FRESHWATER INVERTEBRATE FAUNA OF NUKU-HIVA ISLAND (FRENCH POLYNESIA): DATA DURING A RAINY SEASON

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ABSTRACT

The streams of Nuku-Hiva Island, Marquesas Archipelago, were sampled during the rainy season in June 1990. The invertebrate fauna was scarce and had a low diversity. Gastropoda and Decapoda accounted for the major part of the biomass. Insects were represented by Simuliidae, Chironomidae and a few Ceratopogonidae, Coleoptera and Zygoptera. Oligochaeta were numerically important. The role of insularity and the effects of hydraulic conditions on this fauna are briefly discussed.

INTRODUCTION

Simulium buissoni Roubaud is a nuisance to men and animals in Nuku-Hiva Island (Pichon, 1970). An important programme (Sechan et al, 1986) will be conducted over the next few years in order to fight against this small insect whose larvae and nymphs live in all flowing waters of this island. As part of this programme, a better knowledge of the freshwater invertebrate fauna is necessary. The June 1990 study was the first step in the investigation of freshwater invertebrate communities in Nuku-Hiva.

NUKU-HIVA ISLAND

Located in the South-Eastern Pacific, the Marquesas Islands (French Polynesia) are high volcanic islands, less than 6 million years old (Brousse et al, 1978).

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Nuku-Hiva (8°56'S, 140° 5'W) is one of the three main islands of the northern group. It is about 30 km long and 15 km in breadth and has a maximum elevation of 1224 m. The island resulted from two volcanic calderas which are still easily visible in the Nuku-Hiva landscape (Fig. 1).

The climate of Marquesas Islands is tropical and oceanic, with average temperatures between 25-27°C near the sea. The rainfall is relatively low, between 700 to 1400 mm y^{-1} at sea level (Cauchard and Inchauspe, 1978). In Nuku-Hiva, the wet season is usually December to August, while September to November is the dry season. The variability of the rainfall, however, is important and the dry season may extend until March or even later.

This climate enables the development of an important hydrographic structure. Two main streams, the Hakaui River and the Taipivai River (Fig. 1) have more than 650 l s^{-1} discharge at their mouths during low flow periods. Some other rivers are medium-sized and permanent, for example, the Hatiheu River (about 190 l s^{-1}), while a huge number of small streams appear during the rainy season.

METHODS

Nuku-Hiva freshwater invertebrate fauna was sampled using a hand net (300 m mesh, 10 x 20 cm frame, 40 cm depth). Each hand net sample comprised a 10-minute collection using both kicking and sweeping techniques. All the available biotopes within one station were sampled in proportion to their occurrence. All the samples were collected by the same person (O. Fossati). Eighteen samples have been taken this way: 4 in non-permanent streams, 4 in small, 6 in medium and 4 in large permanent rivers. Due to the sampling method, the small cascades were not sampled. Table 1 gives the main characteristics of the sampling sites which are located on Figure 2.

In addition to these samples, hand catches of Mollusca were made in June 1990 and the Decapoda were collected in April 1991 using small keep-nets made with mineral water bottles (Danigo, in preparation).

RESULTS

Some groups are still under examination and the data presented here are preliminary. Twenty nine taxa were collected (Table 2), mainly Diptera (9),

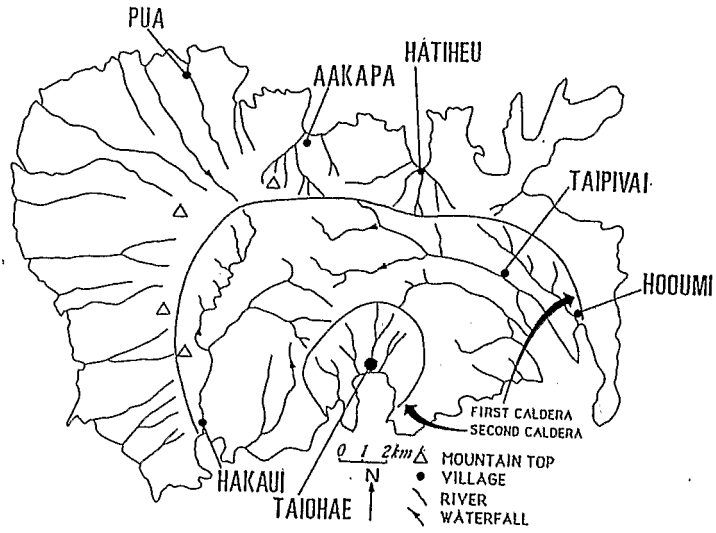


Fig. 1 : Geomorphologic features of Nuku-Hiva : localisation of the two volcanic calderas and main streams.

