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**Instituut voor Taxonomische Zoologie (Zoologisch Museum)  
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**Collection of Groundwater and Freshwater Fauna on  
the Islands of the South Pacific**

**Operation Raleigh -- Pacific Crossing**

**by**

**Nico W. Broodbakker**

**1988**

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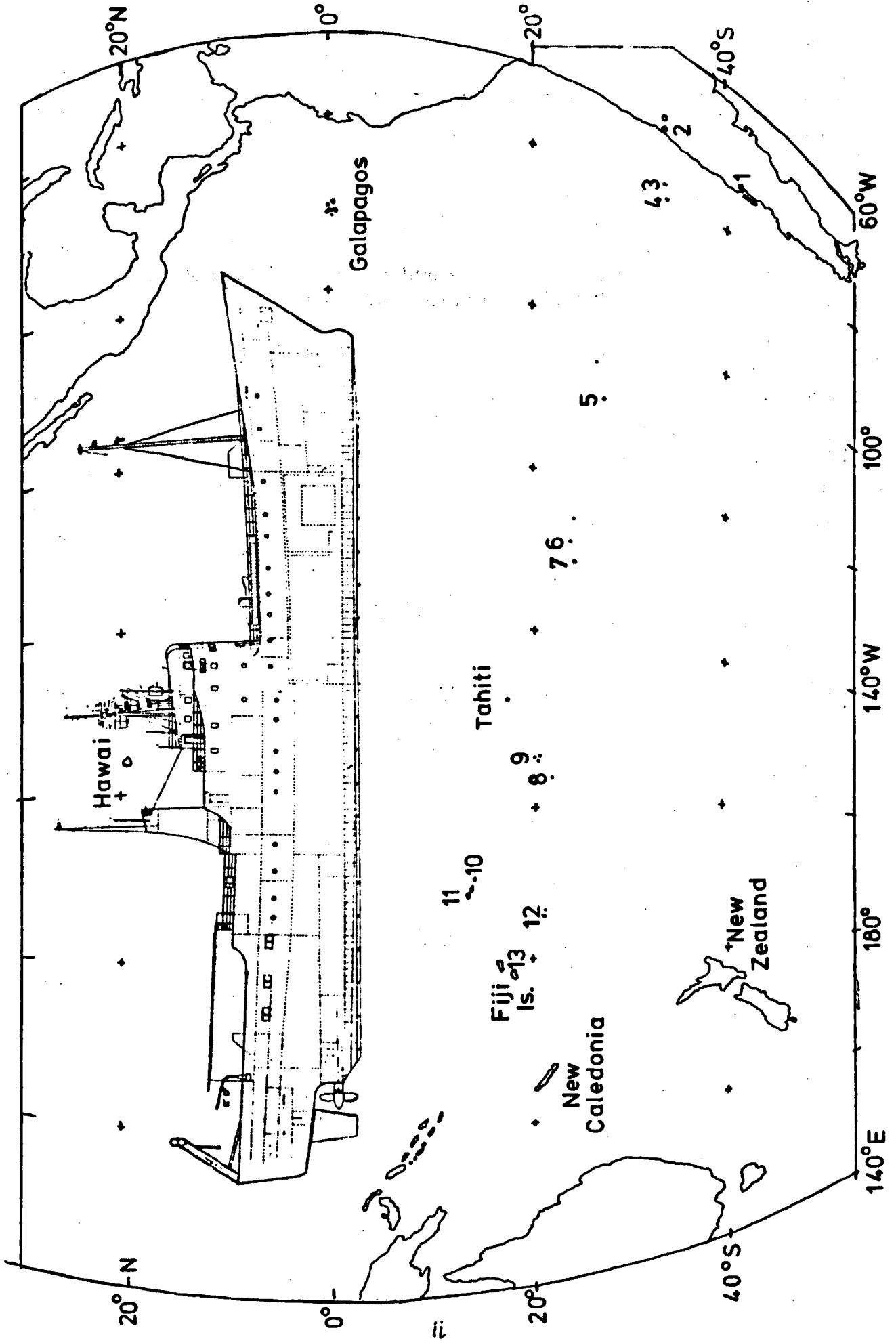
**Operation Raleigh -- Pacific Crossing**

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**Nico W. Broodbakker**

88 Meadvale Road,  
London W5 1NR  
Great-Britain

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Left: Map of the South Pacific, the islands visited are numbered and indicated in the table below. Also indicated are the sailing times between the islands and the inter island distances.

No.	Island, or town (Country)	Date of Arrival	Distance (km)	Sailing time(hr)
1	Puerto Montt (Chile)			
2	Valparaiso (Chile)	22 May	700	43
<b>Juan Fernandez Islands (Chile)</b>				
3	Isla Robinson Crusoe (Mas a Tierra)	25 May	700	42
4	Isla Alexandro Selkirk (Mas Afuera)	27 May	170	16
5	<b>Easter Island (Rapa Nui) (Chile)</b>	4 June	2850	158
6	<b>Henderson Island (U.K.)</b>	15 June	2030	110
7	<b>Pitcairn Island (U.K.)</b>	23 June	190	12
<b>Cook Islands (Independent)</b>				
8	Rarotonga	3 July	250	178
9	Atiu	7 July	56	12
9	Mitiaro	11 July	45	4
9	Mauke	13 July	45	3.5
10	Tutuila (American Samoa, U.S.A.)	20 July	1600	66
<b>Western Samoa (Independent)</b>				
11	'Upolu	29 July	110	10
11	Savai'i	31 July	21	1.5
<b>Tonga Islands (Independent)</b>				
12	Tongatapu	11 August	820	50
12	'Eua	16 August	40	4
13	Suva, Viti Levu (Fiji Islands)	20 August	700	58

## CONTENTS

1	ABSTRACT . . . . .	1
2	INTRODUCTION . . . . .	1
3	PERSONNEL . . . . .	2
4	METHODS . . . . .	3
5	RESULTS & DISCUSSION . . . . .	4
	5.1 JUAN FERNANDEZ ISLANDS . . . . .	4
	5.2 EASTER ISLAND . . . . .	5
	5.3 HENDERSON ISLAND . . . . .	5
	5.4 PITCAIRN ISLAND . . . . .	6
	5.5 COOK ISLANDS . . . . .	7
	RAROTONGA . . . . .	7
	ATIU, MITIARO, MAUKE . . . . .	7
	5.6 AMERICAN SAMOA . . . . .	8
	5.7 WESTERN SAMOA . . . . .	8
	5.8 TONGATAPU & 'EUA . . . . .	9
6	ACKNOWLEDGEMENTS . . . . .	10
7	LITERATURE . . . . .	10
8	LIST OF STATIONS . . . . .	11
	Juan Fernandez Islands . . . . .	11
	Easter Island . . . . .	12
	Henderson Island . . . . .	14
	Pitcairn Island . . . . .	15
	Rarotonga (Cook Islands). . . . .	17
	Atiu (Cook Islands) . . . . .	18
	Mitiaro (Cook Islands) . . . . .	20
	Mauke (Cook Islands) . . . . .	21
	Tutuila (American Samoa) . . . . .	23
	Savai'i (Western Samoa) . . . . .	25
	'Upolu (Western Samoa) . . . . .	27
	Tongatapu (Tonga Islands) . . . . .	29
	'Eua (Tonga Islands) . . . . .	31

## 1 ABSTRACT

During this project about 150 groundwater habitats were sampled on a number of islands in the South Pacific. The main habitats sampled were: wells, springs, caves, beaches and streams.

Groundwater fauna was only found on two islands. On Easter Island we found a new species belonging to the Isopoda (Crustacea), living in marine groundwater interstitia. On Tongatapu a new species of groundwater Amphipoda (Crustacea) was found in Anahulu Cave. Fragments which possibly belong to the same species were found in some wells on the island.

Many samples have not yet been sorted out. Therefore it is possible that more groundwater species will be found, particularly in the beach samples from the Cook Islands, and in the spring, cave, well, and beach samples of the Samoa's.

The absence of groundwater fauna on most volcanic islands was expected, but the lack of groundwater fauna on the uplifted coral islands, such as the outer Cooks, was surprising. Tongatapu and the other Tongan islands seem to be more promising as far as groundwater fauna is concerned.

As a side-study many freshwater shrimps have been collected on the Cook Islands and the Samoa's.

On Robinson Crusoe Island, Henderson, Pitcairn, Atiu, and 'Eua, terrestrial Amphipoda belonging to the family Talitridae (sandhoppers or beach fleas) have been found.

## 2 INTRODUCTION

Islands offer something special to biologists and particularly to evolutionists. They are smaller than continents, so it's easier to get an idea about the number of related species present, and there are less factors to complicate the picture than on the mainland.

Islands are excellent testing grounds for theories about the distribution and origin of species. It is also possible to calculate the time needed for the development of new species and to test models for colonization and survival of the colonizing species.

There are several ways in which species may be dispersed from one island to another, or from the mainland to an island. These are:

- active dispersal; some species can fly or swim to another island;
- passive dispersal; e.g. rafting with trees or other floating objects, with the wind (either the whole animal or its more or less resistant eggs). Another very important way of passive dispersal is by man (on ships or planes), or by other animals like birds.

After these events and the successive colonization of an island, the species may either become extinct, remain the same, or change with time into a new species, either gradually or abruptly. The new species will be different from their ancestors in some aspects, but similar in other characters which makes it possible to recognize relationships between species.

There are, however, other ways apart from dispersal for a species to come into existence, these are:

1) Vicariance; some islands were once part of former continents or larger islands, and with time have become isolated. Populations of a species become isolated as a consequence and can evolve in different ways compared with their relatives on the mainland or other islands.

2) Regression; species that originally lived in the sea may have adapted to the salt or brackish groundwater. Later they may have become isolated, e.g. because of uplifting of the island, or sea-level changes. After isolation they may either adapt themselves to a freshwater environment or become extinct.

Groundwater species will have developed either through regression or vicariance. They are not able to survive exposure to the surface world. Therefore they provide an excellent tool to study evolution (through vicariance or regression), by examining morphological similarities and dissimilarities with related species on other islands and the mainland. The number and type of groundwater species of a chosen group, found on an island, can give an indication about the last time of emergence above sealevel. Examination of the similarities with other related species living in marine environments, including marine interstitia (living between the sandgrains or gravel), and on other islands and the mainland, can give an indication about the age and the evolutionary history of the island.

### 3 PERSONNEL

The project was initiated by Prof. Dr. J.H. Stock, the official project leader. Prof. Stock is head of science at the Institute of taxonomic Zoology in Amsterdam, and has carried out a great deal of fieldwork in the Caribbean, from 1973 until the present. He is also studying the groundwater species of Atlantic islands of the coast of West Africa and the Baleares. Numerous publications have resulted from his fieldwork and that of other people involved with the study of groundwater fauna and Crustacea in particular.

Dr. Nico W. Broodbakker, was responsible for the fieldwork during the Pacific Phase of Operation Raleigh. He wrote a PhD thesis on Ostracoda (Crustacea) of the Caribbean from 1981 to 1984, and has carried out fieldwork concerned with freshwater, groundwater and marine fauna on various islands in the Caribbean, Venezuela, Japan, France, Ireland and the Netherlands.

#### 4 METHODS

The aim of this project was to take as many samples as possible of groundwater habitats on each island visited. There are many ways of getting access to the groundwater, depending on the type of soil, island and waterbodies. The most commonly encountered habitats are:

- Wells: These can be deep or shallow, covered or uncovered, polluted or unpolluted, etc. Obviously a deep, covered unpolluted well gives the greatest chance of collecting groundwater fauna;

- Caves: These give direct access to the groundwater, which can be either fresh, brackish or salt;

- River beds: By digging a hole next to a river or in a dried out river bed, one has access to interstitial groundwater. Part of the fauna collected in this way will be normal surface-water animals, but there is also a chance of catching some real groundwater or interstitial animals (living between the sediment grains);

- Springs: Here groundwater comes to the surface. Sometimes groundwater animals are brought to the surface by the spring;

- Beaches: When beaches are composed of coarse sand or pebbles, they form enough space between the grains for an interstitial marine fauna to develop. Marine interstitial species are often related to animal groups living in the sea. Their morphology may give a clue to the transition of some marine species via interstitial littoral species to groundwater species living in freshwater.

The most commonly encountered animal groups in groundwater are Crustacea (Ostracoda, Copepoda, Amphipoda, Isopoda); worms, and insect larvae. Sometimes fish or amphibia occur, but these are much rarer and only found in systems with crevices, usually caves.

