Healthy Estuary and Rivers of the City

Water quality and ecosystem health monitoring programme of Ihutai

The sediments and biota of the Avon-Heathcote Estuary/Ihutai and tidal reaches of the Avon and Heathcote rivers

Summary report on data collected in 2010

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Data collected by EOS Ecology, for Christchurch City Council

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1 Introduction

In order to assess the state of the sediments and biota of the Avon-Heathcote Estuary/Ihutai and tidal reaches of the Avon and Heathcote rivers a monitoring[1] programme started in 2007. This programme is one the four monitoring programmes described in The Healthy Estuary and Rivers of the City: Water quality and ecosystem health monitoring programme of Ihutai document (2009)[2].

Healthy mudflats of an estuary and tidal reaches of a river support a diverse range of animals such as anemones, snails, shellfish, worms, crabs and hoppers. The presence and survival of these animals (biota) not only depends on the quality and salinity of the water[3] but also on the quality of the sediments, i.e. the mudflats, that they live on or in. The diversity and abundance of animals living on and in the mudflats provides food for fish and birds while an abundance of healthy shellfish, such as cockles, are a valued food item for many people. In addition these mudflat-living animals, by their normal actions such as feeding and burrowing, keep the sediments well oxygenated and healthy.

The quality of the sediment in the estuary and the tidal reaches of the rivers have the potential to be impacted by:

- soil that runs off the land and into the rivers and estuary
- excessive amounts of organic matter, e.g. from dead and decaying plants including seaweeds and from bird and mammal excrement
- the quality of the overlying water
- contaminants such as metals, pesticides and herbicides that enter the rivers and the estuary in stormwater and other legal and illegal discharges

The features of the sediment that influence the types and abundance of the animals that live on or in it are:

- the size of the sediment grains that make up the sediment
- the amount of organic matter in the sediment
- the concentrations of potentially toxic contaminants

This annual report is a summary of the sediment and biota data collected in 2010 and is the fourth such report. The information provided in this report only gives the state of the sediments and biota in 2010. The reader can refer to the annual summary reports (available at www.estuary.org.nz or www.ecan.govt.nz search:Ihutai) to evaluate differences over time. A report including more detailed analysis, such as analysis of trends over time, will be produced following five years of data collection.

[1] Monitoring is the routine collection of data over time in order to assess the state of the environment and identify changes over time.

[2] Batcheler, L., Bolton-Ritchie, L., Bond, J., Dagg, D., Dickson, P., Drysdale, A., Handforth, D and Hayward, S. 2009. Healthy Estuary and Rivers of the City: Water quality and ecosystem health monitoring programme of Ihutai. Environment Canterbury Report No RO9/8. 60pp.

[3] The water within the Avon-Heathcote Estuary/Ihutai is primarily a mix of the freshwater flowing out of the Avon and Heathcote rivers and the sea water from Pegasus Bay that flows into the estuary as the tide rises. At the time of sampling in 2010 the discharge of tertiary treated wastewater into the estuary had only just ceased (ceased on 4 March 2010). Refer to the summary report on the water quality of the Avon-Heathcote Estuary/Ihutai for more information on the impact of the wastewater discharge on the water quality of the estuary prior to cessation of the wastewater discharge and after cessation of the discharge.

2 Sampling

2.1 Sampling sites

The sites sampled in 2010 are shown in Figure 1.