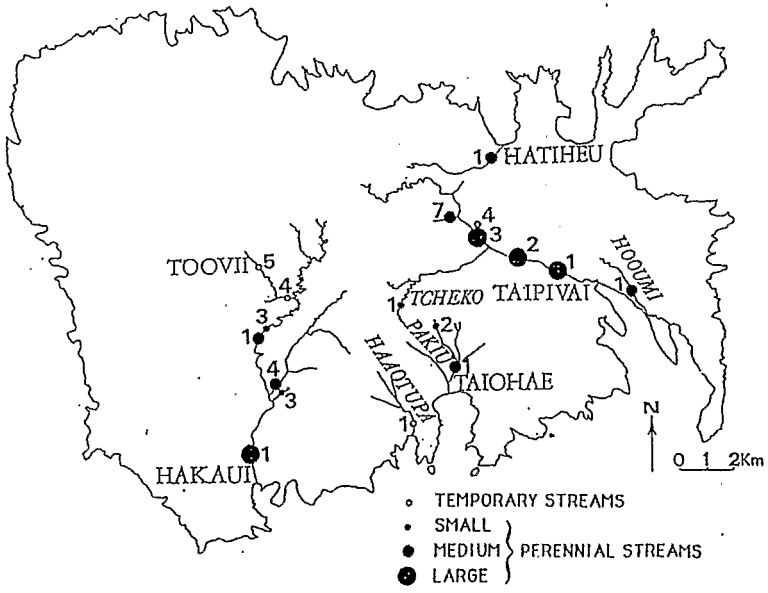


Fig. 2 · Sampling sites

Table 1: Main physical characteristics of the sampling sites.

RIVER	SITE	WIDTH	TYPE	DATE	WATER LEVEL	COLOR	DEPTH (cm)	SPEED
TOOYII	5	small	temporary	16/6	medium	brownish	10-20	medium
	4	small	temporary	16/6	low	brownish	0-50	slow-fast
	3	small	perennial	21/6	low	clear	0-20	medium
	1	medium	perennial	21/6	medium	troubled	0-30	very fast
HAKAUI	4	small	perennial	22/6	medium	little troubled	0-20	fast
	3	medium	perennial	22/6	medium	little troubled	10-50	fast-very fast
	1	large	perennial	22/6	medium	little troubled	10-50	nul-low
HAAOTUPA	1	small	temporary	10/6	low	clear	0-30	nul-low
PAKIU	2	small	perennial	9/6	low	clear	0-30	fast-very fast
	1	medium	perennial	20/6	low	clear	0-30	fast
TCHEKO	1	small	perennial	17/6	high	troubled	10-30	fast
TAIPIYAI	7	medium	perennial	19/6	high	troubled	20-60	very fast
	4	small	temporary	13/6	low	clear	0-10	slow
	3	large	perennial	12/6	low	clear	0-50	slow-fast
	2	large	perennial	11/6	low	clear	0-40	medium fast
	1	large	perennial	12/6	low	clear	0-30	fast-very fast
HATIHEU	1	medium	perennial	20/6	medium	little troubled	10-30	fast
HOOUMI	1	medium	perennial	19/6	high	troubled	0-30	fast-very fast

Gastropoda (6) and Decapoda (5). The more numerous taxa probably consist of more than one species: Decapoda larvae (24% of individuals collected), Orthocladiinae larve (21%), Oligochaeta (13%) and Simuliidae larvae (9%). The major part of the biomass (not measured for all the samples) was clearly represented by the Mollusca and the Decapoda.

The data were studied using a multi-factor-analysis (Factorial Correspondence Analysis). This analysis shows that the communities are quite homogeneous within the island. The factorial map (Fig. 3) groups the more numerous invertebrates such as Simuliidae, Copepoda and Oligochaeta in the small permanent streams (F1+). It differentiates the larger rivers, the presence of roots (F1-,F2+), where numerous *Neritina canalis, Neritilia rubida* (Gastropoda) and *Atyoida pilipes* (Decapoda) were found, and the presence of small organic particles (F1-, F2-) with *Melanoides tuberculata* (Gastropoda) as the most characteristic invertebrate.