Wells were sampled with vertical, self-closing plankton nets (Cvetkov nets). In caves handnets or Cvetkov nets were used, while walking or snorkeling through the water, depending on water depth and accessibility. Beaches were sampled with a 1.20 m long hollow steel pipe, with small holes at the bottom end, and a pump (Bou-Rouch pump). River beds were sampled by digging a hole, collecting about 100 liters of water, and filtering it through a fine meshed net (Karaman-Chappuis method). A good and concise summary of methods and techniques is given by Danielopol (1978).

During fieldwork samples were preserved in 5% formalin. In the lab samples were washed as soon as possible, and when not immediately examined, preserved in 70% ethanol. An asterisk in the stationlist means that a sample has not been sorted out yet.



## 5 RESULTS & DISCUSSION

### 5.1 JUAN FERNANDEZ ISLANDS

There were no wells, springs, or caves containing water on either of these islands. Therefore collecting had to be limited to sampling some gravel and pebble beaches. The most suitable type of beaches consisting of coarse sand or gravel are not very common on either of the islands. One potentially interesting beach on the western part of Robinson Crusoe Island could not be reached because of rough weather conditions.

On the beaches of Bahia Cumberland and Pangal, only one sample could be collected, because the underlying layers were too compacted in most places. This sample did not contain any animals. On Selkirk Island the only accesible gravel beach is Loberia Vieja. Reaching this beach took all of our available time. The one sample collected did not contain groundwater animals.

Because of lack of groundwater habitats we decided to take some samples in freshwater streams. Small Amphipoda belonging to the Talitridae (sand hoppers or beach fleas) were found in every stream on Robinson Crusoe Island. Only juvenile animals of about 3-5 mm were found in the lower reaches of the streams. Higher up, halfway up the Mirador (Robinson Crusoe's Lookout) animals of about 1 cm in length were found. At night members of the "Spider Group" observed and collected some very large animals (1.5 - 2 cm), jumping up the path right under the Mirador, making use of temporary rainwater streamlets. All specimens found on the island seem to belong to one species. The larger animals seem to migrate further up the streams and mountains than the younger ones, while the juveniles live in the lower reaches of the streams. Stebbing (1888) described Orchestia selkirki, a sandhopper species living near the high-water-mark on Robinson Crusoe Island, collected during the H.M.S. Challenger Expedition. Superficial examination showed this species to resemble the inland species collected on the island. Further research is needed to find out if the two species are close relatives or identical.

In the southern hemisphere species belonging to the Talitridae have colonized freshwater and even terrestrial habitats, such as moist leaf litter. In the northern hemisphere they are confined to beaches and sometimes the edges of rivers. To date most freshwater and terrestrial species have been described from South America, and Australia and New Zealand, respectively.

The freshwater fauna on Robinson Crusoe Island is very poor. Only a few species of Trichoptera (caddisfly larvae) and the Talitridae species were found. The freshwater fauna of Selkirk Island seems to be even poorer. In the lower reaches of the streams on this island no fauna was found at all, while higher up in the Quebrada Casas only one species of Trichoptera was found.

The explanation of the relatively poor fauna on both islands could be the fact that they are geologically very young, Robinson Crusoe Island is about 5 million and Selkirk Island is less than 1 million years old. Both islands are located far from the mainland and possible freshwater colonizers. They have never been in contact with the mainland. Another explanation for the

absence of life in the freshwater streams of Selkirk Island could be the presence in the water of iron oxide and other minerals washed out of the volcanic rocks. Maybe these minerals are poisonous for potential freshwater colonizers.

## 5.2 EASTER ISLAND

On Easter Island there are no streams, rivers or springs. The main freshwater bodies are the crater lakes in Rano Kau and Rano Raraku. There are several smaller freshwater bodies such as small man-made wells and some water-bearing caves in the western part of the island. However, there seems to be no groundwater complex accessible for the collection of animals. All sampled water bodies are isolated from each other. The freshwater pools in the caves originate from rainwater dripping through the roof. The water in the shallow wells also seems to come mainly from rainwater.

In the crater lakes a fauna limited to large quantities of small fish, Gambusia affinis (Baird & Girard, 1853); Chironomidae (midges); and Oligochaeta (Tubifex worms) was found. The fish have been introduced by man because they eat mosquito larvae.

In the small wells two species of Ostracoda (Seed shrimps), mosquito larvae and Oligochaeta were found. Ostracoda and Oligochaeta were also found in the cave pools in semi-darkness.

In one of the interstitial beach samples, taken at Hanga Tanaroa (OR 13), 8 specimens of a new species belonging to the order of the Isopoda (Crustacea) were found. They have been described as Cyathura rapanuia by Botosaneanu (1987), and belong to a genus which is specific for groundwater habitats. The animals are unpigmented, blind, and have reduced legs and body size.

## 5.3 HENDERSON ISLAND

Henderson Island is an uplifted old coral reef, or makatea island. Normally this means that through erosion the limestone is penetrated by rainwater forming caves, tunnels and underground connections with the sea. For Henderson this is not the case and the central part of the island seems to be quite solid limestone. There has however been erosion at the edges of the island forming some minor caves which are dry, or occasionally have some rainwater dripping from the roof. Therefore no freshwater or brackish water habitats are present on the island. The only possible places to search for groundwater fauna are the beaches. However, no interstitial animals were found in the five samples that were pumped up from varying depths on the North and East beaches.

Most of my time on the island was spent hacking a path from north to east together with Dr. Jon Woodhead, in order to collect an interstitial sample on the East beach. In addition we collected shells and sponges for other departments of the Institute of Taxonomic Zoology in Amsterdam.

Under the group of palm trees on North beach a colony of a large coenobite species was found. The smaller animals live in Turbo shells, whilst the larger specimens live in halves of coconut shells. One animal was collected while it was trying to steal one of my Turbo shells, leaving behind an old battered one. This specimen has recently been identified as Coenobita spinosus H. Milne Edwards, by Dr. Jacques Forest, from the Museum National d'Histoire Naturelle, Paris. Parts of the exoskeleton of a landcrab belonging to the Gecarcinidae, probably Gecarcinus sp., were collected in a cave in the cliff face on North beach. In the same cave a live specimen was observed but not collected. In several places on the island other red land hermit crabs, probably Coenobita perlata were observed.

#### 5.4 PITCAIRN ISLAND

Pitcairn is a volcanic island without any coral limestone. There is only one beach, Down Rope, where two interstitial samples were collected. A damaged specimen of a groundwater isopod was found in one sample, which seems to belong to the same species as those found on Easter Island (Botosaneanu, 1987).

There are some minor springs west and southwest of Adamstown, where water siphons out of the rocks at several places forming pools interconnected by small trickles (Up Valley, Brown's Water). We collected many small eyeless Isopoda (sort of woodlice) at all stations, but later inspection proved them to be juvenile terrestrial Isopoda.

Another striking feature was the presence of terrestrial Amphipoda, Talitridae (sandhoppers). They are very numerous and live under leaf litter and in other humid places along the secondary paths on the island. They were found along the whole length of the road from Adamstown up to Flatland. The first specimens were observed by Deborah Procter on Ted's Side. Some specimens were found in the trickles of Brown's Water. The species is probably present all over the island.

The most interesting aspect of this discovery is the fact that the Talitridae are also one of the few freshwater colonizers on Robinson Crusoe island. There they were mainly found in, and next to streams, and only along the paths after heavy rainfall. On Pitcairn they seem to have developed into an almost terrestrial species.

Several other freshwater samples were collected in places such as oil-drums and concrete containers filled with rainwater, and some goldfish ponds. These samples contained mainly mosquito larvae. At St. Paul's Point several sponges and a few Conidae (cone shells) were collected.

## 5.5 COOK ISLANDS

### RAROTONGA

Rarotonga is a volcanic island without any uplifted coral reefs. Therefore there are not many real groundwater habitats. There used to be some wells on the island, but most of these have been filled in with time, or are too hard to locate. Groundwater research had to be limited to beaches.

In the streams of Rarotonga several species of freshwater shrimps have been found. Three of these are large species with long claws: Macrobrachium lar (Fabricius); M. australe (Guerin); and M. aemulum (Nobili). They were often found together with two small species belonging to the family Atyidae. The members of this last family have claws shaped like brooms. The species collected are: Atyoida pilipes (Newport) and Caridina weberi De Man. A third small species, Palaemon sp., was found in Avana Stream, at a distance of 900 m from the seashore. It belongs to the same genus as the prawns collected by Matt Richmond in the lagoon at the east coast of the island (P. debilis Dana).

All these species have a very wide distribution in the Pacific. Some of them, like M. lar, are found in East Africa and China as well as most islands of the SW Pacific. M. lar is also often introduced by man for prawn farming. The larvae of most freshwater shrimps are able to migrate through seawater from island to island.

### ATIU, MITIARO, MAUKE

The outer rims of these islands consist for the greater part of uplifted coral reefs, or makatea. The makatea is very weathered and eroded, and is overgrown by forest. A great part of the limestone has been dissolved and transported elsewhere, leaving behind a large system of crevices, sinkholes, caves, and tunnels in the makatea, partly filled with water. Lake Tiroto on Atiu is connected to the coast by tunnels in the makatea. In spite of this the salinity of the lake is very low. No groundwater fauna has been found in any parts of the system on any of these islands. The marine interstitial samples have not been analysed yet.

There are several possible explanations for the lack of groundwater fauna. Most of the caves are relatively exposed to influences from the surface, so groundwater animals may therefore avoid these places. In many of the systems water-filled tunnels lead further under the makatea. To explore these tunnels scuba equipment would obviously be necessary. Dr. Tom Iliffe from Bermuda has recently explored many caves on the Pacific islands with the help of scuba gear. His results will show if groundwater fauna is present deeper in the system.

The absence of groundwater fauna could also be due to the presence of large predators, especially fish, such as eel, Gobidae or maybe even the small fish Poecilia reticulata Peters, 1859, which has been introduced by man in order to eradicate mosquito larvae. Macrobrachium lar might also predate on small crustaceans.

## 5.6 AMERICAN SAMOA

Tutuila, the main island of American Samoa, is volcanic. There are no uplifted coral formations, or limestone rocks. Drinking water is obtained from the many streams and rivers on the island and from several deep drilled wells in the mountains. The Department of Environmental Protection helped me to sample some of these wells, by turning open the tap next to each pump and filtering the water through a net. No animals were collected in this way.

The "Coring Group" mentioned the existence of many man-made shallow wells on Aunuu Island, just off the south-east coast of Tutuila. Most of the wells in the main village of Aunuu were subsequently sampled. The samples have not been sorted out yet.

On most of the beaches on the south-east coast of Tutuila coral terraces reached up to the high water line. Therefore most interstitial beach samples had to be collected on the south-west coast. They have not been sorted out yet.

The US Marines Corps of Engineers has done a survey of the freshwater shrimps on the island in 1978. Three of the most promising streams, according to their survey, were sampled. The Atyidae species caught in these streams are Atyopsis spinipes (Newport) (in Afutele Stream); Caridina serratirostris De Man (in Vaipuna and Papa Streams); C. typus H. Milne Edwards and Atyoida pilipes (in Vaipuna Stream); and C. weberi (in Afutele and Papa Stream). Only the last two species were found on Rarotonga. Macrobrachium aff. lepidactyloides (De Man) was found in Afutele Stream. It has not been recorded before from this island. M. lar was found in Vaipuna and Papa Stream, and M. australe in Papa Stream.

## 5.7 WESTERN SAMOA

The sampling was started on the island of Savai'i, a volcanic island rich in coastal springs. Most springs originate from lava tubes, which are hidden below the surface and terminate under water on the coast. Three large lava tunnels were directly accessible from the land but contained only isolated waterbodies. In one of these pools M. lar was observed. Two interstitial samples were collected on beaches.

On 'Upolu, an older volcanic island of lower altitude, only a few springs and one lava cave were sampled. Three interstitial beach samples were also collected.

None of the samples from these islands have been sorted out yet.

## 5.8 TONGATAPU & 'EUA

Both Tongatapu and 'Eua are islands consisting of uplifted coral reefs. They are both covered with a layer of weathered volcanic ash, which makes them fertile and different from more exposed makatea islands. Tongatapu is flat, and there are no rivers or springs, which means that in the past drinking water had to be obtained from wells. Nowadays most wells are filled up with dirt and soil. The remaining wells are mainly used for irrigation purposes. About 20 wells could be sampled. Most of them contained surface freshwater fauna, but in two wells fragments of groundwater Amphipoda were found.