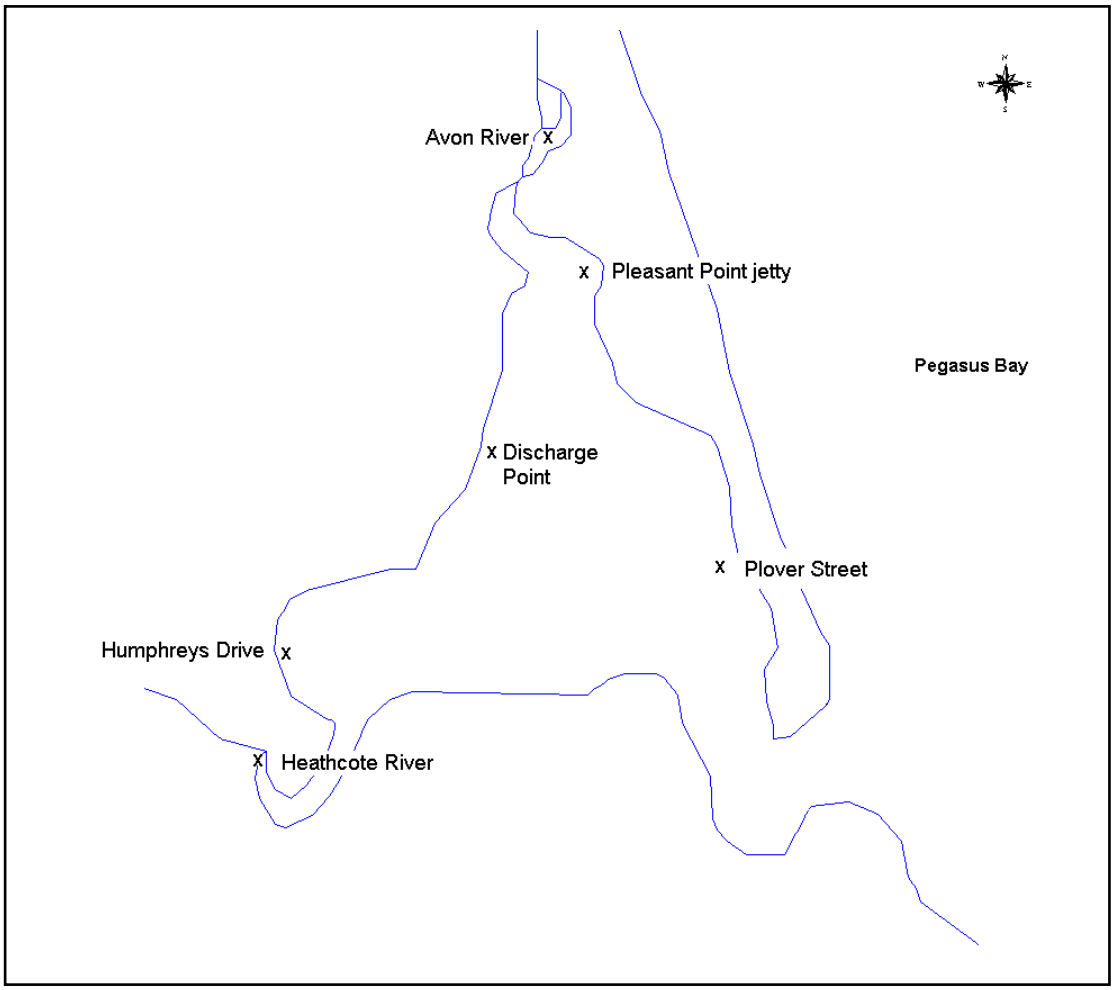

Figure 1: The sampling sites within the Avon-Heathcote Estuary/Ihutai and in the tidal reaches of the Avon and Heathcote rivers

2.2 Collection of samples

The methods used followed the national protocol for monitoring estuarine environments (Robertson *et al.*, 2002). The GPS co-ordinates of each site were recorded.

Samples from the river sites were collected on 17 and 20 March and those from the estuary sites were collected on 5, 6, 7 and 14 March, 2010.

These sites were sampled by EOS Ecology on contract to the Christchurch City Council. The following samples were collected at the sampling sites.

2.2.1 Sediments

Ten samples from the estuary sites and five composite samples from the river sites were collected and analysed. The top 20 mm of sediment was collected for analysis. Sediment samples were only analysed for sediment grain size.

2.2.2 Biota

Plants and animals on the surface of the sediment
Fifteen, 50 cm x 50 cm (0.25 m^2) quadrats were sampled. The number of each different type of animal on the surface of the mud and the number of crab burrows in each quadrat was counted and recorded. The percentage cover of the surface by seaweeds was determined using a grid overlying the quadrat.

Animals living in the sediment
Fifteen 130 mm diameter x 150 mm deep cores were sampled. Each sample was sieved through a 0.5 mm screen and the material retained on the screen stored in alcohol for analysis. The number of each different type of animal in each core was counted and recorded.

Size distribution of some common animals
The height of all mudflat snails present in the quadrats was measured.
The length of all cockles in each quadrat (dug to a depth of 120 mm) was measured.

3 Results

The results are presented on the following pages. The data are typically presented as bar graphs. The bars have been positioned on a map and below each bar are the minimum and maximum values recorded at a site. This form of presentation makes it is easy to see the similarities and differences between sites.

Bar graphs
The bars for the sediment grain size and the biological data represent the average[4] value. The height of a bar represents the value.

Pie graphs
Pie graphs have been used to show the average number of individuals of each type of animal living in the mud at each site. The size of a piece of the pie represents the proportion of the total number of individuals present for each type of animal based on the average of the fifteen cores.

