

## A NEW SAMPLING METHOD FOR FRESHWATER SHRIMPS

Odile FOSSATI\*, Hélène DANIGO\*

\*ORSTOM / ITRMLM B.P. 30, Papeete, TAHITI, French Polynesia

### SUMMARY

Macrobrachium (*Palaemonidae*, Decapoda, Crustacea) communities have been sampled in the rivers of Nuku-Hiva Island (French Polynesia) using small traps made with mineral water bottles. Experiments were made to test the effect of trap density in a pool, the effect of sampling duration, and to determine the trap selectivity in terms of species and size.

The number of shrimps caught was neither related to the density of traps, nor to the duration of the experiment. The main limitation of this passive catch-trap was in relation to the shrimp size. The sampling efficiency is estimated to about 50%.

**KEY-WORDS :** Decapoda, Communities, sampling, Tahiti

### RÉSUMÉ

Les peuplements de *Macrobrachium* (*Palaemonidae*, Decapoda, Crustacea) ont été étudiés dans l'île de Nuku-Hiva (Polynésie Française) à l'aide de petites nasses faites à partir de bouteilles d'eau minérale. Différentes expériences ont été réalisées pour tester l'effet de la densité des nasses dans une vasque, l'effet de la durée d'échantillonnage, et pour essayer d'estimer la sélectivité des nasses en terme d'espèce et de taille.

Aucune relation n'est apparue entre le nombre de crustacés capturés et la densité des nasses ou la durée de la capture. La principale limitation de cette méthode de capture passive apparaît liée à la taille des individus. L'efficacité de l'échantillonnage a été estimé à environ 50 %.

**MOTS CLÉS :** Décapodes, peuplements, échantillonnage, Tahiti

### INTRODUCTION

Nuku-Hiva is a small island located in the middle of the Pacific Ocean (8°56'S-140°5'W, Marquesas Island, French Polynesia). The rivers of the island will be treated with an insecticid for a tentative eradication of the blackfly, *Simulium buissoni*, which is a scourge for local human populations and a serious problem for tourism development (Séchan *et al.* in print). The only non-target species of economic importance is *Macrobrachium lar*, a freshwater shrimp (Crustacea, Decapoda) commonly fished and a local culinary speciality (Fossati, Gibon, in print). A reliable sampling method for freshwater macrocrustacea had first to be established in order to monitor the *Macrobrachium* communities during and after the treatment. Nuku-Hiva Island (340 km<sup>2</sup>) is a high volcanic island, less than 6 million years old with tropical-humid

climate (Brousse *et al.* 1978). The two mains rivers have more than 600 l/s discharge at sea level during dry season and a huge number of streams have a minimum discharge between 5 to 100 l/s (minimum estimate: 473 km of riverbed). Because of steep slopes, these streams are very sensitive to rainfalls which induce rapid elevations of water level and production of turbid waters. The substrates of the rivers are generally very coarse, dominated with boulders. The rivers are torrential, with steep riverbeds often broken by small pools where finer substrate (sand) can be found (Fossati, Gibon, in print).

The three dominant species of *Macrobrachium* found in Nuku-Hiva have a different spatial distribution. *M. latimanus* dominates upstream of waterfalls and in upper locations, *M. australe* is found in the lower parts of the rivers. *M. lar* can be

*M. acmulum* is found in Tahiti, in the downstream reaches, instead of *M. australe* (Marquet 1988). *Macrobrachium* species are more abundant in small pools (usually less than 50 cm depth), where water velocity is low, than in faster flowing water.

Large traps are commonly used to sample *Macrobrachium* populations (e.g. Lévêque 1974 ; Horne-Beisser 1977 ; Anderson 1983 ; Odinetz-Collart 1987 ; Mashoko 1990), but cannot be used in small pools. Kubota (1972), Gillet (1983), Schonbee *et al.* (1988) and Marquet (1988) used electric fishing. This method requires a special equipment and can not easily be used by one person alone. Moreover, unlike many fish species, *Macrobrachium* are not attracted by the anode. When shocked, they jump in any direction, then sink in the water, between rocks where they are difficult to catch.

