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THE SYSTEMATICS OF THE NEW ZEALAND SPECIES OF POTAMOPYRGUS  
(MOLLUSCA : HYDROBIIDAE), AND STUDIES ON THE BIOLOGY OF  
POTAMOPYRGUS ANTIPODUM

A thesis  
presented in partial fulfilment  
of the requirements for the degree of  
Doctor of Philosophy in Zoology  
at Massey University

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1968

### ABSTRACT

This investigation has shown that only three species of Potamopyrgus Stimpson can be recognized from New Zealand, compared with the six species and three subspecies recognized by Suter (1913). The species are, P. antipodum Gray 1843, P. pupoides Hutton 1882, and P. estuarinus n. sp. P. dawbini Powell 1955 from the Auckland Islands is probably referable to P. antipodum, but the position of (?) P. melvilli (Hedley 1916) from the Kermadec Islands has not been determined. The European species P. jenkinsi (Smith 1889) cannot be separated from P. antipodum on morphological or anatomical grounds and may also be referable to that species. All species now placed in Fluvio pupa Pilsbry 1911 should probably be referred to Potamopyrgus.

P. estuarinus and P. pupoides are both smooth-shelled, bisexual, non-ovoviviparous and confined to brackish water. P. antipodum is highly variable in shell size, shape and ornamentation, inhabits fresh and brackish water, is ovoviviparous, and populations may consist entirely of parthenogenetic females, or contain variable numbers of sexually functional males. Rearing of snails in the laboratory has shown that snails do not necessarily breed true with respect to shell ornamentation, and that shell shape and ornamentation is not determined primarily by environmental factors.

The shell of P. estuarinus cannot be distinguished from that of some P. antipodum but P. pupoides may be readily identified using shell characters alone. No significant interspecific differences in operculum, external morphology,

body pigmentation or structure of the male reproductive system are found but P. pupoides possesses minor radular differences, and P. antipodum differs in the condition of the female reproductive system. The diploid (2n) chromosome number of all three species is 24.

Qualitative paper chromatography of crude foot muscle and mantle edge extracts, and quantitative ion-exchange chromatography of shell periostracal protein have disclosed no important biochemical differences between species.

P. antipodum is widely distributed in fresh waters and no clear relationship between shell shape and ornamentation, and different kinds of habitat have been found. P. estuarinus has a fairly restricted brackish water habitat and is frequently found near river mouths in harbours where snails may regularly be exposed to the air for part of each tide cycle. P. pupoides is also restricted to brackish water but normally remains fully aquatic at all times. Experimental studies on salinity relationships, habitat selection and the effects of desiccation have demonstrated important differences in the environmental relationships of the three species which can be correlated with their distributions.

Life history and population studies made in three populations of P. antipodum (two ponds and a stream) over a 13-14 month period have shown that reproduction occurs throughout the year with peak activity in spring and summer. Generation time as indicated by laboratory rearing of snails is 9-12 months. Population age structures differed markedly between ponds and stream and reflected differences in the



physical environments of the two habitats. Distribution, occurrence in drift and effects of floods were examined in the stream. Snails were generally most abundant in places sheltered from the main current or among vegetation, and large numbers were present within mats of willow roots. P. antipodum is a regular member of the drift fauna and floods have an important role in regulating population age structure.

The distribution of P. antipodum in thermal waters was also investigated, and experimental work indicates that high water temperature is probably the most important factor limiting distribution. The maximum temperature at which snails were found in the field, 28°C, is also the temperature at which activity ceases and the snails enter a comatose state.

Finally, a study has been made of the parasites of Potamopyrgus. An unidentified protozoan (Sporozoa : Porosporidae), occurring in an encysted state, is the most important internal parasite with infection rates as high as 86% having been recorded. The larvae of 13 species of Trematoda were identified and briefly described and their rates of infection determined. The monostome cercariae are the most important group of parasitic trematodes. The commensal oligochaete Chaetogaster limnaei limnaei was found in association with P. antipodum in Lake Pupuke, Auckland, and was observed to be predacious on embryonic snails.

## PREFACE

A thorough investigation of the systematics of the New Zealand species of Potamoopyrgus has long been overdue and is the main aim of this thesis. Comparative examinations of morphological, anatomical and biochemical factors, as well as environmental relationships have been made in the search for species differences and in order to describe the extent of inter- and intraspecific variation within the component species. All factors have been examined primarily for any systematic information they may yield rather than to elucidate structure and function for its own sake.

