

Samples for bacteria and nutrients were collected in the van Dorn sampler and transferred to individual small (about 140 ml) or large (about 400 ml) sterile 'Whirlpacs'. Nutrient samples were placed directly on ice packs and stored frozen while bacterial samples were kept cool for return to the laboratory where analysis was commenced immediately.

Samples for BOD₅ were collected in dark glass BOD bottles, kept cool and in the dark until return to the laboratory where analysis was commenced immediately.

Sediment samples for hydrocarbon utilizing bacteria analysis were collected in sterile glass containers by diving.

Meteorological conditions varying during the five water quality sampling trips from calm (10 January and 31 January) with wind speeds generally less than 3 m/sec and wave heights less than 0.2 m to rough (24 January) with wind speeds approximately 4 to 8 m/sec and wave heights greater than 1 m. Heavy rain fell in late December with Gustav Creek breaking through the foredune in early January.

8. TRIBUTYLTIN BIOLOGICAL EFFECTS STUDY

8.1 Introduction

Tributyltin (TBT) residues in water have been shown to exhibit effects on biota at levels of 2.5 ng/l (Goldberg, 1987). This suggests that water quality guideline values should be considerably less than this, allowing for standard effect margins. The problem is that regular measurements of TBT at less than 1 ng/l in water samples is technically difficult and it has been suggested that biological effects monitoring may effectively supplement water analysis.

Gastropods of the genera Nucella and Nassarius have been shown to develop imposex (i.e. where female snails develop male sex organs) by exposure to low concentrations of TBT (Smith 1981; Bryan et al., 1986). This type of monitoring has been applied in the field as an aid to chemical monitoring (Davies et al., 1987).

It was decided to carry out a preliminary survey of Nassarius species and numbers in Nelly Bay and measure male/female ratios and evidence of natural imposex and its extent.

8.2 Experimental Procedure

The snails used in this study were found predominantly in the intertidal zone and were collected approximately two hours either side of the low tide. Sampling was by sight along random paths of the collector and collecting was by hand. The collected individuals were transported back to the laboratory where they were maintained in aquaria for no longer than 72 hours (for samples taken 24/2/89 and 1/3/89 this time was reduced to 48 hours and 3 hours respectively).

In the laboratory each individual was identified to species level by the following key:

- 1a. Has development of columellar callus.....Go to 2
- b. No columellar callus.....Nassarius luridus
- 2a. Has axial ribs.....Nassarius pullus
- b. Has smooth body whorl.....Nassarius coronatus

(adapted from Cernohorsky, 1972)

Once identified the snails were measured for shell height and then inspected for the following sexual characteristics.

1. Presence of a ventral pedal gland in females. This is observed on a live snail by inspecting the antero-ventral surface of the foot (against a clean glass surface) with a X 10 handlens. This structure appears as a small glandular pit or groove if present (Fretter, 1941).
2. Presence of a penis in males and imposex females. This is a wing like structure located posterior to the right cephalic tentacle and generally cloaked by a sheet of free mantle tissue (Smith, 1980). This may be resorbed in some males, although this has been associated with seasonal breeders (Jenner & Chamberlain, 1955), or these males may be immature.

3. Histological examination of gonads for evidence of spermatozoa or ova to confirm sexual identification.

The recording of penis presence or absence and the preparation for histological procedures required decalcification of the shell in a formic acid- formalin mix. Histological staining was with a Mayer's Haemalum and Eosin regime as described in Winsor (1984).

8.3 Results

The data is compiled in chronological order of collection and in species groups. The data in Table 2 is a summary of the raw data in Appendix 5.

Table 2.

	Males		Females		Imposex females		Resorbed males		Immature		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
N. pullus	65	39.4	46	27.9	18	10.9	3	1.8	1	0.6	133	80.6
N. luridus	12	7.3	6	3.6	3	1.8	1	0.6	0	0	22	13.3
N. coronatus	2	1.2	6	3.6	1	0.6	0	0	1	0.6	10	6.1
Total	79	47.9	58	35.1	22	13.3	4	2.4	2	1.2	165	100