Prawns are fished, in Nuku-Hiva, as in Tahiti (Grand 1972), during the night, using a light to immobilize the animal, and a small harpoon to catch it. This method damages the prawn and allows only the larger individuals to be caught. Smaller specimens are fished by women, who disturb the water in order to make the shrimps escape and they are caught in a piece of material used as a net, or on the riverside, with the hand, or a small harpoon. Children, as a game, fish shrimps with a small piece of string ("lasso"). These last methods can not be used for any quantitative or even semi-quantitative sampling.

The new method to be developed had to be inexpensive, easy to use by one person alone and suitable for the type of habitats found in the rivers of Nuku-Hiva.

## SAMPLING METHODS AND SAMPLING SITES

Plastic mineral water bottles were used by cutting the upper part and inverting it inside the other part in order to prevent the shrimps escaping from the trap (fig. 1). The 1.5 l bottles used are 22.2 cm high and 8 cm diameter with an aperture of 2.8 cm diameter. Round bottles are easier to use than square one. The bottles were ballasted with a stone, then laid on the bottom of the river before sunset and picked up the following morning. After identification and measurement, the shrimps were immediately released with little apparent damage. The first use of this method gave useful results and showed that shrimps were able to be caught without any bait.

Experiments were conducted, without bait, in Nuku-Hiva, in April-May 1991, during a very stable low-discharge period. More than 1500 individuals were caught, 46% *M. australe*, 36% *M. lar* and 18% *M. latimanus*, in 31 sampling sites. (fig.2). Electricity fishings were done in three rivers, after removal of the traps, during September 1992.

A more precise comparison between traps and electricity fishing was conducted in a pool of the Papenoo River (Tahiti,