Only one cave on the east coast of Tongatapu, Anahulu Cave, was sampled. This stalactite cave consists of several rooms of which some are partly filled with water. In this cave groundwater Amphipoda were found that belong to a genus recently described from the Andaman Islands. Prof. Stock (1988) described this new species as Josephosella hamata, together with another species of the same genus that was found in the Fiji Islands. The amphipod parts that were found in the wells might well belong to the same species.

On 'Eua an extensive cave exploration and sampling programme had just been completed by a group of geologists from Manchester (U.K.). According to them most caves on 'Eua are inaccessible without proper ropes and other professional equipment. Only 2 caves closer to the west coast are more accessible. These caves have been formed and eroded by freshwater streams. The fauna in these streams seems to consist mainly of ordinary freshwater shrimps of the family Atyidae.

A terrestrial species belonging to the Talitridae (sandhoppers) was found at the entrance of Ana Peka Peka cave.

## 6 ACKNOWLEDGEMENTS

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Also special thanks to the Rarotongan venturers who joined us in the Cook Islands: Reima Chitty, Lesley Turepu, Dorothy Monroe and Thuria Vogel, and to all our guides and helpers during our stay on the various islands, particularly: Ray and Bill, Hans Gabriel, Charlie Toilolo, Gerald McCormack, Faatino Toia, Fifita Sili, Pai Hiti Uira Rano, Taipuni, Colombo and X-ray. Furthermore I would like to thank all members of the crew, staff and all venturers for their pleasant company during this expedition.

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## 7 LITERATURE

Botosaneanu, L., 1987. A new thalassostygobiont species of *Cyathura* (Isopoda: Anthuridae) from the South-East Pacific. *Stygologia*, 3 (4): 296-304.

Danielopol, D.L., 1978. Introduction to groundwater ecology. Lecture notes for the UNESCO Training Course in Limnology. Limnologisches Institut, Wien: 47 pp.

Stebbing, T.R.R., 1888. Report on the Amphipoda collected by H.M.S. Challenger during the years 1873-76. In: Great Britain, Report on the Scientific Results of the Voyage of H.M.S. Challenger during the years 1873-1876, Zoology, 29: 1-1737.

Stock, J.H., 1988. Two new stygobiont Amphipoda (Crustacea) from Polynesia. *Stygologia*, 4 (1): (in press).

## 8 LIST OF STATIONS

### JUAN FERNANDEZ ISLANDS

- OR 1 Quebrada Pangal, Isla Robinson Crusoe, 25-05-1986. Small stream, with large boulders, depth 0-10 cm, width 1-2 m. Soil consisting of a mixture of gravel and clay. Salinity: 0. Coord.: 33°37'21" S, 78°49'11" W. Fauna: Talitridae, Trichoptera; in hyporheal many juvenile Talitridae.

Dried out sponge fragments of Spongia magellanica Thiele, 1905 were collected at the pebbly beach of Quebrada Pangal.

- OR 2 Small stream just W. of Punta Pangal, Isla Robinson Crusoe, 25-05-1986. Small stream, width 1-2 m, depth 10-20 cm, clayish soil with some gravel and large boulders. Coord.: 33°37'11" S, 78°49'42" W. Fauna: Numerous small Talitridae, and Trichoptera larvae.

- OR 3 NW. side of Cumberland bay, Isla Robinson Crusoe, 26-05-1986. Marine interstitia, pipe depth 30 cm. Bouldery beach with most pebbles 10-30 cm, sediment between boulders blackish sand with silt and some shell grit. Coord.: 33°36'36" S, 78°49'53" W. Fauna: Ostracoda, Foraminifera (mostly dead).

Some littoral Gastropoda were collected at the jetty of Cumberland Bay, + 1 Talitridae.

- OR 4 Quelebra Colonial (La Polydra), Isla Robinson Crusoe, 26-05-1986. Small stream, width 1-2 m, depth 0-10 cm, next to water basin used for drinking water of San Juan Bautista, large boulders and pebbles, clayish soil on rock. Coord.: 33°36'56" S, 78°50'54" W. Fauna: Talitridae

- 4 B: Leaf litter next to the stream, very wet because of heavy rainfall. Fauna: Talitridae.

- OR 5 Path just W of Mirador de Alexandro Selkirk (15 meters down), Isla Robinson Crusoe, 25-05-1986. Because of heavy rainfall the path was partly flooded with rainwater. Many talitrids were jumping up the path. 3 males, 1 female (?), 1 terrestrial isopod. Coord.: 33°36'50" S, 78°51'10" W.

- 5 B: Leaf litter beside the path, under the mirtle bushes. Fauna: Talitridae.

- OR 6 Loberia Vieja, Isla Alexandro Selkirk, 28-05-1986. Marine interstitia, pipe depth 75-90 cm, near HWL. Coord.: 33°45'34" S, 80°46'56" W. Fauna: Negative.

On this location some small pieces of Spongia magellanica were collected on the beach and a few talitrids in rockpools. According to our divers the sponges live at a depth of 5-10 m and have a blue-grey colour. Because of regulations they were not allowed to collect fresh specimens.

- OR 7 Quebrada Varadero, Isla Alexandro Selkirk, 28-05-1986. Talitridae collected under stones about 1 m above the water level of a small river flowing through the ravine. Coord.: 33°46'19" S, 80°43'38" W. Fauna: Talitridae.

- OR 8 Quebrada Casas o Baquedano, Isla Alexandro Selkirk, 28-05-1986. Talitridae collected under stones near HWL at the boat landing place of the settlement. Coord.: 33°44'55" S, 80°43'13" W. Fauna: Talitridae.



EASTER ISLAND

- OR 9 Rano Kau, Easter Island, 04-06-1986. Sample taken on N side of large swampy crater lake, on the edge of small forest patch. Between Scirpus and Bamboo-like reeds. Bottom muddy with much leaf litter and creeping roots. Depth 10-20 cm. Coord.: 27°10'56" S, 109°26'32" W. Fauna: Pisces: Gambusia affinis (Baird & Girard, 1853).
- OR 10 Vaihu (Hanga Tee), Easter Island, 05-06-1986. Bay at S coast of the island. Marine interstitia with pipe from 35-50 cm depth, at HWL. Black volcanic sand with larger pebbles (mostly 0.5-5 cm, some 10-100 cm). Grain size of sand 0.5-2 mm. Coord.: 27°10'00" S, 109°22'03" W. Fauna: 3 young Nereids (?), 1 young Amphipod (with eye)
- 10 B: Amphipoda (Talitridae ?) collected in rockpools at MTL, from submerged brown algae (Sargasso type). Coll.: M. Richmond.
- 10 C: Littoral Gastropoda collected on rocks near HWL.
- OR 11 Rano Raraku, Easter Island, 06-06-1986. Concrete basin 2 x 2.5 m, with small opening 0.6 x 0.6 m, 90% covered by wooden lid. Watertable + depth: 1 + 0.25 m. Next to house on camping W of Rano Raraku. Basin filled with rainwater from gutter on roof of house, by a downpipe. Thin layer of detritus and some mud. Clear water. Coord.: 27°07'34" S, 109°17'45" W. Fauna: Ostracoda: Cypretta sp., Culicidae, Oligochaeta.
- OR 12 Rano Raraku, Easter Island, 06-06-1986. N side of crater lake, much Scirpus, muddy bottom with roots and leaf litter. Svetkov net. Coord.: 27°07'25" S, 109°17'34" W. Fauna: Pisces: Gambusia affinis, Oligochaeta, Chironomus sp., 1 Ephemeroptera.
- OR 13 Hanga Tanaroa, Easter Island, 06-06-1986. SW side of bay at SE coast, along slip-way. Marine interstitia from 40-55 cm depth. Black volcanic sand with shell/coral grit. Many larger pebbles and boulders. Coord.: 27°07'44" S, 109°16'46" W. Fauna: Isopoda: Cyathura rapanuia Botosaneanu, 1987 (NEW SPECIES), Gastropoda (+), 1 Oligochaeta.
- OR 14 Anakena, Easter Island, 06-06-1986. Artesian well with broken windmill about 200 m S of Anakena Beach. Watertable + depth: 20 + 6 m. Clear water, some gravel and detritus. Well consists of metal pipe diam. 30 cm covered with a metal lid, with a small hole in the middle. Not fully closed. Sal. 2 ‰. Coord.: 27°04'37" S, 109°19'30" W. Fauna: 1 Ostracod: Cypridopsinae A.
- OR 15 Ovahe, Easter Island, 07-06-1986. Marine interstitia from 50-70 cm depth. N side of sandy beach at N side of island, E of Point Rosalia. Mixture of gravel, white sand, black sand and red silt, between large volcanic boulders, near HWL. Coord.: 27°04'37" S, 109°18'55" W. Fauna: 1 Amphipoda + 1 Cyclopoidae (with eyes).
- 15 B: Gastropoda collected from red algae growing at 2-3 m depth, + 1 hermit crab. Coll.: M. Richmond
- OR 16 Vaitarakaihu, Easter Island, 07-06-1986. Man made well, next to buried garden with bananatrees. 1.5 km NW of Anakena, 150 m from the sea. Well dug out, walls constructed of stones, Watertable + depth: 3 + 0.7 m. Oval opening 1.5 x 1 m, area of water 0.5 x 0.5 m. Entrance and water are 2 m apart horizontally. Only slightly dark. Clear water, some green moss on the stones. Thin layer of silt and detritus. Permanent. Uncovered. Sal. 1 ‰. Coord.: 27°04'04" S, 109°20'17" W. Fauna: Chironomus sp., Ostracoda.

- OR 17 Shallow rainwater puddle in hollow rock on top of hill, directly S of Ana Tuaroma, Easter Island, 07-06-1986. About 2.5 km NW of Anakena, 600 m E of Papa Tekena, 150 m from the sea. Depth of hollow, 30 cm, of water 3 cm. Area 0.3 x 0.4 m, only 20% covered. Bottom mud with gravel on rock. Coord.: 27°03'45" S, 109°21'05" W. Fauna: Oligochaeta, Ostracoda: Cypretta sp.
- OR 18 Series of caves about 800 m NNE of Mount Vaca Kipo, and 700 m W of Ahu Akivi (seven restored statues), Easter Island, 08-06-1986. Central large oval depression of about 10 x 8 m and 2.5 m depth, with a few banana trees and many ferns. Three cave entrances, on the S side, 18 A, on the NE side, 18 B, and on the W side, 18 C. All clear water, sal. 0 ‰. Coord.: 27°07'00" S, 109°24'18-23" W.
- 18 A: Practically dry cave, about 7 m wide and 2-3 m high, with three dead-end alleys at 20 m from the entrance. Dripwater puddle about 10 m from the entrance. Area 1 x 1 m, water depth 15 cm. Mud mixed with gravel on rock. Semi-darkness. Fauna: Oligochaeta, Ostracoda: Cypridopsinae A, Cyclopoidae, 1 Culicidae.
- 18 B: Entrance begins wide (3 x 3 m), but narrows quickly (1 x 1.5 m), at the same time going down slightly and curving W ward. After about 10 m the alley ends into a large dome shaped cave of approximately 20 x 10 m and 5 m high in the middle. The floor of the cave consists of a large pool with very muddy, sometimes 2 m wide edges, and large boulders. The water is 5-20 cm deep. Bottom mud mixed with gravel and charcoaled wood. Darkness almost complete. Fauna: Negative.
- 18 C: Entrance very narrow 0.5 x 0.8 m, but widens quickly in large dome shaped cave from 10 x 10 m and 4 m high. Two pools at the end of the cave, each about 2.5 x 1 m, with a depth of 5-15 cm. Soil is muddy, with some gravel and charcoaled wood. Large stones. Practically dark. Fauna: Negative.
- OR 19 Cave 1 km NW of Mount Vaca Kipo, Easter Island, 08-06-1986. About 1 km from sea, 600 m N of Sanatorio. Oval depression of 20 x 15 m, 2.5 m deep. At the W side of the depression some banana trees, next to a large fruit tree (yellow fruit, in Rapa Nui: Haia). Entrance to cave on the E side next to some more banana trees. Entrance is 2 x 1.5 m wide and widens quickly into an elongated cave of more than 30 m deep and appr. 6 m wide. At the back of the first part cave extends further, but only 0.5 m high. Several shallow pools, the deepest being 2 x 1 m and 5-15 cm deep. Small Svetkov. Semi-darkness. Bottom of pools muddy with some gravel and large boulders and stones. Sal. 0 ‰. Coord.: 27°07'08" S, 109°24'50-60" W. Fauna: Negative.
- OR 20 Tahai, Easter Island, 09-06-1986. Next to Ahu Vaihuri, N of Hanga Roa. Shells collected at HWL between and under stones, mostly dead but many Melampus castaneus Von Mühlfelt, alive. 1 Ocean water reader in very small rockpool (0.1 x 0.1 m). Coord.: 27°08'28" S, 109°25'48" W.