Names of plants and animals
The scientific names of the plants and animals are used but if there are common names they are also used.

Interpretation of biota data
The biota data presented summarises the types and abundance of animals, the size range of mudflat snails and cockles and the abundance of seaweeds at the sites in 2010. No analyses have been undertaken to investigate why there are differences in the plants and animals between sites.

[4] The average is obtained by adding up all the vales and then dividing the total by the number of values used

3.1 Sediments

3.1.1 Sediment grain size

This is a measure of the size of particles that make up the sediment. The sediment grain size distribution affects the types of animals that live at a site. Some types of animals live in or on sandy sediment without too much silt or clay while other types live in or on muddy (silt and clay) sediment.

From the results obtained the percentage of sand, silt and clay in each sample was calculated. The average percentages of sand, silt and clay at each site are shown in Figure 2.

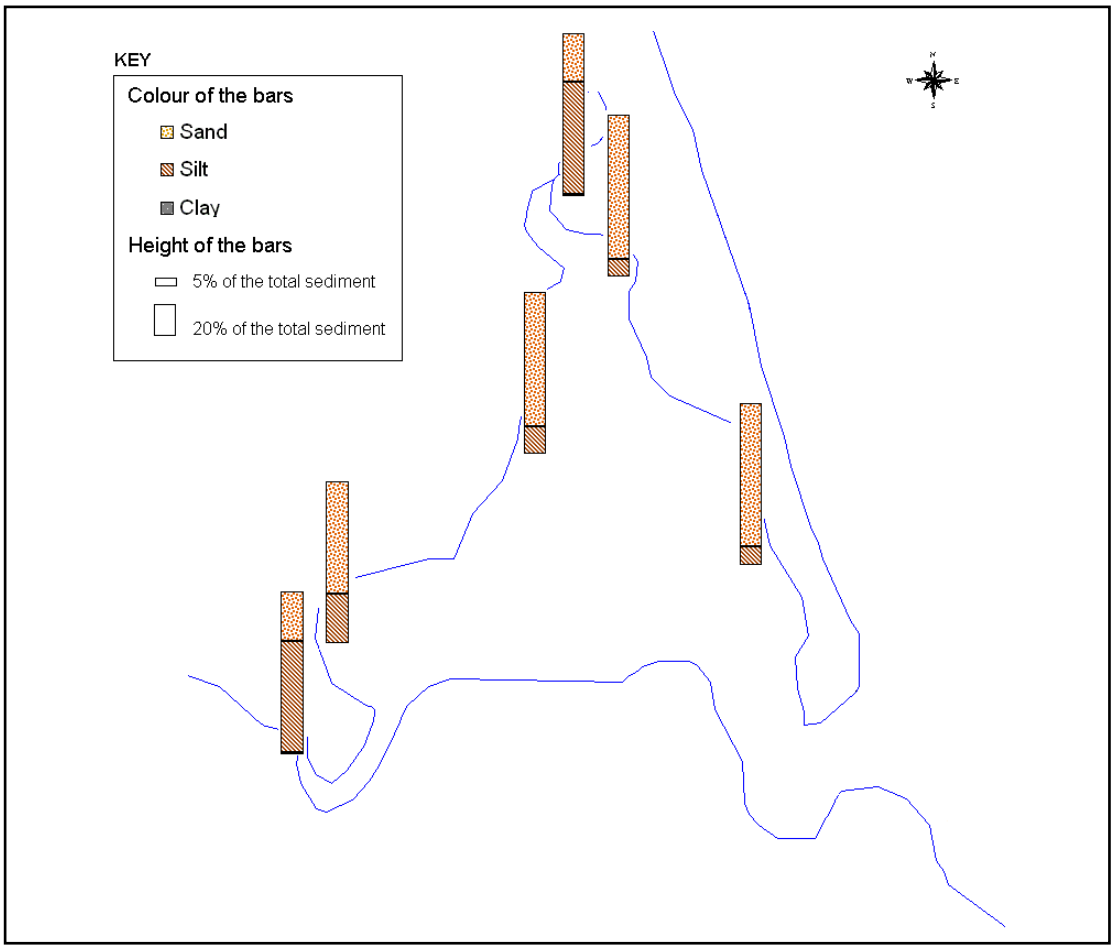

Figure 2: Percentage of sand, silt and clay in the sediment

The sediment at all sites in the estuary was predominantly sand (more than 69%) with less than 30 % silt and 1% clay. There was less silt at sites on the eastern side than on the western side of the estuary.