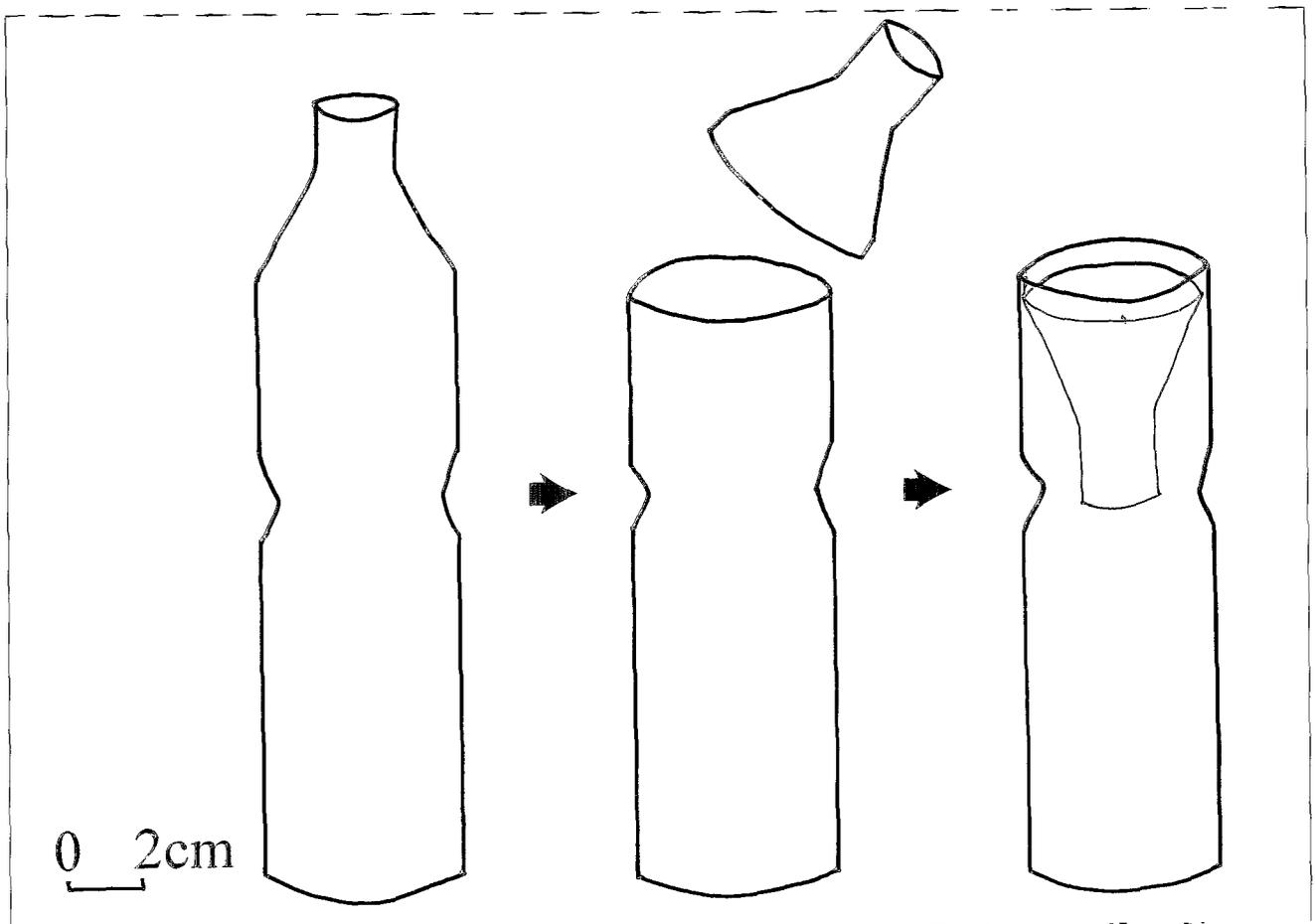


Figure 1: How to make a trap with a mineral water bottle.