HENDERSON ISLAND (24 22'S, 128 19'W)

- OR 21 North beach, Henderson Island, 16-06-1986. 20 m E of second coral headland. Marine interstitia 15-35 cm depth at HWL. Fossil coral pebbles, coral sand & gravel. Coord.: 24°19'29" S, 128°18'39" W. Fauna: Gastropoda (dead), Foraminifera.
- 21 B: Melampus cf. luteus, Conidae and other shell species, collected on N beach, 15-17 -06-1986.
- 21 C: Thin encrusting orange-red sponges, Spirastrella decumbens Ridley, 1884, collected on dead coral and other substrate, mostly in small patches, very numerous, only dominant sponge species. 0.5 m depth at MTL near 2nd coral headland.
- OR 22 North beach, Henderson Island, 16-06-1986. 55 m E of fourth coral headland. Marine interstitia 35-55 cm depth at HWL. 50 l pumped up. Fine coral sand, deeper somewhat coarser. Coord.: 24°19'26" S, 128°18'28" W. Fauna: Oligochaeta, Polychaeta, Foraminifera (+++), Gastropoda (dead).
- OR 23 North beach, Henderson Island, 17-06-1986. 350 m E of most W point on N beach, next to block of coral (2.5 x 5 x 1.5 m) sticking out of the sand. Marine interstitia 40-60 cm depth near HWL. 70 l. Sal. 34‰. Coarse coral sand. Coord.: 24°19'32" S, 128°19'40" W. Fauna: Foraminifera (+++), Gastropoda (dead).
- OR 24 North beach, Henderson Island, 17-06-1986. Most W side of N beach, under the overhanging coral cliff. Marine interstitia 75-95 cm depth near HWL. 150 l. Coarse coral sand. Coord.: 24°19'32" S, 128°19'51" W. Fauna: Foraminifera (+++), Gastropoda (dead).
- 24 B: Sponges a.o. collected at appr. 1 m depth, growing on dead coral boulders:
- Leather coral, Alcyonacea, with calcareous outside (liver colour), and soft inside (greyish-white);
  - Thin encrusting yellow sponge, Aka sp. only small patches of 0.5-1 cm diam.
- OR 25 East beach, Henderson Island, 19-06-1986. Puddle in coral rock, about 100 m inland from the edge of the cliff. 10 x 10 x 5 cm. Leaf litter and detritus. Coord.: 24°19'32" S, 128°18'05" W. Fauna: Dead terrestrial Gastropoda.
- OR 26 East beach, Henderson Island, 20-06-1986. 500 m S of most N side of beach, next to large lump of coral (5 x 5 x 3 m) on beach. Marine interstitia 60-80 cm depth, near HWL. 100 l. Fine to coarse sand. Coord.: 24°19'42" S, 128°18'05" W. Fauna: Oligochaeta (3), Foraminifera (+++), Gastropoda (dead).
- At East Beach some other fauna was collected:
- Dead Gastropoda: i.e. Melampus cf. luteus, Conidae.
  - Goose barnacles, collected on a round plastic buoy.
- OR \*\* Various animals collected on or near the site of the base-camp on North beach, Henderson Island, 22-06-1986. Coord.: 24°19'42" S, 128°19'13" W:
- 2 Crabs collected under purple sea-urchins. Leg. M. Richmond.
  - 1 Uca type crab from the sand.
  - 1 Birgus latro (L.) in Turbo shell (bigger ones live in coconut shells).
  - 3 Lizards, collected on the beach and on the cliff.
  - 1 encrusting orange-red sponge, Aka sp. from underside of stone (0.5 x 0.7 m) at MTL, colony about 20 cm diam.

PITCAIRN ISLAND (25 04'S, 130 06'W)

- OR 27 Adamstown, Pitcairn, 23-06-1986. Oil drum filled with rainwater at Tom Christian's house. Watercolour green, leaf litter and detritus on bottom of drum. Sal. 0 ‰. Coord.: 25°03'46" S, 130°06'03" W. Fauna: Negative.
- OR 28 Up Valley, Pitcairn, 23-06-1986. Valley about 150 m W of school, forested, with large rock boulders and rock outcrops. Soil consists of red-brown clay, mixed with gravel and stones. Small pools and puddles formed by water siphoning from the rocks. Water slowly streaming from puddle to puddle. All pools smaller than 0.5 x 0.2 x 0.1 m. Watercolour clear to whitish. Sal. 0 ‰. Coord.: 25°03'47" S, 130°06'14" W. Fauna: Juvenile terrestrial Isopoda (4), Ostracoda: Candoninae (++), Cyclopidae (1), Oligochaeta (1).
- OR 29 Up Valley, Pitcairn, 23-06-1986. Large and small pools, formed by water siphoning from the rocks, higher up in the valley, about 50 m SW of OR 28. Watercolour milky-white, soil red-brown clay with some gravel. Coord.: 25°03'49" S, 130°06'16" W.
- 29 A: Three small pools, from about 0.4 x 0.2 x 0.05 m. Fauna: Lumbricidae (6), Oligochaeta (+), Chironomus sp. (+), Thaumaleidae (1), terrestrial Isopoda (10), Cyclopidae (4), Gastropoda (+).
- 29 B: Larger pool, 1 x 0.5 x 0.1 m. Fauna: Insecta: Chironomus sp. (4), Thaumaleidae (2), Lepidoptera larv. (1), terrestrial Isopoda (4), Ostracoda: Candoninae (1).
- OR 30 Down Rope, Pitcairn, 24-06-1986. Gravely beach with big boulders, volcanic gravel mixed with coral and shell grit (1-5 mm diam.). Sal. 34 ‰. Coord.: 25°04'25" S, 130°05'36" W.
- 30 A: Marine interstitia 40-60 cm depth, 150 l. Between boulders near waterline at MTL. Fauna: Foraminifera (++), Gastropoda (dead).
- 30 B: Marine interstitia 50-70 cm depth, 150 l. On the waterline where the boulders start appearing. Finer gravel, more silt. Fauna: Foraminifera (+).
- 30 C: Gastropoda i.e. Melampus luteus Quoy & Gaimard, Conidae etc.; collected at HWLS.
- OR 31 St. Paul's Point, Pitcairn, 24-06-1986. Large rockpool 60 x 20 m, depth 0.5-3 m. Coord.: 25°04'36" S, 130°05'10" W. Fauna:  
- 3 Orange-yellow sponges, Tethya diploderma Schmidt, 1870: Roundish clumps of about 3 cm diam. Inside dark-yellow, outside orange, growing on rock walls at 1-2 m depth;  
- Thin encrusting sponges Phoriospongia sp.: 1 Turquoise-blue colour, 1 orange-red, growing together with a pink variety on the living shell of a Spondylus at 2 m depth.  
- 2 dead Conidae, on sandy bottom of the pool, depth 3 m.
- OR 32 Adamstown, Pitcairn, 25-06-1986. Oil drum filled with rainwater at Ben Christian's house. Greenish water, leaf litter and detritus on bottom. Sal. 0 ‰. Coord.: 25°03'53" S, 130°06'01" W. Fauna: Culicidae (+), Chironomidae (+).
- OR 33 Adamstown, Pitcairn, 25-06-1986. Concrete container used as goldfish pond at Jay Carrol's house, 2.5 x 1 x 0.4 m. Greenish water, leaf litter and detritus. Sal. 0 ‰. Coord.: 25°03'56" S, 130°05'53" W. Fauna: Oligochaeta (+), Ostracoda valves (Cypridinae A).

- OR 34 Brown's Water, Pitcairn, 25-06-1986. Series of large pools fed by water siphoning from the rocks and interconnected by small slowly flowing trickles, about 100 m up the valley SW from the bridge at road fork near black watercontainer. Largest pool 4 x 2 x 1 m, others smaller and less deep. Surroundings and bottom red-brown clay, mixed with stones of various sizes. Surroundings: Forested with large boulders and steep walls consisting of a mixture of a weathered conglomerate of rocks and clay. Watercolour light brownish. Sal. 0 ‰. Coord.: 25° 03'58" S, 130°06'21" W.
- 34 A: Large and smaller pools. Fauna: Terrestrial Isopoda (3), Ostracoda: Cypridinae B (2).
- 34 B: Trickles connecting the pools. Fauna: Terrestrial Isopoda (4), Talitridae (4), Oligochaeta (8), Chironomus sp. (2), Thaumaleidae (1).
- OR 35 House on top of the hill NW of Brown's Water, Pitcairn, 25-06-1986. Concrete covered container of 3 x 3 m, opening 0.7 x 0.7 m, covered with plastic mosquito net in wooden frame. Probably sometimes open. Bottom, many flocculent green algae, detritus and some leaf litter. Depth 1 m. Sal. 0 ‰. Coord.: 25°03'54" S, 130°06'22" W. Fauna: Culicidae (1), Lumbricidae (1).
- OR 36 Flatland, Pitcairn, 25-06-1986. Numerous Amphipoda (Talitridae) collected under leaf litter of rododendron type tree, on small clearing next to path. Bottom dry, reddish-brown clay. Coord.: 25°03'54" S, 130°06'28" W.
- OR 37 Leaf litter next to secondary path from Flatland back to Adamstown. Numerous Amphipoda (Talitridae) collected under and between the leaf litter on and next to the path. Coord.: 25°03'53" S, 130°06'26" W.
- Checking the rest of the path along Pulli back to Adamstown proved that this species of jumping amphipod was present everywhere under leaf litter on the path. The species was not found on the main road through Adamstown.
- OR 38 Mini Off, Pitcairn, 25-06-1986. Flatworm (Polyclada) collected between dead coral branches in rockpool, at a depth of 0.5 m at LW. Coord.: 25°03'43" S, 130°05'58" W. Leg. M. Richmond.

RAROTONGA (Cook Islands)

