Graeffea crouani</u> <u>Oryctes rhinoceros</u> <u>Pyroderces paradotis</u> - male flowers	Palmae	Niu
5.	<u>Cordia subcordata</u> <u>Eucosma</u> sp. - leaf-folder	Boraginaceae	Kanava
6.	<u>Ficus tinctoria</u> <u>Euploea</u> ? <u>lewenii</u>	Moraceae	Mati
7.	<u>Gardenia</u> sp. <u>Aphis gossypii</u> <u>Cephonodes armatus</u>	Rubiaceae	Tiale



- Coccus hesperidum  
Planococcus citri
8. Guettarda speciosa Rubiaceae Pua Pua  
Cephonodes armatus  
Chloauges woodfordii - leaf-roller
9. Ipomoea spp. Convolvulaceae Kumara  
Agrius convolvuli
10. Messerschmidia argentea Boraginaceae Tausunu  
Anthribid beetle  
Utetheisa pulchelloides
11. Morinda citrifolia Rubiaceae Nonu  
Aphis gossypii  
Chromis erotus eras  
Macroglossum hirundo samoanum  
Pegala biguttula  
Pinnaspis strachani  
Ugyops oromedon
12. Musa spp. Musaceae Banana  
Pentalonia nigronervosa
13. Pandanus spp. Pandanaceae Whala  
Docidothrips sp. - male inflorescence  
Graeffea crouani  
Oryctes rhinoceros  
Pseudococcid  
Pyroderces paradotis
14. Pemphis acidula Lythraceae Gagie  
Achaea janata  
Planococcus citri
15. Pisonia grandis Nyctaginaceae Pukavai  
Sphingid, ?Apocalypsis velox
16. Saccharum officinarum Gramineae Sugarcane  
Dysmicoccus brevipes
17. Scaevola taccada Goodeniaceae Gasu  
Anthribid  
Aphis gossypii  
Ophiomyia cornuta - leafminer  
Precis villida  
Ugyops oromedon
18. Sida sp. Malvaceae Fau  
Hypolimnas bolina

19. Various  
Megachile diligens buxtoni - leaf cutter.

B. XYLOPHAGOUS and SAPROPHAGOUS

1. Copra (rotten)
  - Anthicus sp. (Dale, 1959)
  - Cadra cautella "
  - Carpophilus spp. "
  - Periplaneta spp. "
  - Scholastes bimaculatus
2. Flour sacks
  - Oryzaeophilus mercator
  - Tribolium castaneum
3. Garden pits (with coconut husks, etc.)
  - Cutilia spp.
  - Periplaneta spp.
  - Pycnoscelus surinamensis
4. Hermit crab (dead)
  - Sarcophaga misera
5. Logs, stumps and dead branches
  - Amarygmus hydrophiloides - coconut, etc.
  - Dihammus fasciatus - breadfruit
  - Epilohmannia cylindrica - coconut
  - Glyptotermes xantholabrum- "
  - Incisitermes repandus - "
  - Olgamasine sp. - "
  - Opsis nutator - ?nonu
  - Oryctes rhinoceros - coconut, breadfruit, pandanus, etc.
  - Phyllhermonia sp.nr. foliata "
  - Prorhinotermes inopinatus- pandanus
  - ?Spirostrophus naresii - coconut
  - Sybra sp. (Dale, 1959)
  - Xyleborus affinis
6. Pandanus fruit (rotten)
  - ?Fuscuropoda sp.
  - Proctolaelaps sp.
7. Shelf fungus (on breadfruit stump)
  - ?Drosophila sp.
8. Sooty mold (on gardenia)
  - Ectopsocus sp.

C. ENTOMOPHAGOUS

1. Agonoxena argaula (pupae)  
Brachymeria sp.

2. Ant  
Chalcura sp.
3. Aphis gossypii  
?Chrysopa basalis  
Coelophora inaequalis  
?Phisis pallida  
Xanthogramma scutellare
4. Ectopsocus sp.  
Pheidole megacephala
5. Ophiomyia cornuta  
?Hemiptarsenus sp.
6. Oryctes rhinoceros  
Coenobita spp.  
Pheidole megacephala  
Scolopendra morsitans
7. Periplaneta spp.  
?Evania punctaticeps  
?Scolopendra morsitans
8. Pinnaspis strachani  
Aphelinid
9. Planococcus citri  
Cecidomyiid