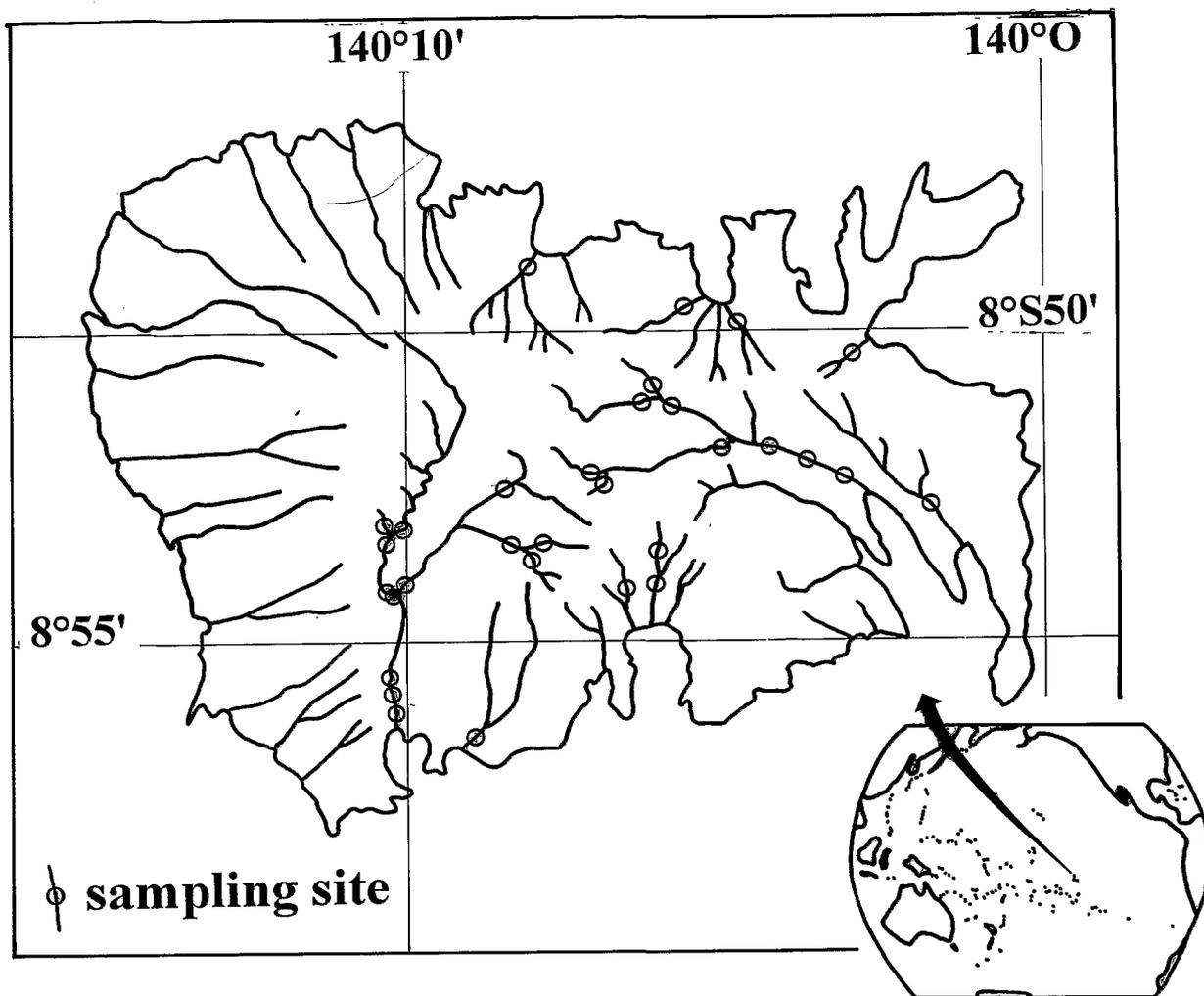


Figure 2: Map of Nuku-Hiva Island with sampling sites indicated.

August 1991). The 5 m<sup>2</sup> pool chosen was shallow, with regular bottom and the water was very clear and still in the pool.

## RESULTS

### Trapping susceptibility

Percentages of individuals of each sex show that, except for *M. latimanus* (51% males), more males are caught than females (*M. australe*: 79% males; *M. lar*: 69% males). As the males grow bigger than females, this might not be related only to the trapping device. Hence, although the traps are a passive capturing device, the trapping success may involve the behaviour of the shrimps.

Comparisons between traps and electricity fishing confirm that males are more numerous than females: 82 ± 12% and 73 ± 7% for *M. australe*, respectively in the traps and with electricity fishing; 76 ± 7% and 60 ± 11% for *M. lar*.

### Efficiency of the sampling

A pool was sampled with different bottle densities. The river had an estimated discharge of 3 l/s. The surface of the pool

was 6.72 m<sup>2</sup> and its depth less than 40 cm. *M. lar* dominated the community. Mortality and number of animals per bottle were lower with higher bottle density (more than 5/m<sup>2</sup>) but the total number of shrimps caught was not affected by the density of the bottles, from 4 to 10/m<sup>2</sup> (tabl. I).

Some bottles were laid for two nights in order to compare trapping with a one night sampling (same pool as above, tabl. II). Mortality and number of shrimps caught by traps laid for one or two nights were not statistically different (Student T = 0.51 and 0.86; ddl = 104).

In the Papenoo River (Tahiti), the traps caught 39% (*M. aemulum*), 50% (*M. lar*), and 79% (*M. latimanus*) of the *Macrobrachium* present. The shrimps collected by electric fishing were often damaged by autotomy of the claws (reaction to the electric shock), or damaged during capture, while the shrimps caught in the traps were in good condition.

## DISCUSSION

The biggest shrimps fished were, respectively, 92, 111 and 105 mm long. Compared to the data given by Holthuis (1980: 105, 181 and 125 mm), these figures show that the larger indi

Table I: Shrimps caught in traps laid for one or two nights.

	1 NIGHT	2 NIGHT
<i>Macrobrachium</i> per trap	3.25 + 2.42	2.70 + 3.75
dead <i>Macrobrachium</i> per trap	0.40 + 0.99	0.41 + 1.0

Table II: Mortalities and numbers of shrimps for different densities of trap in the same pool.

