# THE STRUCTURAL DYNAMICS
# OF A
# TIDAL FLAT MOLLUSC COMMUNITY

by

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submitted in fulfilment of the requirements for the degree of

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(Volume 1 of 2)

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D. Woodward

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Raw Data listing deposited in University of Tasmania Library with this thesis

Magnetic Tape holding raw data and analytical programs deposited in University of Tasmania Library with this thesis.

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## SUMMARY

1. A transect survey of the tidal flat mollusc community in the coastal Pipe Clay Lagoon, south-eastern Tasmania, was conducted over four seasons. The survey was conducted along a 700 m transect running down the tidal gradient from EHWS to MLW. In each season a 'distribution' transect was conducted with single quadrat (0.25 m x 0.25 m) samples being taken down to the anoxic layer every 20 m. At the same time a 'dispersion' transect was taken; every 100 m a grid (0.5 m x 0.5 m) consisting 8 x 8 cells was sampled down to the anoxic layer. A number of physical variables were also measured.

2. All molluscs and anemones that were retained by 0.5 mm mesh were defined to make up the community. The community comprised:

i. three suspension feeding bivalves - *Anapella cycladea*, *Katelysia scalarina* and *Wallucina assimilis*,

ii. one deposit feeding bivalve - *Soletellina biradiata*,

iii. two deposit feeding gastropods - *Hydrococcus brazieri* and *Salinator fragilis*,

iv. six algivorous gastropods - *Zeacumantus diemenensis*, *Rissopsis consobrina*, *Microdiscula charopa*, *Bembicium auratum*, *Austrocochlea constricta* and *Notoacmea alta*,

v. two carnivorous gastropods - *Cylichnina pygmaea* and *Nassarius pauperatus*,

vi. one parasitic gastropod - *Agatha metcalfei*

and vii. one carnivorous anemone - *Anthopleura aureoradiata*.

3. Statistical analysis of the survey data, followed by caging manipulation experiments, was used in an attempt to identify the principal factors responsible for controlling the structure of the community.

4. The survey provided information on the habitat and on the spatial and demographic patterns of the species. The habitat proved to be very stable. The beach profile showed little change throughout the sampling period and there were no obvious sediment sorting gradients over the transects.

5. The habitat stability was reflected in the relative stability of the populations making up the community. Species did not exhibit marked changes in either distribution or abundance from season to season, apart from those associated with recruitment.

6. The tidal gradient was the overriding environmental parameter and it appeared to exert its strongest influence on the species during their recruitment. Reproductive

patterns varied both between and within species according to the position on the beach. In most species, recruitment appeared to be virtually continuous although considerable temporal variations occurred. Generally, bivalve recruitment was greatest over the cooler months of the year and reproductive success, as measured by settled juveniles, tended to increase in high beach areas during the cooler months. The gastropods appeared to be less sensitive to desiccatory stress and their principal period of recruitment was over spring and summer.

7. The spatial and temporal variations in the structure of the community allowed a working hypothesis to be proposed. The structure of the community could be explained by a linking of the trophic group amensalism hypothesis of Rhoads and Young (1970) and Huston's (1979) dynamic equilibrium hypothesis for the maintainance of species diversity. It appeared that trophic group amensalism, acting on juvenile animals, was the major factor controlling the observed changes in community structure along the transects. Apart from *Anthopleura*, predators did not play a major role in determining the community structure.

8. A systematic analysis of the survey data, using serial and planar correlation analysis, followed by caging manipulation experiments, was used in an attempt to test the working hypothesis in three stages, each stage having successively greater fidelity.

9. The factors that appear to be responsible for the maintenance of the community structure can be outlined as follows:

i. The deposit feeding gastropods, *Hydrococcus* and *Salinator*, can tolerate a wide range of conditions, are distributed over most of the beach and compete for trophic resources. The two species show competitive exclusion in areas of high densities. Their feeding activities rework the substrate, making the sediment-water interface unstable.

ii. Larvae of the suspension feeding bivalves, *Anapella* and *Katelysia*, settle indiscriminantly on the substrate but are unable to survive in areas of highly reworked sediment. In areas where there are relatively low densities of deposit feeders, the bivalves are able to survive to maturity. Competition for resources (space and/or food) between adults of one bivalve species and juveniles of the other leads to a segregation of the two species along the tidal gradient. *Katelysia*, being less tolerant of desiccation, becomes confined to the lower sections of the beach.

iii. The other suspension feeding bivalve, *Wallucina*, is able to take advantage of low numbers of *Anapella* and *Katelysia* near a major beach ridge and *Wallucina* densities are highest there.

iv. The anemone, *Anthopleura*, uses large bivalves as a substrate and is most abundant in the middle sections of the beach. Passive predation by *Anthopleura* acts to keep the numbers of deposit feeding gastropods low, thus minimising the effects of trophic amensalism in those regions. In the absence of *Anthopleura* at either end of the transect, relatively high numbers of deposit feeding gastropods lead to an exclusion of suspension feeding bivalves and hence to a reduction in community diversity.

v. The upper half of the beach appears to be most suitable for gastropods feeding on microalgae. Although the distributions of the algivorous gastropods suggested a degree of local competitive exclusion, this was not statistically significant.

vi. Interference competition between the algivorous gastropods and both the suspension feeding bivalves and the deposit feeding gastropods may be sufficient to influence the local distributions of those species.

vii. The gastropod *Nassarius* obtains its main food supply by scavenging dead, and preying on living, *Anapella* and *Katelysia*. The other carnivorous gastropod, *Cylichnina*, probably feeds on juvenile bivalves, and also on juvenile *Hydrococcus* and *Salinator*. Typically, the distribution of the predators is determined by the distribution of the prey and not *vice versa*. Apart from *Anthopleura*, therefore, predation appears to play a minor role in the maintenance of the community structure.

To summarise, the principal determining factor of the tidal flat community's structure appears to be trophic group amensalism, reinforced by the predation of *Anthopleura* on juvenile deposit feeders. The community structure, as described by diversity indices, can be explained in terms of Huston's (1979) dynamic equilibrium hypothesis, mediated by the trophic amensalism.