In the systematic section of this thesis the conclusions reached as a result of the study are presented before the detailed account of the investigations leading to their formulation. This has permitted a more cohesive account to be written with the emphasis being placed on interspecific differences.

The secondary aim of this work has been to examine some aspects of the biology of the freshwater species P. antipodum. This has involved studies of the life history and population dynamics in three populations, field and experimental work on thermal relations, and an examination of the snails' parasites and their rates of infection.

### ACKNOWLEDGMENTS

I am pleased to acknowledge and thank those people who have assisted me during the course of this work, in particular Dr. T.J. Brown for his interest and criticism throughout. The advice and criticism of Dr. W.C. Clark and Mr. L. Gurr of the Zoology Department, Massey University, and Dr. R.K. Dell and Mr. W.F. Ponder of the Dominion Museum, Wellington, has also been greatly appreciated, as has the help given by Dr. G.G. Midwinter, Department of Chemistry and Biochemistry, Massey University, with biochemical analyses, and Miss Pauline Campbell and Mr. D. Greenwood for technical assistance.

Dr. Dell and Mr. Ponder have kindly allowed me to examine material in the Dominion Museum collections and have introduced me to much relevant literature. Collections of snails have been made for me by Messrs. John McLean of Auckland and Ian McLellan of Westport. Mr. Tom Warwick of the University of Edinburgh has sent me living material of P. jenkinsi, and Mrs. Shirley Rhind of the Zoology Department, University of Canterbury, has lent me trematode material. It gives me pleasure to acknowledge the help given by all these people.

All figures in this thesis were reproduced by the Massey University, Central Photographic Unit.



	Page
1.42 BIOCHEMICAL FACTORS	
Introduction	46
Methods	51
Results and discussion	
(a) Mucus fluorescence	54
(b) Free amino acids	54
(c) Amino acids of periostracal protein	55
1.43 ENVIRONMENTAL RELATIONSHIPS	
(a) Distribution and general ecology	61
(b) Salinity relations	66
(c) Habitat preference	72
(d) Desiccation	74
1.44 DISCUSSION	
(a) The species problem	79
(b) The significance of parthenogenesis	84
(c) Shell ornamentation	89
(d) The relationship of <u>Fluviopupa</u> to <u>Potamopyrgus</u>	93
(e) The relationship of <u>P. antipodum</u> to the European species <u>P. jenkinsi</u>	95
2.0 BIOLOGICAL STUDIES ON <u>P. ANTIPODUM</u>	
2.1 POPULATION STUDIES	
Introduction	100
Study areas	101
Climate	102
Methods	106
Results and discussions	
(a) Life history and population dynamics	111
(b) Stream ecology	127

	Page
3.0 THERMAL RELATIONSHIPS OF <u>P. ANTIPODUM</u>	
Introduction	134
Materials and methods	134
Results	137
Discussion	139
4.0 PARASITES OF <u>POTAMOPYRGUS</u>	
Introduction	140
Methods	140
Larval Trematoda	141
Protozoa	156
Oligochaeta	158
5.0 REFERENCES	160
APPENDICES	183

	Page
3.0 THERMAL RELATIONSHIPS OF <u>P. ANTIPODUM</u>	
Introduction	134
Materials and methods	134
Results	137
Discussion	139
4.0 PARASITES OF <u>POTAMOPYRGUS</u>	
Introduction	140
Methods	140
Larval Trematoda	141
Protozoa	156
Oligochaeta	158
5.0 REFERENCES	160
APPENDICES	183