Number of traps	28	30	39	63
Trap density	4.2	4.5	5.8	9.4
date (04-1992)	19	17	30	20
Empty traps	0	2	3	11
Total <i>Macrobrachium</i>	89	105	88	111
<i>Macrobrachium</i> per trap	3.2 + 2.1	3.5 + 1.8	2.3 + 1.7	1.8 + 1.4
dead <i>Macrobrachium</i>	14	16	3	3
Mortality (%)	15.7	15.2	3.4	2.7

viduals are not caught by the traps, especially for *M. lar* which is the largest species. This selectivity with regard to the size of Crustacea is related to the diameter of the aperture: the larger *Macrobrachium* are unable to go into the bottle.

Another selectivity may be related to behaviour of the shrimps. The dominant males, exploring their territory may be more active and more able to visit the traps. On the other hand, a large shrimp was seen on the top of a bottle and behaviourally stopping other animals from going inside. The stone ballast in the bottle might induce the shrimps, when visiting their home range, or searching for food, to go into the bottle and so act as a bait.

Some *Macrobrachium* populations are known to be dominated by females (*M. ohione*, Anderson 1983; *M. amazonicum*, Odinetz-Collart 1991). Marquesan populations were dominated by males, as has been noted in other polynesian islands (Marquet 1988). As males, which grow bigger than females, are probably more exploited, the disequilibrium observed between sexes might be even greater in non-exploited populations.

Observations have been made of *Macrobrachium* escaping from the traps. The traps do not act as a concentrating device. The number caught inside seems to be in equilibrium with the number outside. This is attested to by the fact that when more bottles are laid, the number of individuals in each trap decreases and the total number of shrimps captured does not increase. Even at the highest bottle density (904 bottles/m<sup>2</sup>), which left little space between the bottles, shrimps have been seen outside the bottles after the night sampling.

Mortality within the traps remains low, but can be observed when shrimps are numerous in one trap and water velocity is low. This may be related to a disappearance of oxygen and could be avoided by making holes in the bottom of the bottles to improve water circulation.

Another limitation of this method is related to current velocity. It is impossible to keep bottles in the fast flowing riffles. When bottles have been laid prior to a flood, most have disappeared.

## CONCLUSIONS

The reproductibility of the sampling is good and it is possible to collect living and non-damaged animals.

It is necessary to go to the rivers twice, to lay and to pick up the traps, and they cannot be used during flooding. Otherwise, the bottles are inexpensive, easy to use and give consistent date. They seem to be the best method to sample *Macrobrachium* communities in the small, torrential, coarse-substrate rivers of Nuku-Hiva Island.

These traps are a passive sampling method and not a concentrating device. More experiments are needed to precise the part of the communities sampled and to describe fully different aspects related to shrimps behaviour: escaping from the traps, catchability in relation to daytime or to moon cycle..

## ACKNOWLEDGEMENTS

We thank P. Bach, D. Craig, J. Fossati and S. Loncke for helpful suggestions on the manuscript. This work benefited from the help of the *Simulium buissoni* control program in Nuku-Hiva.