This general survey shows the poverty of the entomological fauna: no Plecoptera, Trichoptera or Ephemeroptera. The more important groups collected include the invertebrates keyed to species, i.e., the gastropod Mollusca and the decapod Crustacea.

GASTROPODA

Gastropoda were relatively numerous and widespread in Nuku-Hiva streams. Six of the 7 species quoted by Marquet (1988) were found. The snails were more abundant in permanent streams. *Melanoides tuberculata* Muller was the most widespread Gastropod (Fig. 4). It is a cosmopolitan species which probably arrived accidentally in recent times in Pacific Islands (Haynes, 1990). *Neritina canalis* Sowerby (Fig. 4) and *Neritilia rubida* Pease are two Pacific Neritidae inhabiting fast flowing streams and rivers, with coarse rocky subtrates (Haynes, 1990).

Septaria porcellana Linnaeus live throughout the system from the cascades to the lower courses of streams (Haynes, 1990). Smaller individuals were found near the sea and larger animals in the middle section of the Taipivai River, probably in relation to a brackish or even marine development of veliger larvae. *Clithon spinosus* Budgin was collected at the river mouths (Fig. 4); it is known from Tahiti and Fiji (Haynes, 1988). The large shells of these two species were often broken, suggesting hydraulic disturbances due to water level and substrate instability within these rivers. Only one *Physa acuta*

Draparnaud was found.

The number of endemic species of freshwater Gastropoda in the South Pacific Islands is low. Their wide distributions may be caused by accidental introductions for *Melanoides tuberculata* and possibly by migrations of veliger larvae for other Neritids and Thiarids (Haynes, 1990). The distance of Nuku-Hiva from the continents, and its small size explain the low diversity of invertebrates on this island.

DECAPODA

Four species of *Macrobrachium*, palaemonidae, are present on the island, three of them being widespread (Fig. 5). *M. lar* Fabricius, *M. latimanus* Von Martens and *M. australe* Guerin have large Indo-Pacific distributions (Holthuis, 1980). These species are fished and eaten in most countries where they occur. In French Polynesia, they are known as "chevrettes" (Grand, 1972; Marquet, 1988) and, especially in the Marquesas Islands, are included in some famous culinary specialities.

Macrobrachium lar was present in all the sampling sites, except some non-permanent streams and the Tcheko River (Fig. 5). *M. australe* was usually found in lower to middle courses while *M. latimanus* was more abundant at high altitudes (Fig. 5).

The fourth *Macrobrachium* species, *M. lepidactyloides* De Man, is known from Malaysia and Fiji (Holthuis, 1980). Its taxonomic status is not clear and the few individuals collected in Nuku-Hiva may belong to a new species or subspecies (Holthuis, personal communication).

The small atyid species, *Atyoida pilipes* Newport, was caught at all sampling stations (Fig. 5). Its distribution does not seem to depend on the size or on the permanence of the stream. This species was peculiarly numerous where abundant small roots were found in the water.

DISCUSSION AND CONCLUSIONS

The rivers of Nuku-Hiva, even perennial ones, have low discharges, except for the Taipivai and Hakaui Rivers. After heavy rain these streams quickly become flooded with muddy water which rapidly increases the elevation of the water level and changes the colour of the water. The water level falls

Table 2 : Faunistic results of hand-net samples (1 = 1 individual, 2 = 2 or 3 individuals, 3 = 4 to 7 individuals, 4 = 8 to 15 individuals ...)