The sediment at the Avon and Heathcote river sites was predominantly silt (more than 69 %) with less than 31% sand and 1% clay.

3.2 Biota

3.2.1 Plants and animals on the surface of the sediment

Number of different animals
Twenty six types of animals were found to be present. Of these 26 types of animals one was an anemone, 12 were snails and shellfish, four were worms and nine were crustacea (crabs, lice, hoppers and a barnacle).
The number of each type of animal living on the surface of the sediment at each site, is shown on Figure 3.

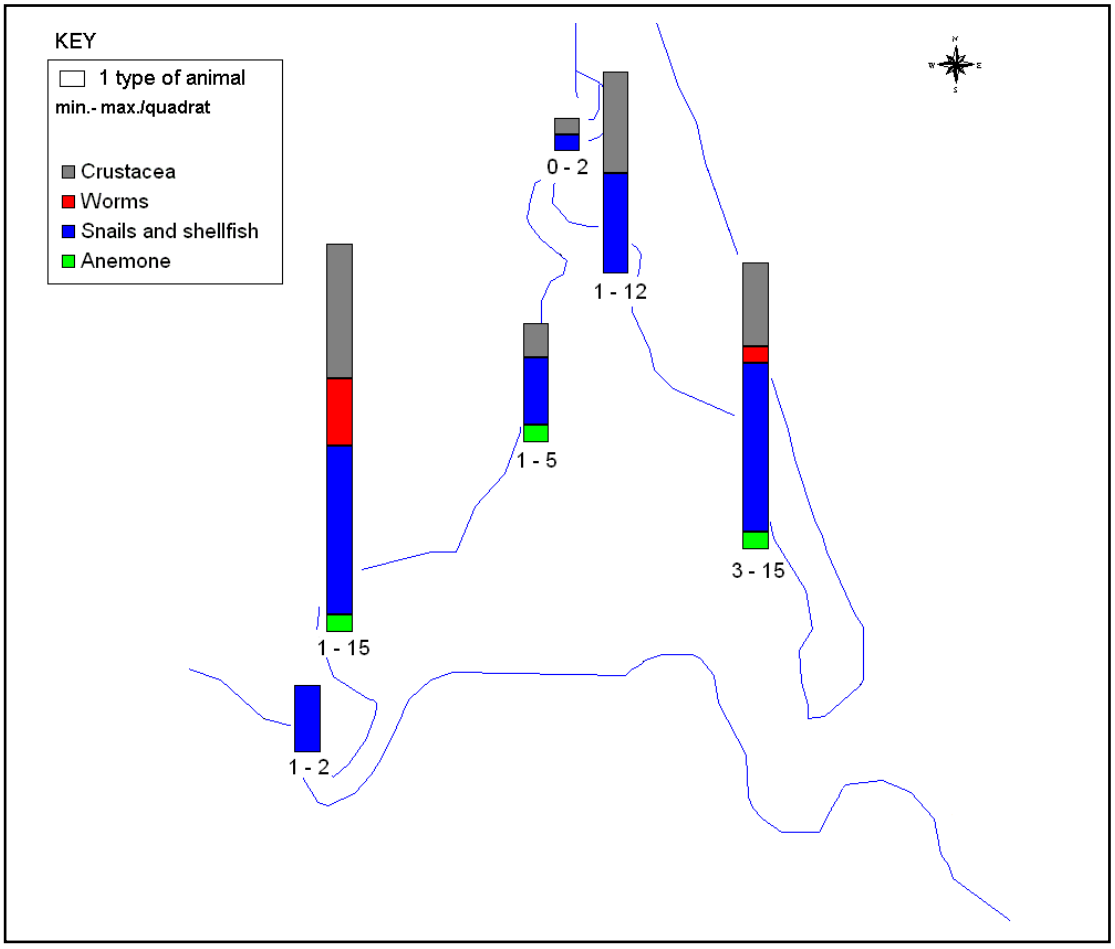

Figure 3: Number of different types of animals living on the sediment surface

Snails and shellfish were present at all sites, crustacea (not including crab burrows) were found at all except the Heathcote River site and anemones and worms were present at two sites.

There were more types of animals at estuary sites than river sites. Within the estuary there were more types of animals at Humphreys Drive than at the other sites. At Humphreys Drive worms, lice and hoppers were living amongst the seaweed that was on the sediment surface.