# INDEX TO FIGURES

<u>Figure</u>		<u>Following page</u>
1.	Measurements made in the study of shell shape variation.	14
2.	Shell height plotted against shell width, and aperture height in <u>P. antipodum</u> .	14
3.	Outline tracings of fully-grown smooth shells of <u>Potamopyrgus</u> spp.	21
4.	Outline tracings of fully-grown ornamented (spiny) shells of <u>P. antipodum</u> .	21
5.	Shells of <u>P. estuarinus</u> and <u>P. pupoides</u> , and periostracal ornamentation of <u>P. antipodum</u> .	21
6.	(a) Maximum shell height in populations of <u>Potamopyrgus</u> spp. (b) Mean height:width and height:aperture height ratios in <u>P. antipodum</u> .	21
7.	Mean shell height plotted against mean height:aperture height ratio, and against mean height:width ratio, in <u>P. antipodum</u> .	22
8.	(a) Whorl diameters of embryonic shells of <u>P. antipodum</u> . (b) Range of variation in shell height:shell width, and shell height:aperture height ratios in <u>P. antipodum</u> .	22
9.	"Dice-grams" showing variation in shell measurement ratios in selected populations of <u>P. antipodum</u> .	22



<u>Figure</u>		<u>Following page</u>
10.	"Dice-grams" showing variation in shell measurement ratios in populations of <u>P. pupoides</u> and <u>P. estuarinus</u> .	22
11.	"Dice-grams" showing variation in shell measurement ratios of <u>P. antipodum</u> from three populations at 12 monthly intervals.	22
12.	Comparative graphical representation of variation in shell shape in the three species of <u>Potamopyrgus</u> .	23
13.	Outline tracings of shells showing range of variation in shape and ornamentation in five populations of <u>P. antipodum</u> .	24
14.	Radula, operculum, embryo shells, animal extended, and head pigmentation of <u>Potamopyrgus</u> spp.	30
15.	(a) Numbers of serrations on marginal teeth in three populations of <u>P. antipodum</u> . (b) Number of rows of teeth per unit length of radula in <u>Potamopyrgus</u> spp.	32
16.	Radula length plotted against shell height in <u>Potamopyrgus</u> spp.	32
17.	Male reproductive system.	38
18.	Female reproductive system.	41
19.	Ultra-violet fluorescence and absorption patterns obtained from foot muscle squashes of four species of Gastropoda.	54

<u>Figure</u>		<u>Following page</u>
20.	Free amino acid patterns obtained on chromatographing foot muscle and mantle edge tissue of four species of Gastropoda.	55
21.	Relationships between shell height, shell form, shell encrustment, and type of habitat, in <u>P. antipodum</u> .	65
22.	Distribution of <u>Potamopyrgus</u> spp. in an arm of Hobson Bay, Auckland, in relation to water salinity.	69
23.	Selection of submerged and exposed substrata by <u>P. estuarinus</u> and <u>P. antipodum</u> in laboratory experiments.	73
24.	Survival time of <u>Potamopyrgus</u> spp. at 100% RH on a damp substrate at 20-26°C.	78
25.	Suggested steps in the evolution of the New Zealand species of <u>Potamopyrgus</u> .	92
26.	(a) Air temperatures recorded at Grasslands Division, D.S.I.R., Palmerston North; March 1965 - April 1966. (b) Diurnal air and water temperatures recorded in Tiritea Stream valley, September 1966.	103
27.	Monthly size structures of three populations of <u>P. antipodum</u> from April 1965-April 1966.	111
28.	Population structure in Pond A during the period between draining and refilling, 1965.	112

<u>Figure</u>		<u>Following page</u>
29.	Numbers of embryos present each month in gravid females from three populations of <u>P. antipodum</u> .	117
30.	Mean growth of four laboratory populations of <u>P. antipodum</u> .	121
31.	Diagram of a section of Tiritea Stream showing position of drift net.	130
32.	Experimental apparatus used to produce superoxygenated conditions at above ambient temperatures.	137
33.	Numbers of snails active at experimental temperatures between 26 and 30°C.	138
34.	The trematode parasites of <u>P. antipodum</u> recorded by Macfarlane.	141
35.	Trematode parasites of <u>Potamopyrgus</u> spp.; Monostome cercariae.	141
36.	Trematode parasites of <u>P. antipodum</u> ; Furcocercariae, Cercariae, Xiphidiocercariae.	147
37.	Trematode parasites of <u>P. antipodum</u> ; Gymnocephalus cercariae.	151
38.	The protozoan (Sporozoa : Porosporidae) parasite of <u>P. antipodum</u> ; sporozoite.	157
39.	The protozoan parasite of <u>P. antipodum</u> ; cysts.	157
40.	The oligochaete <u>Chaetogaster limnaei limnaei</u> with shells of embryonic <u>P. antipodum</u> visible in the gut.	159