RIVER	TO	TO	TO	TO	HI	HI	HI	HA	PA	PA	TC	TA	TA	TA	TA	TA	HU	HO	Abbr	TOT.	%
SITE	5	4	3	1	4	3	1	1	2	1	1	7	4	3	2	1	1	1			
Nematoda		1	1	2					2		2			1					Ne	10	+
Oligochaeta	2	7	3	4	5	4	3	5	6		5	5		5	6	4	3	5	Ol	358	13
Melanoides tuberculata			1	4	2	3				7	2	1	7	3	5	3	3	2	Me	253	9
Neritina canalis						2				1			1			4	6	4	Nc	65	2
Neritilia rubida																	5		Nr	30	1
Septaria porcellana														2					Se	2	+
Clithon spinosus							3												Cs	4	+
Physa acuta													1						Ph	1	+
Copepoda		3	3	6	2		1	3	4		7	3		2	2			1	Cp	155	6
Ostracoda	1	1							2			2							Os	7	+
Amphipoda	1	4																	Am	15	1
Isopoda	2								2				1	1				2	Is	8	+
Decapoda larvae			4	3	3	2	3	2	5	1	3	7	7	1	8	8	5	6	LM	649	24
Atyoida pilipes			2		4	4			4	2		2	4	2	4	3	7		At	179	7
Macrobrachium australe															3				Ma	5	+
Macrobrachium lar						1		2		1				1	1		1		Ml	8	+
Macrobrachium latimanus			1																Ms	1	+
Collembola	2												2					2	Cb	7	+
Orthocladiinae larvae	6	4	6		7	4			5		5	5	2	7	7	8	3	4	Or	576	21
Tanypodinae larvae						2			3		4			3					Ta	20	1
Chironomidae Nymphs	2				2	1		1	2		2			1	4	3	4		Ch	37	1
Simulidae larvae	4	2	1	2		5			8		2	5	2	1					Sl	250	9
Simulidae Nymphs						1			3										SN	7	+
Ceratopogonidae larvae					2						1	2							Cl	6	+
Ceratopogonidae Nymphs					3				2			4				3	1		CN	22	1
Diptera larvae 1		5							2										D1	19	1
Diptera larvae 2									2		2	2	1	1		2	1	3	D2	18	1
Coleoptera		1			1						2	1		1					Co	6	+
Odonata larvae			1			4			3		4	2	2	1	2		1	2	Od	33	1
TOTAL OF INDIVIDUALS	64	113	60	72	124	81	13	36	343	84	143	167	197	107	369	452	221	105		2751	100
NUMBER OF TAXA	8	9	10	6	10	12	4	5	16	5	13	13	11	16	10	9	12	10			

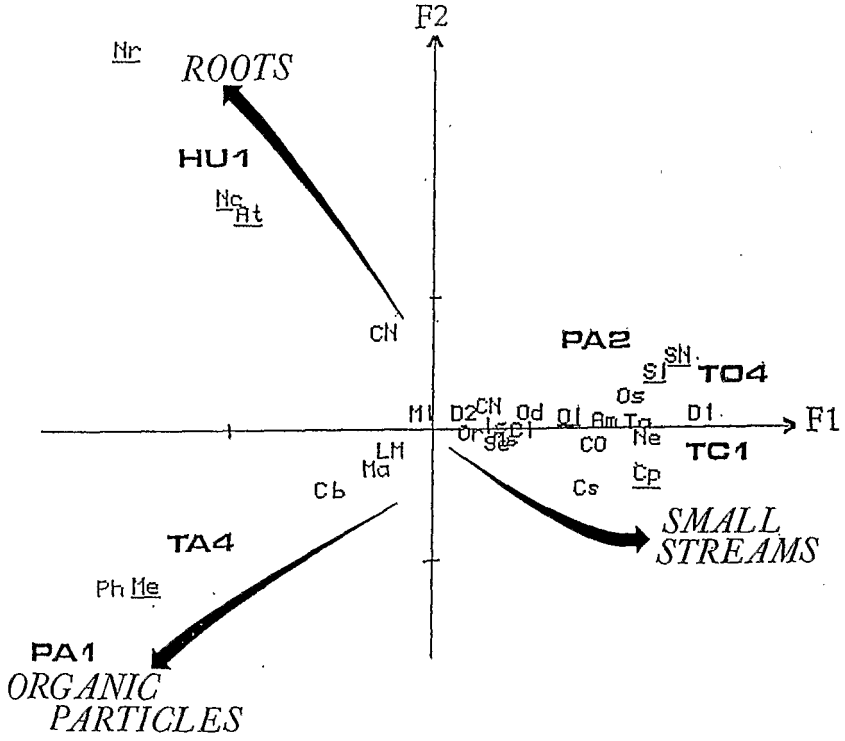
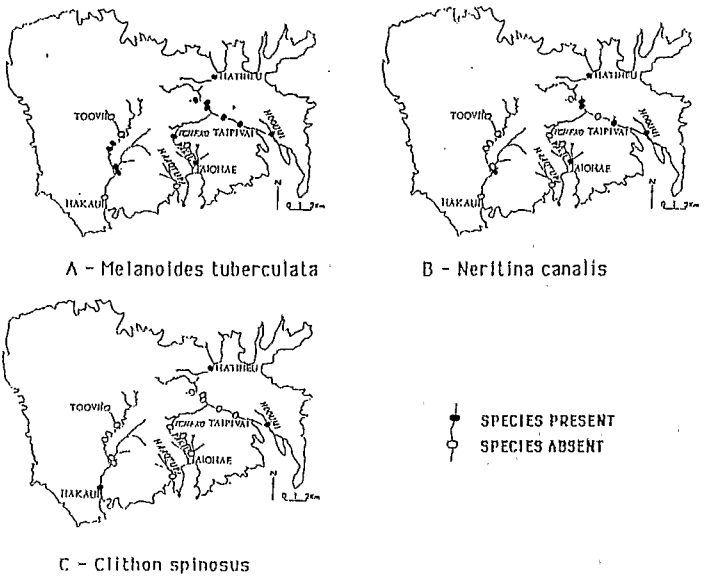