Mudflat snail (Amphibola crenata)

Mudflat snails feed on the micro-organisms and organic matter in the sediment. As they feed they leave a string-like trail of waste on the surface of the mud. They lay their eggs into a tyre-like rim of mud. These egg cases can be seen on the mud surface from late November to March. Mudflat snails can tolerate a wide range of salinity and temperature and exposure to air for considerable periods of time.

Number of snails

The average number of snails per m^2 at each site is shown on Figure 4.

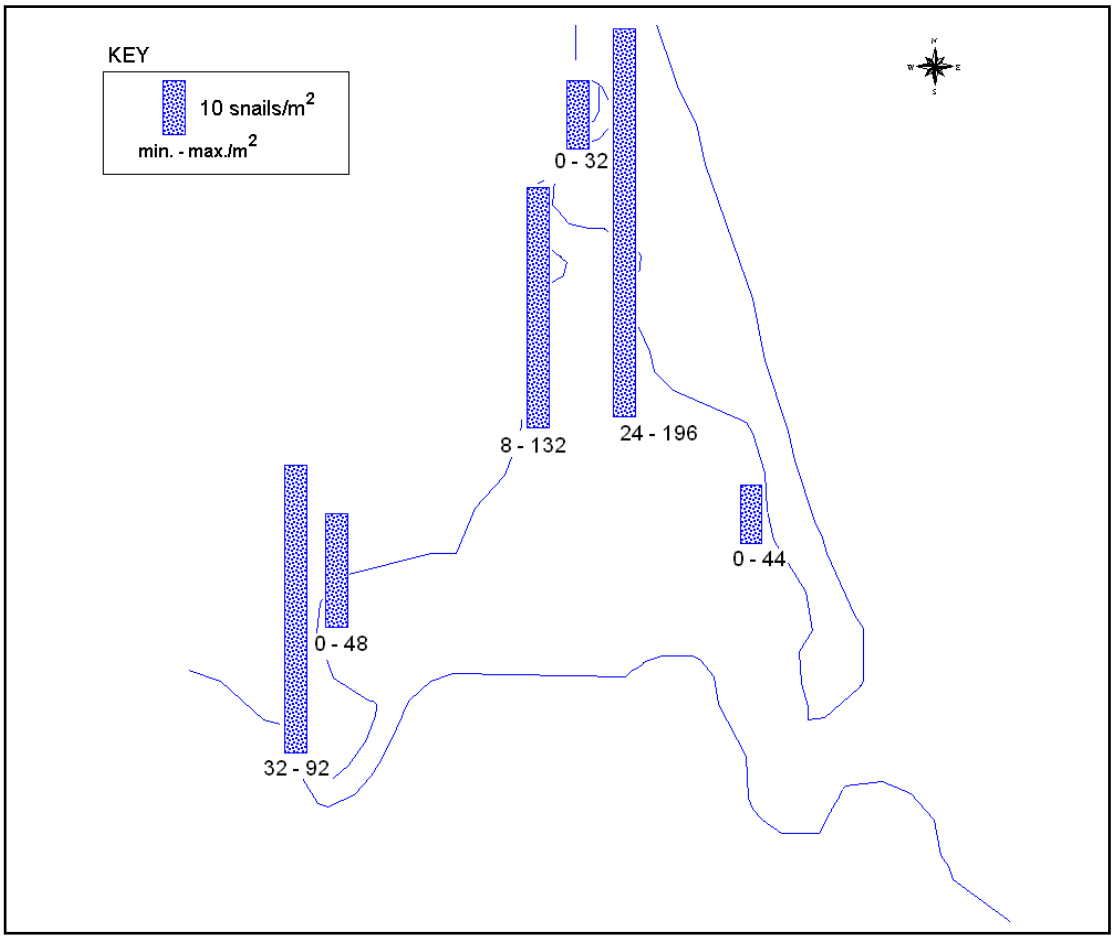

Figure 4: Average number of mudflat snails per square metre on the surface of the sediment

Mud flat snails occurred at all sites. Within the estuary the highest average number of snails occurred at Pleasant Point jetty while the lowest occurred at Plover Street. There were more snails at Discharge Point than Humphreys Drive. At both Discharge Point and the Pleasant Point jetty there was a large range in the number of snails per square metre. There were more snails at the Heathcote River site than the Avon River site.

Size of mud flat snails

The height distribution of all mud flat snails present in the 15 quadrats sampled at each site are shown in Figure 5.