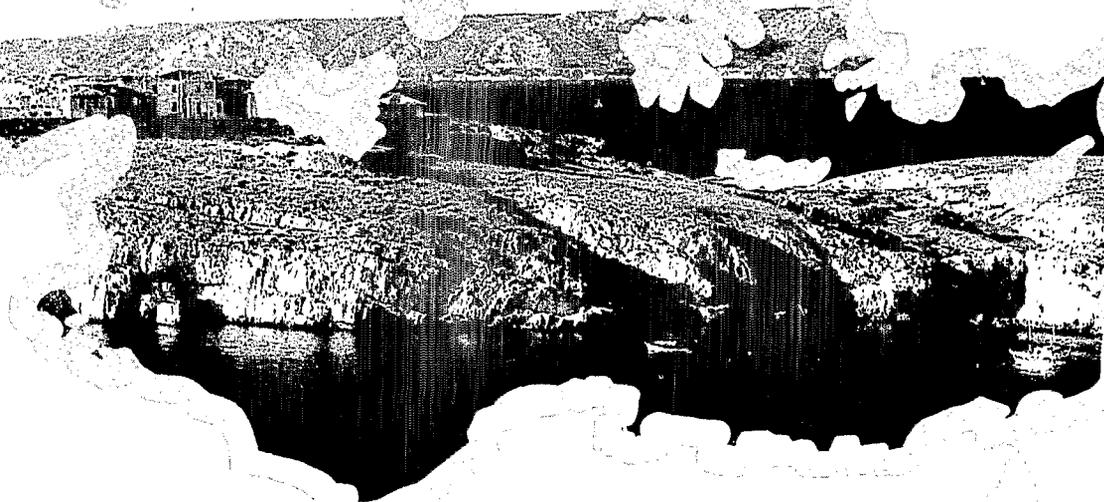
## REFERENCES

- Anderson G., 1983. Observations on the distribution and movements of *Macrobrachium ohione* (Smith, 1874) in the Pascagoula River estuary, Jackson County, Mississippi, USA (Decapoda, Palaemonidae). *Crustaceana* 44, 123-140.
- Fossati O., Gibon F.M., 1992. Freshwater invertebrate fauna of Nuku-Hiva Island (French Polynesian): first data during a rainy season. *Pac. Sci. Bull.*, 12, 45-56.

- Fossati O., Wendling B., Danigo A.H.**, in print. Freshwater invertebrate fauna of Nuku-Hiva Island (French Polynesia): comparison between wet and dry season. *Verh. int. Verein Limmol.*
- Gillet C.**, 1983. Les peuplements de poissons et de crevettes des rivières de la Guadeloupe: quelques données sur le biologie, la reproduction, la répartition des espèces. *Rev. Hydrobiol. Trop.* 16 : 327-340.
- Grand S.**, 1972. *Contribution à l'étude préliminaire sur la biologie, la systématique et l'écologie des Macrobrachium (Palaemonidae) de Tahiti.* Thèse Univ. Montpellier, 79 pp.
- Holthuis L. B.**, 1980. Shrimps and prawns of the world. An annotated catalogue of species of interest to fisheries. *FAO Species Catalogue*, vol. 1 FAO Fisheries Synopsis, 125, 271 pp.
- Horne F., Beisser S.**, 1977. Distribution of river shrimp in the Guadalupe and San Marcos rivers of Central Texas, USA (Decapoda, Caridea). *Crustaceana* 33 : 56-60.
- Kubota W.T.**, 1972. *The biology of an introduced prawn (Macrobrachium lar) in Kahana stream.* PHD, Univ. Hawaii,
- Lévêque C.**, 1974. Crevettes d'eau douce de la Guadeloupe (Atyidae et Palaemonidae). *Cah. ORSTOM, Ser. Hydrobiol.* 8 : 41-49.
- Marquet G.**, 1988. *Les eaux intérieures de la Polynésie Française: principales caractéristiques physiques, chimiques et biologiques.* Thèse Doct. Univ. Paris VI, 188 pp.
- Mashiko K.**, 1990. Diversified egg and clutch size among local populations of the freshwater prawn *Macrobrachium nipponense* De Haan. *J. Crust Biol.* 10 : 306-314.
- Schonbee H.J., Cort M., Ferreira J.T., Wisser J.G.J.**, 1988. Species records of the river prawn *Macrobrachium* (Decapoda, Natantia, Palaemonidae) from Labe Cubhu, Zululand, Natal. *Water SA* 15 : 49-51.
- Séchan Y., Fossati O., Danigo A.H., Loncke S., Guillet P.**, in print. *Presentation of the control program of Simulium buissoni in Nuku-Hiva (French Polynesia).* *Verh. int. Verein. Limmol.*

DA 10  
Pole 3

# MESOGEE



BULLETIN  
DU MUSEUM  
D'HISTOIRE  
NATURELLE  
DE MARSEILLE

VOLUME 54.1995



010011410

Fonds Documentaire ORSTOM

Cote: ~~B\*11410~~ Ex: 1  
B\*11410