- OR 39 Arorangi, Rarotonga, 04-07-1986. Opposite of the Church of JCLDS. Marine interstitia 80-100 cm depth at MTL; 150 l; coarse sand, mainly shell and algae grit and some coral. Coord.: 21°14'11" S, 159°49'41" W. Fauna: \*
- OR 40 Rutaki Stream, Rarotonga, 04-07-1986. Brackish interstitia 80-100 cm depth at MTL; 150 l; fine sand mixed with gravel and small stones. Sal. 11 ‰. Coord.: 21°15'15" S, 159°48'30" W. Fauna: \*
- OR 41 Taipara Stream, Rarotonga, 04-07-1986. 15 m N of bridge on coast road. Freshwater interstitia 70-90 cm, in river bank; 150 l. Bottom gravel, mixed with sand and small stones. Water greyish. River width: 2-5 m. Slowly streaming. Sal. 0 ‰. Coord.: 21°15'40" S, 159°46'49" W. Fauna: \*
- OR 42 W beach, opposite of "The Pitcairn" memorial and S.D.A. school and compound, Rarotonga, 04-07-1986. Marine interstitia 85-105 cm at MTL; 150 l. Fine shell, algae and coral sand. Water milky white. Sal. 36 ‰. Coord. 21°15'54" S, 159°46'00" W. Fauna: \*
- OR 43 Avatiu Stream at Culvert, Rarotonga, 05-07-1986. Moderate to fastly streaming river, with a big, almost stagnant, pool next to the bridge. Stones & large boulders. Bottom gravel and clay. Width 5 m. Depth 5-50 cm. Sal. 0 ‰. Coord.: 21°13'18" S, 159°47'40" W. Fauna: Crustacea: Natantia: Macrobrachium australe; M. aemulum; Atyoida pilipes; Caridina weberi.
- OR 44 Norrie Park opposite school, Rarotonga, 05-07-1986. Marine interstitia at MTL, 150 l. Coarse sand and coral rubble. Lower bouldery reef flat with stagnant water at LW. Sal. 30 ‰. Coord.: 21°12'45" S, 159°44'05" W. Fauna: \*
- OR 45 N beach at W side of the airstrip, next to meteorological station, Rarotonga, 05-07-1986. Marine interstitia 95-115 cm depth at MTL, 100 l. Coarse sand with coral rubble. Coord.: 21°11'48" S, 159°44'05" W. Fauna: \*
- OR 46 Stream in Aroe, Arorangi, Rarotonga, 06-07-1986. Under bridge at Ara Metua, E of Sunday school. Width 2 m, depth 5-40 cm. Bottom gravel and mud, with pebbles, stones and boulders. Moderately streaming. Sal. 0 ‰. Coord.: 21°13'42" S, 159°49'30" W. Fauna: Natantia: Macrobrachium aemulum (2); M. australe (5); Atyoida pilipes (5); Caridina weberi (1).
- OR 47 Rutaki Stream, Rarotonga, 06-07-1986. At bridge on Ara Metua, Width 1-5 m, depth 5-20 cm. Bottom gravel with clay, covered with pebbles (mostly up to 10 cm). Sal. 0 ‰. Coord.: 21°15'08" S, 159°48'28" W. Fauna: Crustacea: Brachyura: Ptychognathus sp. aff. easteranus Rathbun; Natantia: Macrobrachium australe
- OR 48 Avana Stream, Rarotonga, 06-07-1986. About 900 m upstream from the sea. Width 3-5 m, depth mostly up to 10 cm, one pool more than 50 cm. (in the pool large species A). Sal. 0 ‰. Coord.: 21°14'29" S, 159°44'16" W. Fauna: Natantia: Macrobrachium aemulum (5); Palaemon sp. (1).
- OR 49 Takuvaine Stream, Rarotonga, 06-07-1986. S of concrete bridge leading to side path, S of Noa's Ark. Width 1.5-2 m, depth 5-15 cm. Fastly streaming. Bottom clay and gravel with pebbles (up to 20 cm) and some boulders. Sal. 0 ‰. Coord.: 21°12'55" S, 159°46'19" W. Fauna: Natantia: Macrobrachium aemulum (+); M. australe (8); Atyoida pilipes (4); Caridina weberi (1).

OR 50 Side stream of Takuvaine Stream 20 m from OR 49, Farctonga, 06-07-1986. Width 0.5-1 m, depth 5-10 cm. Fastly streaming. Bottom gravel and clay with pebbles up to 20 cm. Sal. 0 ‰. Coord.: 21°12'55" S, 159°46'18" W. Fauna: Natantia: Macrobrachium aemulum (10); M. australe (3); Atyoida pilipes (5).

ATIUI (COOK ISLANDS) (7-10 July 1986)

OR 51 Vai Tapoto, Atiu, 07-07-1986. Deep sink hole in the makatea. Watertable + depth: 20 + 18.5 m. Watercolour whitish-green. Dimensions 3 x 6 m. Sal. 1 ‰. Coord.: 20°00'46" S, 158°07'01" W. Fauna: Dead Gastropoda (various sp.); Ostracoda: Strandesia sp. (valves).

OR 52 Te Kopua, Atiu, 07-07-1986. Big shallow pool in chestnut forest in the makatea, next to coral cliff. Nearly dry, filled with leaf litter, very muddy. Depth 5-10 cm, dimensions 25 x 5 m. Sal. 0 ‰. Coord.: 20°00'41" S, 158°07'03" W. Fauna: Cyclopidae (++); Ostracoda: Strandesia sp. A & B (+++), Cyprina sp. (+); Gastropoda: Melanoides tuberculata (1), Physastra masuta (+).

OR 53-56 Ana Takitaki, Atiu, 08-07-1986. Large cave with many passageways and rooms with stalactites and stalagmites. Mostly dry, some shallow dripwater pools. Home of the "Kopeka" bird, a small swallow-like bird adapted to living in caves. Sal. 0 ‰. Coord.: 19°59'35-41" S, 158°05'8-14" W.

53: Shallow pool at the end of the cave, under an overhang in a corner, in total darkness. Depth 5-10 cm, dim. 0.5 x 1 m. Bottom muddy mixed with fossil shell grit. Fauna: Ostracoda: Neocypridopsis sp. (9); Myriapoda (5: small); Colembola (2); Oribatidae (1); fossil Gastropoda.

54: Shallow pool on 3/4 of the way into the cave. Total darkness. Depth 5-15 cm, dim. 4 x 2 m. Bottom muddy, mixed with fossil shell grit and detritus. Fauna: Ostracoda: Neocypridopsis sp. (15); Myriapoda (1), Thaumaleidae (1), fossil Gastropoda.

55: Shallow pool under overhanging rock, halfway into the cave. Total darkness. Depth 10-15 cm, dim. 4 x 2 m. Bottom muddy. Fauna: Ostracoda: Neocypridopsis sp. (16); Oligochaeta (1); Oribatidae (1).

56: Several small pools at the entrance of the cave in semi-darkness, on top of rock outcrop. Depth 5-15 cm, dim. up to 1.5 x 0.5 m. Bottom mud on rock. Fauna: Chironomidae (++); Culicidae (+); Ostracoda: Neocypridopsis sp. (25); fossil Gastropoda.

OR 57 Secondary cave of Ana Takitaki, Atiu, 08-07-1986. Small entrance 1 x 1.5 m, next to entrance of large cave. Large pool at 4-5 m below groundlevel. Waterdepth 1.5-2 m, dim. 10 x 2-4 m. Practically dark. Bottom rocky plus stones, mud and sand in some places. Fauna: Negative.

OR 58 Vai Momoiri, Atiu, 08-07-1986. Large circular open hole (diam. 20 m) connected by tunnel (semi-darkness) under the path with other smaller open holes in the makatea. Watertable + depth: 7 + 0.5-1.5 m. Sal. 0 ‰. Coord.: 19°59'12" S, 158°05'31" W. Fauna: Pisces: Poecilia reticulata Peters, 1859 (++); dead Gastropoda (3 spec.).

OR 59 Oravaru Beach, Atiu, 08-07-1986. Marine interstitia 40-60 cm depth at MTL, 100 l. Coarse shell, algae and coral sand. Much shell grit and air pumped up. Sal. 36 ‰. Coord.: 19°59'26" S, 158°08'07" W. Fauna: \*

59 B: Conidae (2 living cones with red markings).

- OR 60 Oneroa Beach, Atiu, 09-07-1986. Marine interstitia 40-60 cm depth at MTL, 70 l. Coarse shell, algae and coral sand, with coral rubble. Much shell grit and air pumped up. Sal. 36 ‰. Coord.: 20°00'01" S, 158°04'38" W. Fauna: \*
- 60 B: Gastropoda collected on the beach i.e. Melampus luteus.
- OR 61 Takau-roa Beach, Atiu, 09-07-1986. Marine interstitia 55-75 cm depth at MTL, 150 l. Coarse shell, algae and coral sand, with coral rubble. Sal. 36 ‰. Coord.: 20°00'55" S, 158°05'15" W. Fauna: \*
- 61 B: Living Conidae & small gastropod species, collected on beach and reef (up to 1 m depth at LW).
- 61 C: Sponge like algae (or sponge ?), orange-brown, forming a crust of up to 1 cm thick on the rock surface in pools at HWL.
- OR 62 Taunganui Landing, Atiu, 09-07-1986. Just S of the landing on the reef in shallow water. Coord.: 19°58'46" S, 158°08'00" W. Coll. Isabella Lee.
- 62 A: Conidae (many living).
- 62 B: 4 Anomura (Hermit crabs), taken out of shells.
- OR 63 Large cave complex W of Lake Tiroto, Atiu, 9/10 -07-1986. Cave with many passageways, with water on the bottom, connecting Lake Tiroto with the sea. Entrance at lake-side in coral cliff. Depth of water 0.5-1.5 m (incl. soft mud). Bottom rocky, with very soft mud, covered with a layer of decayed vegetation of a few cm, some volcanic gravel on the bottom. Exit is possible through several open holes in the makatea (watertable about 10 m). Coord.: 20°00' 35-40" S, 158°07' 10-15" W. Fauna: Negative.
- One sample was collected by A. Mitchell on the 9th July, The other by me on the 10th of July. Fauna: Negative, only dead Melanoides sp.
- OR 64 Lake Tiroto, Atiu, 09-07-1986. Natantia: Macrobrachium lar, M. australe collected in the lake with a handnet. Water depth mostly 3-8 m. Diam. 200 m. Sal. 1 ‰. Coord.: 20°00'41" S, 158°07'15" W. Coll. Lesley Turepu & Thuria Vogel.
- OR 65 Taungaroro Beach, Atiu, 10-07-1986. Marine interstitia 50-70 cm depth, 100 l. Coarse shell, algae and coral sand, with coral rubble. Sal. 36 ‰. Coord.: 20°00'11" S, 158°07'55" W. Fauna: \*
- OR \*\* Next to old airstrip, Atiu, 07-07-1986. Talitridae collected in pitfall traps in wooded area in the middle of cultivated land. Coll. D. Proctor.



MITIARO (COOK ISLANDS)(11-12 July 1986)

- OR 66 Vai Ai, Mitiaro, 11-07-1986. Round open sink hole in the makatea, diam. 10 m. Watert. + depth: 3 + 4 m. Bottom muddy with much decayed vegetation, sides bare rock. Sal. 4 ‰. Coord.: 19°50'43" S, 157°42'26" W. Fauna: Pisces: Gambusia sp. (or Poecilia reticulata ? ), Anquilla sp.
- OR 67 Vai Marere, Mitiaro, 11-07-1986. Semi-dark cave, with side entrance (6 x 2.5 m) sloping gently down to big pool of 20 x 10 m. Ceiling with stalactites. Water contains sulphur and is milky-greenish but clear. Bottom fossil coral rubble and gravel on rock. Watert. + depth: 7 + 1.5-3 m. Sal. 2 ‰. Coord.: 19°51'33" S, 157°42'52" W. Fauna: Cyclopidae (Harpacticoida ?); (sub)fossil & recent dead Gastropoda.
- OR 68 Te Unu, Mitiaro, 12-07-1986. Secluded cove at SE coast (width 3 m). Marine interstitia 25-45 cm depth at MTL, 100 l. Coarse coral sand and rubble. Sal. 36 ‰. Coord.: 19°53'11" S, 157°41'15" W. Fauna: \*
- OR 69 Vai Tamaroa, Mitiaro, 12-07-1986. Open sink hole in the makatea. Oval, 15 x 6 m, w.table + depth: 6 + 13 m. Greenish, clear water. Bottom muddy, mostly decayed vegetation. Sal. 2 ‰. Coord. 19°52'19" S, 157°41'00" W. Fauna: Pisces: Gobiidae; Gastropoda: Melanoides sp. (++); Ostracoda: Cypridopsis sp. (++) , Cypretta sp. (2)(Carap.:+), Candoninae carap.; Cyclopidae (1); Oligochaeta: (2).
- OR 70 Vai Naura, Mitiaro, 12-07-1986. Open cave with side entrance (20 x 5 m), and light coming in through opening at the other side near the ceiling. Waterpool triangular shape, 15 x 20 x 15 m, with two deep crevices in the back, and two tunnels leading further under the makatea. Up to 8 m deep, watertable at appr. 8 m. Water cristal clear. Bottom stony with many loose (carbonate) boulders and stones, only slight amount of calcareous sediment, coconut husks and logs, some mud on the bottom of the crevices. Sal. 2 ‰. Coord.: 19°51'47" S, 157°40'50" W. Fauna: Pisces: Gobiidae; Ostracoda: Cypridopsis sp. (6), Cypretta sp.(valve).
- OR 71 Beach near Vai Naura, Mitiaro, 12-07-1986. Marine interstitia 40-60 cm depth, 100 l. Fine coral sand and shell grit. Sal. 36 ‰. Coord.: 19°51'47" S, 157°40'44" W. Fauna: \*

MAUKE (COOK ISLANDS)(13-15 July 1986)