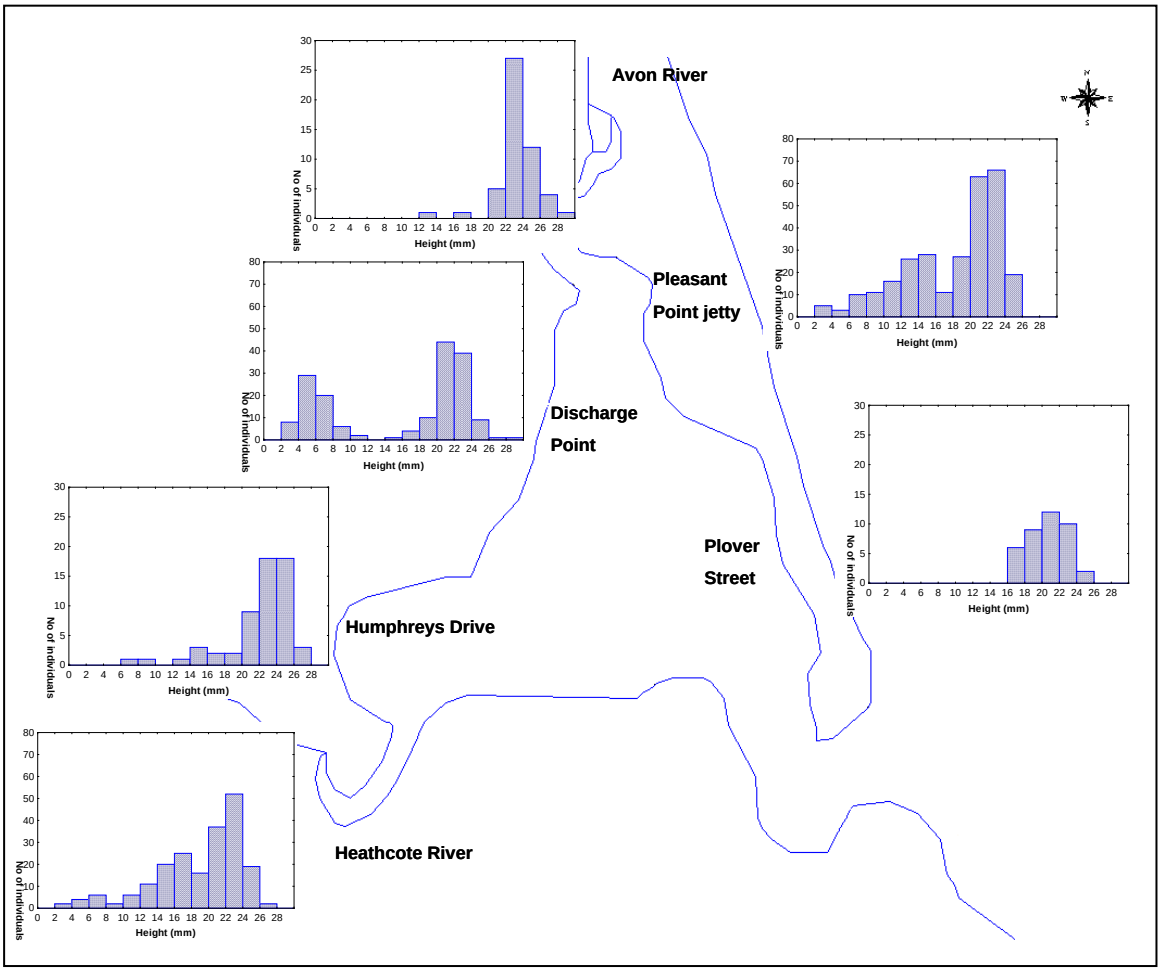

Figure 5: Height (mm) distribution of the mud flat snails

NOTE: Differing scales on the vertical axes of the graphs

The snails sampled ranged in height from 2.5 - 32 mm. Of the individuals measured, 2% at the Avon River site, 5% at Humphreys Drive, 0% at Plover Street and 13% at the Heathcote River site, were smaller than 14 mm. That is, there were few juvenile snails at these sites. At Discharge Point 37% of the individuals were juveniles with a distinct group of individuals smaller than 14 mm. At Pleasant Point jetty 21% of individuals were juveniles.

At all sites there were more individuals in the 20-26 mm size range than in any other size range. At Pleasant Point jetty 57%, Discharge Point 57%, Plover Street 67%, Humphreys Drive 74%, Heathcote River 56% and Avon River site 75%, of individuals had a height of 20-26 mm.