Fig. 3 - F1 x F2 factorial map of the invertebrate hand-net samples (the data and the signification of the abbreviations are in Tab. II). The more contributive taxa are underlined (At : Atyoida pilipes, Cp : Copepoda, Me : Melanoides tuberculata, Nc : Neritina canalis, Nr : Neritilia rubida, Ol : Oligochaeta, SL : Simuliidae Larvae, SN : Simuliidae Nymphs). The position of sites with absolute contributions to one of the axis superior to 0,5% are noted in large letters (HU : Hatiheu, PA : Pakiu, TA : Taipivai, TC : Tcheko, TO : Toovii).

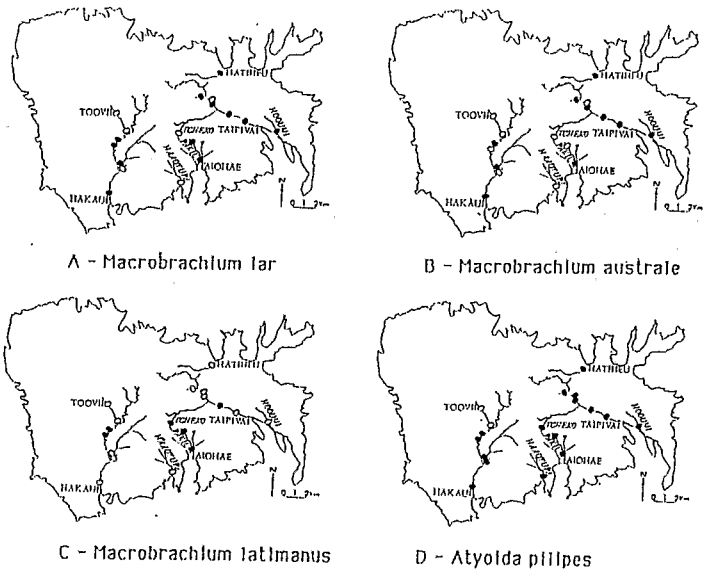


A - Melanoides tuberculata

B - Neritina canalis

C - Clithon spinosus

Fig. 4 : Distributions of the commonest mollusc species.



A - Macrobrachium lar

B - Macrobrachium australe

C - Macrobrachium latimanus

D - Atyoida pilipes

Fig. 5 : Distributions of Decapoda species.

quickly also. This discharge instability, together with the substrate instability, does not favour the development of abundant invertebrate communities. Some motile animals, like decapods, may escape the flood and find shelter near the banks, but each flood is likely to kill a huge number of invertebrates. The number and the importance of floods during the year could explain the scarcity of the freshwater fauna.

The low diversity of the Marquesan fauna has often been noted (Adamson, 1935; Mumford, 1936; Perrault, 1978; Marquet, 1988). It is a consequence of the small size of the islands (330 km2) and of the great distances from the continents. The Marquesas Islands form the most isolated archipelago in the world (4800 km from North America, 6000 km from South America, 7000 km from Australia and 9000 km from the Asian continent). Even the nearest Marquesan island is more than 40 km away from Nuku-Hiva. The low faunistic diversity observed on Nuku-Hiva island seems to fit the MacArthur and Wilson island biogeography theory (MacArthur and Wilson, 1967). A good discussion of this subject is found, for the Pacific freshwater snails, in Haynes (1900) and for Polynesian simuliids in Craig (1983).

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