- OR 72 Vai Ou, Mauke, 13-07-1986. Open cave or sink hole, entrance, passageway at 35°, quarter dark, stalactites and-mites. Triangular pool at the bottom, one side shallow (up to 1.5 m deep), the other side a crevice of 4-5 m deep, with tunnels under the makatea at both ends. Watertable 6 m. Bottom of crevice rocky, covered with fine silt (decayed vegetation), rotten logs and coconut husks, but mostly big limestone boulders. Clear water. Sal. 2 ‰. Coord.: 20°08'31" S, 157°19'23" W. Fauna: Pisces: Gobiidae.
- OR 72 B: Terrestrial Amphipoda (Talitridae) collected in pitfall traps set in grass/scrub beneath palm trees for 22 hrs, 200 m from the coast along the path leading to Vai Ou. 15-07-1986. Coll. D. Proctor.
- OR 73 Ana o Moraro, Mauke, 13-07-1986. passageway at an angle of 45°, leading to a triangular pool in quarterdark, of 4 x 3 x 3 m. W.table + depth: 12 + 3.5-4 m. Tunnel on one side. Bottom rocky with limestone boulders and practically no silt. Clear water. Sal. 2 ‰. Coord.: 20°08'34" S, 157°19'21" W. Fauna: Pisces: Gobiidae.
- OR 74 Vai Tunamoā, Mauke, 13-07-1986. Vertical open hole in the makatea. W.table + depth: 9 + 9 m. Quadrangular shape, 5 x 4 m. Clear water, partially shaded by rockwall overhead. Bottom: much decayed vegetation, tree trunks, leaves and some boulders. Maybe a tunnel. Sal. 0 ‰. Coord.: 20°08'35" S, 157°19'24" W. Fauna: Pisces: Gobiidae; Ostracoda: Cyprretta sp. (1), Candonopsis sp. (?) valves.
- OR 75 Vai Taongo, Mauke, 14-07-1986. Open cavity in the makatea, with at the edge a rectangular pool of 10 x 4 m, sloping down and going further under the makatea at an angle of 45°. W.table + depth: 8 + 3.5 m. Clear water. Bottom muddy, mostly decayed vegetation of 10-20 cm thickness, rotten branches and roots. Sal. 1 ‰. Coord.: 20°08'33" S, 157°19'58" W. Fauna: Pisces: Gobiidae (1 young coll.); Chironomidae (3); Ostracoda: Candoninae, Cyprretta sp.
- OR 76 Moti Cave, Mauke, 14-07-1986. Open cavity with at the edge a rectangular pool of 10 x 4 m, with a tunnel on the right side. W.table + depth: 10 + 3 m. Greenish but clear water. Narrow underwater passageway to small room with airpocket at the right side. Bottom very muddy, with much decayed vegetation, tree trunks, coconut husks and branches. Sal. 0 ‰. Coord.: 20°10'07" S, 157°19'45" W. Fauna: Pisces: Gobiidae; Ostracoda: Cyprretta sp. (1: dead).
- OR 77 Motuanga Cave, "The cave of 100 Rooms", Mauke, 14-07-1986. Real dark cave, with passageway leading down to a room with a rectangular pool of 1-2 x 3 m. Virtually an almost vertical crevice of indefinite depth. The second room is about 2 m behind the first, and contains a rectangular pool of 4-5 x 6-7 m. Up to 2 m deep, with a crevice and tunnel leading to indefinite depth. Bottom and walls practically only limestone rock with stalactites and-mites. Loose limestone boulders and broken stalactites, cobbles and calcareous silt. Water cristal clear. Sal. 2 ‰. Coord.: 20°10'26" S, 157°19'36" W. Fauna: Negative.
- OR 78 Koenga Well, Mauke, 14-07-1986. Just S of Makatea village. Large pool, with Taro plantation. Area 100 m<sup>2</sup>. W.depth 20-30 cm at edges. Water clear without vegetation. Bottom mixed gravel and mud. Sal. 0 ‰. Coord.: 20°09'08" S, 157°20'26" W. Fauna: Pisces: Gambusia sp.; Dead Gastropoda: Physastra and Melanoides sp.

- OR 79 Round concrete container next to Koenga Well, Mauke, 14-07-1986. Diam. 1.5 m, w.depth 1 m, above groundlevel. Bottom covered with various layers of cobbles, covered by green algae (Cladoph. or Ulothrix). Floating green algae. Sal. 0 ‰. Coord.: 20 09'08" S, 17 20'26" W. Fauna: Fishes: Gambusia sp.; Gastropoda: Physastra masuta (+); Insecta: Lepidoptera larvae (1), Homoptera (1), Coleoptera (3), Odonata (1), Chironomidae (1); Oligochaeta.
- OR 80 Te Oneroa Beach, Mauke, 15-07-1986. Marine interstitia 80-100 cm depth, 100 l. Coarse coral sand, shell and algal grit. Sal. 36 ‰. Coord.: 20 10'34" S, 157 20'54" W. Fauna: \*
- OR 81 Anaoko Beach, Mauke (S), 15-07-1986. Marine interstitia 35-55 cm depth, 70 l at MTL. Coarse sand. A lot of air pumped up. Sal. 36 ‰. Coord.: 20 11'01" S, 157 19'49" W. Fauna: \*
- OR 82 House at E side of new airstrip, Mauke, 15-07-1986. Concrete rainwater container of 4 x 4 x 3 m. Waterdepth 1.5 m, above groundlevel. Uncovered. Clear, colourless water, some floating algae. Sal. 0 ‰. Coord.: 20 08'11" S, 157 19'50" W. Fauna: Insecta: Culicidae.
- OR 83 Anarei Beach, Mauke (N), 15-07-1986. Small secluded cove (width 15 m). Marine interstitia 55-75 cm depth, 70 l at MTL. Coarse sand. Sal. 38 ‰. Coord.: 20 07'43" S, 157 20'41" W. Fauna: \*

The sand on the beaches of the Cook Islands consists for a great part of fragments of the calcareous algae Chlamydesmia. A far lesser part of it is formed by shell and coral grit. On all beaches an orange-yellow round Foraminifera with 4 spines is very common.

TUTUILA (AMERICAN SAMOA) (22-28 July 1986)

The sampling of several deep drilled wells W of Pago Pago, did not yield any fauna.

- OR 84 Beach W of Auasi and E of Taugamalama Point, Tutuila (E), 22-07-1986. Marine interstitia 25-45 cm depth, only 10 l at MTL. Coarse sand. Sal. 34 ‰. Coord.: 14°16'40" S, 171°34'26" W. Fauna: \*
- OR 85 Alega Beach, Tutuila (SE), 22-07-1986. Marine interstitia 90-110 cm depth, 100 l at MTL. Fine coral & shell sand. Water pumped up was brown and silty. Sal. 34 ‰. Coord.: 14°17'12" S, 170°38'14" W. Fauna: \*
- OR 86 Saina's house, Aunuu Island, Tutuila, 23-07-1986. Round open well on N side of village. Diam. 1.3 m, watert. + depth: 2 + 0.5 m. Dug out well, sides strengthened by piled up stones. Well sometimes covered with chickenwire. Clear water, sandy bottom with leaf litter. Sal. 2 ‰. Coord.: 14°17'08" S, 170°33'27" W. Fauna: \*
- OR 87 Well of Lemafa family, Aunuu Island, Tutuila, 23-07-1986. Round open well between the houses at open space, same type as OR 86, but surrounded by concrete platform, the well can be covered by chickenwire. W.table + depth: 0.9 + 1.1 m, diam. 1.3 m. Sandy bottom with some leaf litter. Sal. 0 ‰. Coord.: 14°17'17" S, 170°33'29" W. Fauna: \*
- OR 88 Well of Fono fam., Aunuu Island, Tutuila, 23-07-1986. Round open well of 87-type, build in with coral boulders. E of church, next to main path. W.table + depth: 1.4 + 1.1 m, diam. 1.3 m. Sandy bottom with a few mats of green filamentous algae, sides covered with green algae. Clear water. Sal. 2 ‰. Coord.: 14°17'19" S, 170°33'29" W. Fauna: \*
- OR 89 Well at former house of Fono family 100 m E of OR 88, Aunuu Island, Tutuila, 23-07-1986. Round open well of 87-type. W.table + depth: 1.3 + 1 m, diam. 1.4 m. Much green filamentous algae. Clear water. Sandy bottom. Sal. 0 ‰. Coord.: 14°17'24" S, 170°33'26" W. Fauna: Hemiptera (1),
- 89 B: 2 Amphibia, toads, collected under the banana an breadfruit trees, between leaf litter and cobbles. The toads are numerous.
- OR 90 Well of Tamau family, Aunuu Island, Tutuila, 23-07-1986. Round open well of 86-type, 150 m S of OR 89. Only some concrete on top. Clear water, sandy bottom, some leaf litter. W.table + depth: 1.3 + 1 m, diam. 1.3 m. Sal. 1 ‰. Coord.: 14°17'24" S, 170°33'30" W. Fauna: \*
- OR 91 Well of Fuiava family, SE of church, Aunuu Island, Tutuila, 23-07-1986. Round open well of 87-type. Concrete on top. W.table + depth: 2 + 1 m, diam. 2 m. Clear water, rocky bottom with some sand. Sal. 0 ‰. Coord.: 14°17'26" S, 170°33'32" W. Fauna: \*
- OR 92 Well of Sulu family, about 200 m from the coast, Aunuu Island, Tutuila, 23-07-1986. Round open well of 87-type. W.table + depth: 1.8 + 0.5 m, diam. 1.4 m. Clear water, bottom with coral rubble. Sal. 0 ‰. Coord.: 14°17'25" S, 170°33'34" W. Fauna: \*
- OR 93 Well at S end of village, next to pig sty, Aunuu Island, Tutuila, 23-07-1986. Round open well of 87-type. W.table + depth: 1.3 + 0.4 m, diam. 1.3 m. Clear water, sandy bottom with some leaf litter. Sal. 0 ‰. Coord.: 14°17'27" S, 170°33'30" W. Fauna: \*
- OR 94 100 m S of landing, Aunuu Island, Tutuila, 23-07-1986. Marine interstitia 40-60 cm depth, 100 l. Coarse + fine coral sand. Sal. 35 ‰. Coord.: 14°17'21" S, 170°33'34" W. Fauna: \*

- OR 95 Aunuu Island, Tutuila, 23-07-1986. Collected on the path between coral rubble and in vegetation near the sea above HW level, W of Pala Lake. Numerous dead as well as living specimen of: Melampus luteus (Quoy & Gaimard) & Melampus fasciatus Deshayes, 1850.
- OR 96 South beach, Aunuu Island, Tutuila, 23-07-1986. Coord.: 14°17'39"S, 170°33'25" W.
- 96 A: Lizard.
- 96 B: Conidae.
- OR 97 Amanave, Tutuila (W), 24-07-1986. Beach behind Utusiva Point, about 20 m E of Laloafu Stream. Brackish interstitia 60-80 cm depth, 100 l. Fine sand, with a few cobbles. Sal. 17 ‰ (sea: 34 ‰). Coord.: 14°19'52" S, 170°49'45" W. Fauna: \*
- OR 98 Afutele Stream, Agululu, Tutuila (W), 24-07-1986. About 200 m upstream from the coast. Mountainstream, big boulders, gravel & cobbles on black clayish soil. Width 2-3 m. Sal. 0 ‰. Coord.: 14°20'05" S, 170°49'06" W. Fauna: Natantia: Macrobrachium aff. lepidactyloides (1); Caridina weberi (8); Atyopsis spinipes (Newport)(3); Atyoida pilipes (2).
- OR 99 Utumea, Tutuila (W), 24-07-1986. Halfway between Fagaone Point and Maugatee Rock (South coast). Marine interstitia 40-60 cm depth, 100 l. Fine to coarse sand. Sal. 34 ‰. Coord.: 14°20'04" S, 170°48'49" W. Fauna: \*
- OR 100 Asili, Tutuila, 24-07-1986. Brackish interstitia 90-110 cm depth, 120 l. Alluvial sand mixed with some coral grit, but mostly black with much silt. Sal. 29 ‰. Coord.: 14°20'10" S, 170°47'39" W. Fauna: \*
- OR 101 Vaipuna Stream, Amaluia, Tutuila, 24-07-1986. About 200 m upstream from the coast. Mountainstream, big boulders, cobbles and gravel on darkbrown to black clayish soil. Watercolour slightly whitish. Sal. 0 ‰. Coord.: 14°20'14" S, 170°47'28" W. Fauna: Natantia: Macrobrachium lar (18); Atyoida pilipes (4); Caridina typus; C. serratirostris (2).
- OR 102 Papa Stream, Tutuila, 25-07-1986. Just N of bridge on main road. Mountainstream in flatland, mostly cobbles and gravel on darkbrown soil. Clear water. Sal. 0 ‰. Coord.: 14°18'53" S, 170°42'33" W.
- 102 A: Collected Natantia: Caridina serratirostris (30); C. weberi (13); Macrobrachium australe (19); M. lar (3); Palaemon sp. (1).
- River interstitia in gravel bank under bridge for walking. Fine to coarse sand, with red-brown silt.
- 102 B: Karaman-Chappuis method, + 50 l.
- 102 C: Pipe and pump, 65-85 cm depth, 100 l.
- OR 103 : Coconut Point, Tutuila, 25-07-1986. 250 m S of main road. Marine (brackish) interstitia 60-80 cm depth, 100 l. Fine to coarse sand, with brown silty water pumped up, much fine sand. Sal. 32 ‰ (sea: 32.5 ‰). Coord.: 14°19'03" S, 170°41'50" W. Fauna: \*  
Porifera: Spirastrella vespertina Ridley, 1884.
- OR 104 Small bouldery beach E of Fagaalu, Tutuila, 25-07-1986. Marine interstitia 50-80 cm (var.) depth, 70 l. Greyish water, much fine silt. Surface coral rubble mixed with volcanic cobbles & boulders. Sal. 34 ‰. Coord.: 14°17'57" S, 170°40'39" W. Fauna: \*