Crab burrows

Crab burrows are a common sight in the estuary. Burrows are easily counted but whether a crab lives in the burrow is not known nor is the type of crab in the burrow known. The two common crabs that burrow in the estuary are the stalk-eyed mud crab (*Macrophthalmus hirtipes*) and the short-eyed mud crab (*Helice crassa*).

Number of crab burrows

The average number of crab burrows per m^2 at each site is shown in Figure 6.

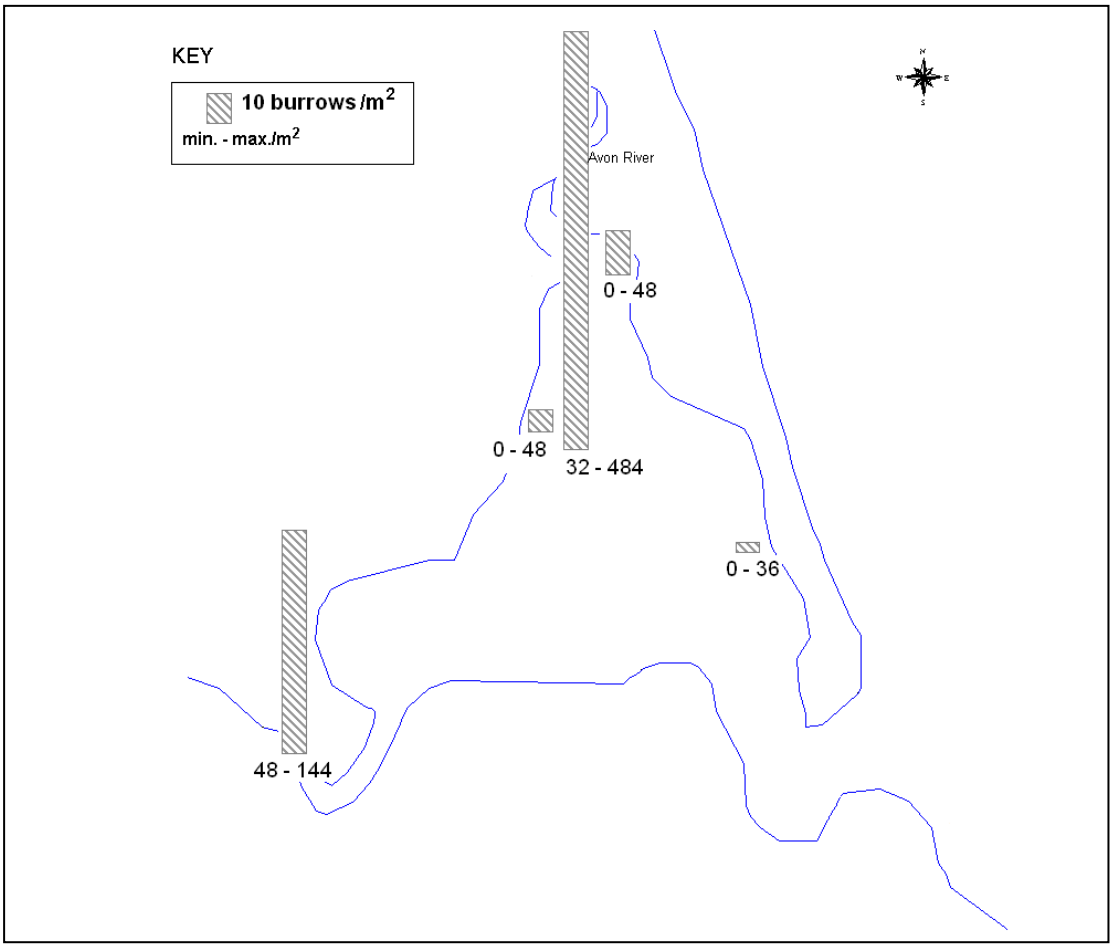

Figure 6: Average number of crab burrows per square metre

Crab burrows were present at all sites except Humphreys Drive.
Crab burrows were present in all quadrats from both river sites but not present in all quadrats from estuary sites. Of the 15 quadrats sampled there were no crab burrows in seven quadrats from Discharge Point, two quadrats from Pleasant Point jetty and twelve quadrats from Plover Street. There were more crab burrows per square metre at the Avon River site than at any other site with a high variability in the number of burrows per square metre at the Avon River site.