WESTERN SAMOA (30 July - 7 August 1986)

SAVAI'I (1-3 August 1986)

- OR 107 Salia Pool, Falealupo, Savai'i (NW), 01-08-1986. Spring on the coast at HWL. Water flowing from under lava rock into oval pool, bordered by concrete edge (8 x 5 x 0.6 m). Bottom lava cobbles with some sand, surrounded by black lava rock & boulders. Sal. 10 ‰. Coord.: 13°29'57" S, 172°47'21" W. Fauna: Cyclopidae.
- OR 108 Falealupo, Savai'i, 01-08-1986. Round open well, with square opening behind the Methodist Church, next to swamp. Concreted in. W.table + depth: 1.5 + 1 m, diam. 1 m. Troubled water, whitish-green, with oil film on surface. OR 87-type well. Bottom sandy or rocky. Sal. 1 ‰. Coord.: 13°29'28" S, 172°46'44" W. Fauna: Gastropoda, Culicidae; Brachycera larv.; Amphipoda: Talitridae (?).
- OR 109 Well NE of Falealupo, Savai'i (NW), 01-08-1986. Shallow round open well bordered with lava stones, on the edge of a swamp. W.table + depth: 0 + 1 m, diam. 2 m. Water troubled and greenish, with a lot of filamentous green algae on the sides. Sal. 0 ‰. Coord.: 13°29'12" S, 172°46'07" W. Fauna: Oligochaeta; Chironomidae; Ostracoda: Cypretta sp., Stenocypris sp., Cypridopsis sp. (?); Cladocera; Talitridae.
- OR 110 Well next to bay of Auala, Savai'i, 01-08-1986. Water flowing from under lava rock into semi-circular pool (6 x 6 m), in open connection with the rest of the bay. Edges build of lava boulders. Depth on edge 60-80 cm, up to 2 m in the middle, bottom rocky with boulders. Whitish-green, somewhat troubled water. Sal. 4 ‰. Coord.: 13°30'32" S, 172°38'50" W. Fauna: Chironomidae; Natantia; Talitridae; Cyclopidae; Cladocera; Ostracoda.
- OR 111 Spring flowing from between lava boulders below the front of a church in Asau, Savai'i, 01-0-1986. Water flows into a small pool (2 x 2 x 0.7 m) bordered with lava cobbles, which is connected with a large pool (25 x 40 m). Clear water. Bottom lava cobbles. Sal. 2 ‰. Coord.: 13°30'41" S, 172°34'54" W. Fauna: Odonata; Talitridae; Cladocera; Cyclopidae; Ostracoda: Stenocypris sp., a.o.
- OR 112 Matavai, Savai'i, 01-08-1986. Small spring at the edge of the bay, water slowly flowing at several places from under the lava rocks into rocky pool, with gravel at some places. Irregularly shaped (3 x 4 m) in open connection with the bay. Waterdepth 0.4 - 1.3 m. Clear, water. Sal. 2 ‰. Coord.: 13°27'46" S, 172°25'07" W. Fauna: \*
- OR 113 Mataolealelo Spring, Matavai, Savai'i, 01-08-1986. Large strong spring. Sides concreted in lava boulders. Rectangular pool in open connection with the bay (12 x 8 m). Water flowing from between the rocks at several places near the bottom of the pool. Clear water, depth up to 3 m. Bottom lava boulders and cobbles. Some gravel. Boulders covered with filamentous brown-green algae. Sal. 2 ‰. Coord.: 13°27'49" S, 172°25'00" W. Fauna: Gastropoda: Spined Neritina (++) .

- OR 114-115 Pea Pea Caves. Two lava tunnels W of Matavai, Savai'i, 01-02 08-1986 20 m W of the track next to the CCCS church. One tunnel for "Women" (114) and one for "Man" (115). Both tunnels start at the sides of a depression in the lava rock, sloping gently down. The tunnels have a diam. of 5-6 m, the bottom of the first 30-40 m is covered with water up to 1 m deep. The bottom is rocky, with some boulders, cobbles and pebbles, with mud in some places, and gravel in other places. In the "Man's" cave lives the Pea Pea bird (Kopeka). Sal. 2 ‰. Coord.: 13°27'51" S, 172°25'18" W. Fauna: Natantia: Macrobrachium lar (not coll.);
- OR 116 Nu'uletau Cave, S of Palai, Savai'i (N), 02-08-1986. Long Lava tunnel running from S to N at about 15 m and more below the surface. Small entrance in a small depression, steep tunnel leading down at an angle of 45° and more to the main tunnel at about 15 m below groundlevel. In the north part of the tunnel after about 150 m, a larger room is found with a waterfilled depression in the rock. The size of the pool is 15 x 6 m. Waterdepth up to 1 m. The bottom is covered with a layer of fine silt up to 70 cm thick. Clear water. Sal. 0 ‰. Coord.: 13°28'58" S, 172°24'16" W. Fauna: \*
- OR 117 Save'e Spring, Safotu, Savai'i, 02-08-1986. Two springs just above HWL on the coast. One for drinking (2 x 2 x 0.5 m), with a gravel bottom, and a larger circular pool for bathing (diam. 5 m, depth up to 1 m). Bottom rocks and boulders, with gravel and cobbles. Sides of the pool boulders covered with concrete. Clear water. Sal. 2 ‰. Coord.: 13°26'37" S, 172°24'11" W. Fauna: \*
- OR 118 Beach halfway between Safotu & Manase, Savai'i (N), 02-08-1986. Marine interstitia 70-90 cm depth, 100 l. Much brown silt. Coarse coral sand & rubble. Sal. 0-5 ‰ (?) (to silty) (sea: 29 ‰). Coord.: 13°26'21" S, 172°22'57" W. Fauna: \*
- OR 119 Mauga Well, Savai'i, 02-08-1986. Round, open, concrete well. W.table + depth: 25 + 3(?) m, diam. 1 m. Clear water, leaflitter. Sal. 1-2 ‰. Coord.: 13°28'07" S, 172°18'34" W. Fauna: Hemiptera;;
- OR 120 Vaimanuia Spring, Pu'a Pu'a, Savai'i, 02-08-1986. Several small and large pools, formed by water flowing from between lava boulders at several places behind the CCCS church. Bottom gravel & coral sand. Waterdepth up to 1 m. Sal. 1 ‰. Coord.: 13°35'00" S, 172°12'15" W. Fauna: Natantia.
- OR 121 Beach 500 m N of Lano, Savai'i, 02-08-1986. Marine interstitia 90-110 cm depth, 100 l. Coarse coral sand. Sal. 32 ‰. Coord.: 13°36'29" S, 172°11'40" W. Fauna: \*
- OR 122 Tuma Spring, Fa'aala, Savai'i (SE), 03-08-1986. Water flowing out from under overhanging lava rock into pool (14 x 5 m), bordered by boulders, in open connection with the sea at HWL. Waterdepth up to 1 m. Strong flow. Bottom rocky with some big boulders, cobbles and pebbles. Thin layer of silty sediment, much leaflitter. Clear, water. Sal. 2 ‰. Coord.: 13°45'10" S, 172°17'16" W. Fauna: \*
- OR 123 Vai Palua, Fa'aala, Savai'i (SE), 03-08-1986. Spring, water flowing from under lava rock on the bottom into small round rockpool (diam. 2 m, depth 1.5 m), connected with larger oval pool, in open connection with the sea at HWL. sal. 2 ‰. Coord.: 13°45'05" S, 172°17'24" W. Fauna: Polychaeta; Isopoda; Amphipoda (1); Ostracoda.

OR 124 Faleata Stream, Savai'i, 03-08-1986. Big, circular pool (diam. 30 m) below waterfall at Letolo Plantation. Waterdepth up to 10 m. Most shrimps collected up to 2 m deep, between stones and leaf litter. Many big boulders, cobbles and stretches of gravel. Leaf litter & branches between the stones. Clear water. Sal. 0 ‰. Coord.: 13° 44'22" S, 172°18'26" W. Fauna: Natantia: Macrobrachium lar (++) ; M. aemulum (++) ; M. latimanus ( ) ; Atyoida spinipes ; A. pilipes ; Caridina weberi ; C. typus.

OR 125 Lalomati Spring, Pitouuu, and is milky-greenish but clear. Bottom fossil coral rubble and gravel on rock. Watert. + depth: 7 + 1.5-3 m. Sal. 2 ‰. Coord.: 19°51'33" S, 157°42'52" W. Fauna: Cyclopidae (Harpacticoida ?); (sub)fossil & recent dead Gastropoda.

UPOLU

OR 105 Piula College, Upolu (NE), 30-07-1986. Cave under Methodist Church W of Falefa. Open pool (20 x 5 x 0.5-1 m), half of it under rock overhang, connected by an underwaterpassage with another room in semi-darkness (30 x 6 x 2-3 m). Side entrance, no visible connections with underground channels. Bottom rocky, with cobbles and gravel near entrance and fine silt at the most inner and deepest side of the cave, in semi-darkness. Clear water. Sal. 0 ‰. Coord.: 13° 51'55" S, 171°35'32" W. Fauna: Natantia: Macrobrachium sp. (not coll.).

OR 106 Apia, Upolu, 30-07-1986. Fisheries Centre. Concrete container of 10 x 2 m, waterdepth 0.5 m. Normally used for culturing shrimps and shells. Collected shrimps have entered by way of the watersupply from a reservoir up-river. Sal. 0 ‰. Coord.: 13°49' S, 171°46' W. Fauna: Natantia: Macrobrachium lar (5); M. sp. (1); Atya spinipes (1);

Caridina weberi.

UPOLU (5-7 August 1986)

OR 126 Bay of Fausaga, Upolu (S), 05-08-1986. Spring flowing from under boulders on HWL, into oval pool of 10 x 4 m, in connection with the bay. Waterdepth 30-40 cm (at LW). Watercolour greenish-whitish. Sal. 5 ‰. Coord.: 13°59'39" S, 171°49'06" W. Fauna: Chironomidae; Amphipoda.

OR 127 Hideaway Hotel, Upolu (S), 06-08-1986. Marine interstitia, depth 60-80 cm, 100 l. Coarse sand, mixture of coral, shell and volcanic sand. Clear water with a lot of sand pumped up. Sal. 32 ‰. Coord.: 14° 00'11" S, 171°47'44" W. Fauna: \*

OR 128 Beach just E of Vavau, Upolu (S), 06-08-1986. Marine interstitia 35-55 cm, 100 l. Coarse sand, mixture of coral, shell and volcanic sand. Clear water with a lot of sand and air pumped up. Sal. 32 ‰ (sea: 33 ‰). Coord.: 14°02' S, 171°32' W. Fauna: \*

OR 129 Vailoa, Upolu, 06-08-1986. Spring from under lava rock overhang, only slowly flowing, into a rectangular pool bordered with boulders (15 x 4 m). Waterdepth 0.5 m. Bottom: cobbles and thin layer of silt, some filamentous algae. Sal. 2 ‰. Coord.: 14°01'57" S, 171°25'49" W.

OR 130 Wharf between Satitua and Malaela, Upolu (E), 06-08-1986. Marine interstitia 80-100 cm, 100 l. Medium coarse coral sand. Dark brown milky water pumped up and a lot of sand. Sal. 30 ‰ (sea: 22 ‰). Coord.: 14°01'01" S, 171°25'29" W. Fauna: \*



- OR 131 Vai Ole Tama, Amaile, 'Upolu (E), 06-08-1986. Spring flowing from under lava rock overhang into oval (rectangular) pool (8 x 30 m), on the coast above HWL. Waterdepth up to 1.5 m. Bottom: Large boulders & cobbles, thin layer of fine silt, on some places more silt and leaf litter. Pool edged with lava boulders. Sal. 0 ‰. Coord.: 13° 59'16" S, 171°25'21" W. Fauna: \*
- OR 132 Letogo Stream, 'Upolu, 07-08-1986. 1500 m upstream from bridge on main road. S of bridge on path. Moderately to fast streaming. Width 6 m, waterdepth 0.2-1 m. Bottom: gravel (40%), cobbles (40%), boulders (20%), leaf litter and branches. Shrimps live mostly between leaf litter. Some smaller Caridinae between rocks. Clear but a bit milky water. Sal. 0 ‰. Coord.: 13°51'23" S, 171°43'24" W. Fauna: Gastropoda: Neritina sp.; Natantia: Caridina serratirostris; C. weberi.
- OR 133 Namo River, 'Upolu, 07-08-1986. 150 m upstream from bridge on coast road. Width 10-20 m, waterdepth up to 50 cm. Riverbed mostly cobbles covered with a thick layer of filamentous green algae, and some gravel banks. Shrimps are living between the roots of long grass growing on the banks of the river. Sal. 0 ‰. Coord.: 13°52'00" S, 171°38'51" W. Fauna: Natantia: Macrobrachiumlar; M. australe; M.sp.; Atyoida pilipes; Caridina serratirostris; C.typus; C. weberi; Atyopsis spinipes.

TONGATAPU (12-14 August 1986)

- OR 134 Anahulu Cave, Tongatapu, 12-08-1986. Stalactite cave complex with several rooms, of which at least 4 are filled with water. Many swifts, Peka peka, live in the cave as well as some bats. Water mostly up to 4 m deep. Bottom rocky with thin layer of sand mixed with silt and gravel at some places. Sal. 2 ‰. Coord.: 21° 11' 58" S, 175° 06' 04" W. Fauna: Macrobrachium cf. lar (observed only); Tanaidacea; Amphipoda: Josephosella hamata Stock, 1988 (NEW SPECIES); Oligochaeta.
- OR 135 Nualei (1.5 km E of Veitongo), Tongatapu, 12-08-1986. Dug out round well in cultivated area (Taro, bananas, coconut), about 150 m N of main road. Well mostly covered with tree trunks and a plate of corrugated iron. Clayish darkbrown soil, somewhat troubled, brownish water. Diam. 1 m. W.table + depth: 1 + 0.5 m. Sal. 0 ‰. Coord.: 21° 10' 40" S, 175° 12' 12" W. Fauna: Coleoptera (); Myriapoda (1); Ostracoda.
- OR 136 Well in cultivated land, 200 m S of Hihifo Road, 3 km W of Nuku'alofa, Tongatapu, 13-08-1986. Round open well, lined with corrugated iron. W.table + depth: 7 + 0.2 m. Diam. 1 m. Darkbrown clayish soil, mixed with weathered limestone boulders. Mosses and ferns on the wall. Sal. 0 ‰. Coord.: 21° 07' 58" S, 175° 14' 07" W. Fauna: \*
- OR 137-142 Wells in the village surrounding Sia'atoutai College, Tongatapu, 13-08-1986. All wells contain clear water.
- OR 137 Square concrete well (1.3 x 1.3 m) next to principals office. Concreted in down to waterlevel. From there limestone rock. Bottom rocky. Covered with wooden boards. Clear water. W.table + depth: 3 + 1 m. Sal. 2 ‰. Coord.: 21° 07' 45" S, 175° 15' 10" W. Fauna: Ostracoda (4).
- OR 138 Square, concrete, open well (0.8 x 0.8 m). Concreted in down to waterlevel, from there limestone rock. Bottom rocky. W.table + depth: 3.3 + 0.2 m. Sal. 1 ‰. Coord.: 21° 07' 45" S, 175° 15' 08" W. Fauna: Culicidae.
- OR 139 Round, open, concrete well of 137-type. W.table + depth: 3.3 + 0.2 m. Diam. 1 m. Last meter limestone rock, bottom rocky, with much leaf litter and some gravel. Sal. 2 ‰. Coord.: 21° 07' 45" S, 175° 15' 08" W. Fauna: Chironomidae; Culicidae; Ostracoda.
- OR 140 Square, concrete well (1 x 1 m), with smaller square opening (0.6 x 0.6 m). W.table + depth: 3 + 0.5 m. Last 0.5 m limestone rock, bottom rocky. Sal. 2 ‰. Coord.: 21° 07' 42" S, 175° 15' 13" W. Fauna: Chironomidae; Culicidae; Ostracoda.
- OR 141 Square, concrete, open well (1 x 1 m). W.table + depth: 3.1 + 0.4 m. Last 1 m limestone rock, bottom rocky with leaf litter & limestone boulders. Sal. 0 ‰. Coord.: 21° 07' 42" S, 175° 15' 19" W. Fauna: Culicidae; Coleoptera; Ostracoda.
- OR 142 Square, open well (0.9 x 0.9 m), in grassy field W of village. Lined with concrete blocks, down to surface of water. Rest cut out in limestone rock. W.table + depth: 2.6 + 0.5 m. Sal. 2 ‰. Coord.: 21° 07' 42" S, 175° 15' 23" W. Fauna: Culicidae; Coleoptera (1); Ostracoda.

- OR 143 Felise (on map Pea), Tongatapu, 14-08-1986. Round well in backyard of house, round corrugated iron lid with square opening. Diam. 1.5 m. W.table + depth: 1.2 + 0.3 m. Blackish water, somewhat troubled. Some leaf litter. Sal. 2 ‰. Coord.: 21°09'48" S, 175°14'09" W. Fauna: Oligochaeta; Gastropoda: Planorbidae; Coleoptera larv. (1); Chironomidae; Culicidae; Ostracoda.
- OR 144 Ha'ateiho, Tongatapu, 14-08-1986. Round well carved out in weathered limestone rock, lined with concrete blocks above the ground, and concrete cover with small square opening (0.3 x 0.4 m). Opening covered with iron lid. Brownish, somewhat troubled water. W.table + depth: 1.7 + 0.8 m. Diam. 1 m. Sal. 1 ‰. Coord.: 21°10'18" S, 175°13'50" W. Fauna: Gastropoda; Pisces; Chironomidae; Cyclopidae.
- OR 145 Lapaha, Tongatapu, 14-08-1986. Octagonal well, in garden of Mr. Sili. E part of village. Upper part constructed of concrete blocks, lower part lined with boulders. W.table + depth: 4.8 + 0.2 m. Diam. 1 m. Branches and leaves in clear water. Sal. 1 ‰. Coord.: 21°10'26" S, 175°06'42" W. Fauna: Chironomidae; Culicidae; Ostracoda.
- OR 146 Lapaka, Tongatapu, 14-08-1986. Round well in grassy garden, opposite of OR 145. Covered with corrugated iron. Diam. 1 m. W.table + depth: 7.5 + 0.1 m. Clear water, with rubbish and leaf litter. Sal. 0 ‰. Coord.: 21°10'26" S, 175°06'47" W. Fauna: Oligochaeta; Ostracoda; Gastropoda: Melanoides sp. (dead).
- OR 147 Talasiu, Tongatapu, 14-08-1986. Shallow well near the coast, dug out in weathered limestone rock. Covered with rusty square iron tank, with round opening and many holes. W.table + depth: 0.7 + 0.3 m. Diam. 1.3 m. Much leaf litter and branches on sand, rock. Sal. 2 ‰. Coord.: 21°10'06" S, 175°06'59" W. Fauna: Cyclopidae; Ostracoda: Stenocypris sp.
- OR 148 Talasiu, Tongatapu, 14-08-1986. Round, open, shallow well, just NW of ancient tomb near coast. Lined in with limestone boulders. Diam. 1.5 m. W.table + depth: 1.2 + 0.4 m. Sal. 3 ‰. Coord.: 21°10'04" S, 175°06'54" W. Fauna: Chironomidae; Heteroptera: Velidae; Ostracoda.
- OR 149 Navutoka, Tongatapu, 14-08-1986. Round, shallow, open well 100 m E of secondary road, parallel to main road. Dug out in weathered limestone. W.table + depth: 0.8 + 0.5 m. Diam. 1 m. Much green filamentous algae, and roots on the sides. Bottom black and white sand on rock, some leaf litter. Sal. ?. Coord.: 21°07'17" S, 175°06'26" W. Fauna: Culicidae; Cyclopidae; Ostracoda: Cypretta sp. (++) , a.o.
- OR 150 Makaunga, Tongatapu, 14-08-1986. Round well in garden of house, covered with tree trunks. Lined with limestone boulders. W.table + depth: 5.5 + 0.1 m. Diam. 1.5 m. Sal. 3 ‰. Coord.: 21°07'59" S, 175°07'12" W. Fauna: Chironomidae; Culicidae; Cyclopidae; Ostracoda: Cypretta sp., Strandesia sp. (?).
- OR 151 Hoi, Tongatapu, 14-08-1986. Round well dug out in clay (2 m) and weathered limestone. W.table + depth: 3.6 + 0.4 m. Diam. 1.2 m. Bottom rocky, with cobbles and gravelly bits of limestone. Covered with tree trunks and corrugated iron., leaving small opening of 0.3 x 0.4 m, covered with drum lid. Sal. 2 ‰. Coord.: 21°09'41" S, 175°06'39" W. Fauna: Culicidae; Cyclopidae; fragments of groundwater Amphipoda.

OR 152 Tatakamotonga, Tongatapu, 14-08-1986. Round well, W of main road, lined with limestone boulders. Concrete tank build on top of well, with a small opening (0.4 x 0.4 m), covered with concrete lid. W.table + depth: 5.5 + 0.6 m. Diam. 1.5 m. Sal. 3 ‰. Coord.: 21 10'39" S, 175 07'24" W. Fauna: Cyclopidae; Ostracoda; Groundwater Amphipoda (fragments).

OR 153 Tatakamotonga, Tongatapu, 14-08-1986. Round well, E of main road, partly lined with limestone boulders. Square concrete enclosure on top (0.8 x 0.8 m), covered with corrugated iron. Diam. 0.9 m. W.table + depth: 5.7 + 0.3 m. Sal. 2 ‰. Coord.: 21 10'53" S, 175 07'20" W. Fauna: Groundwater Amphipoda (fragments); Cyclopidae.

'EUA (16 August 1986)

OR 154 Ana Peka Peka, "Policemans Passage", 'Eua, 16-08-1986. Narrow high cave, probably eroded by stream flowing through. Entrance 6 x 15 m, in a depression in the limestone rock. Vertical walls, with mud, moss and ferns. Long narrow passage up to 2 m wide and about 15 m high. A stream flows through the passage interspersed with rapids and pools of varying depths (up to 60 cm). Bottom boulders, mud and fine gravel. Clear water. Sal. 0 ‰. The stream disappears at the entrance underground and comes out in the open at some distance to the W. Coord.: 21 23'32" S, 175 56'13" W. Fauna: Natantia: Caridina cf. typus; Chironomidae; Odonata.

154 B: Terrestrial Amphipoda (Talitridae), collected on the path near the entrance of the cave. Between leaf litter, twigs, limestone boulders and cobbles.

OR 155 Kenani, 'Eua, 16-08-1986. Small cavern, at the bottom of a deep depression (15 m), surrounded by huge Banyan trees. Circular, diam. 4 m, with mud pile in the middle and at the entrance. Water flows from somewhere out of the rocks into a simitar shaped pool, and streams out of the cavern as a small stream of 0.5 m wide and 5-10 cm deep. Bottom of pool muddy with decayed vegetation. Depth up to 50 cm. Clear water. Sal. 0 ‰. Coord.: 21 23'39" S, 174 55'40" W (appr.). Fauna: Natantia:

SW Beach, 'Eua, 15-08-1986. Dead Gastropoda collected on beach:  
i.e. Melampus bidentatus; M. luteus; Pythia reeveana Pfeiffer, 1853.