Seaweed cover
The most abundant seaweed within the estuary is the green sea lettuce (*Ulva* sp.) with the red seaweed *Gracilaria chilensis* also common. Where these seaweeds occur they cover the mudflat, so in a quadrat it is the percentage of the mudflat covered by seaweed that is used as a measure of seaweed abundance.

The average percent seaweed cover at each of the sites is shown in Figure 7.

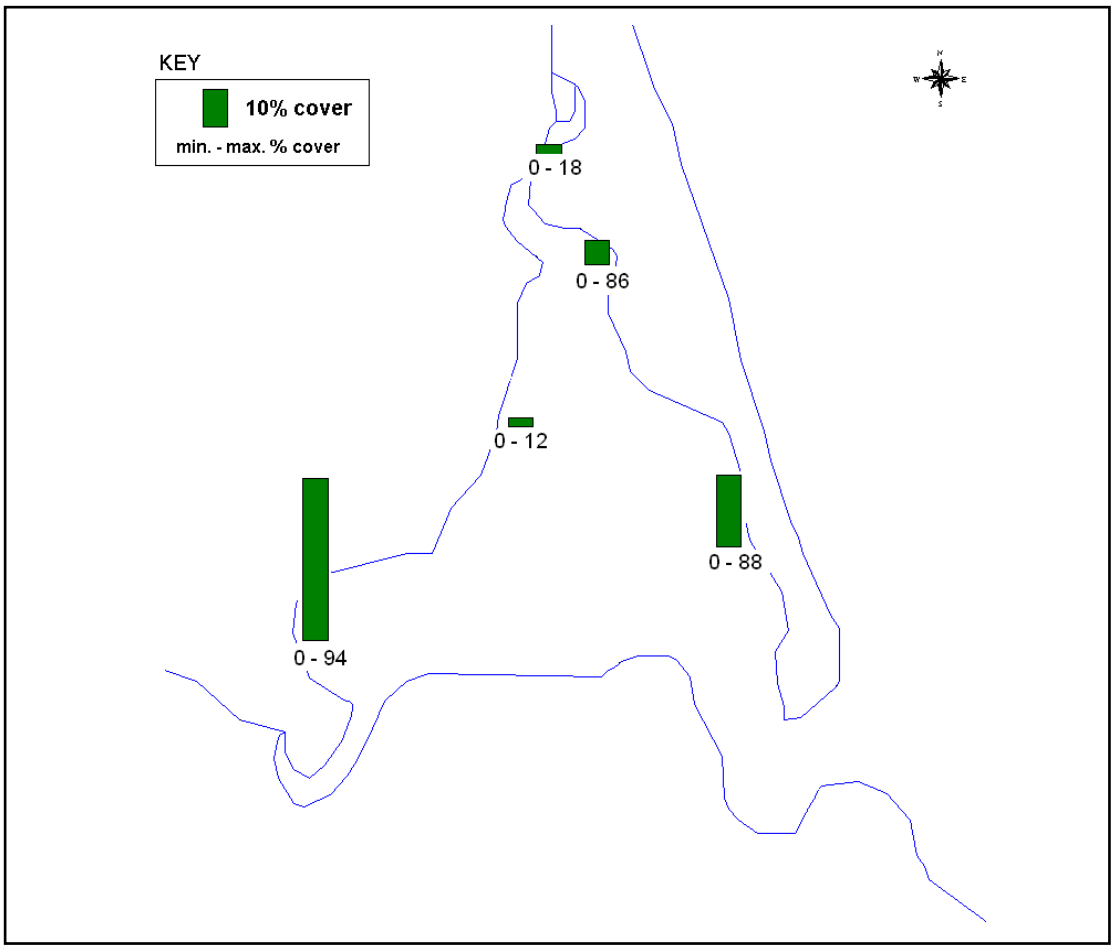

Figure 7: Average percent seaweed cover

Seaweed was not present at the Heathcote River site. At Pleasant Point jetty seaweed was patchy, being present in two quadrats with 2 % cover in one, and 86 % cover in the other, quadrat. Seaweed occurred in eight quadrats at Discharge Point, five quadrats at the Avon

River site and fourteen quadrats at both Plover Street and Humphreys Drive. At Humphreys Drive there was more than 80 % cover in three quadrats.

3.3 Animals that live in the sediment

Number of different animals
Thirty-seven different animals were found to be present in the sediment. Of these 37 animals two were anemones, 11 were snails and shellfish, 16 were worms, seven were crustacea (crabs, lice and hoppers) and one was other (nemertine worm).

The number of each type of animal living in the sediment at each site is shown in Figure 8.

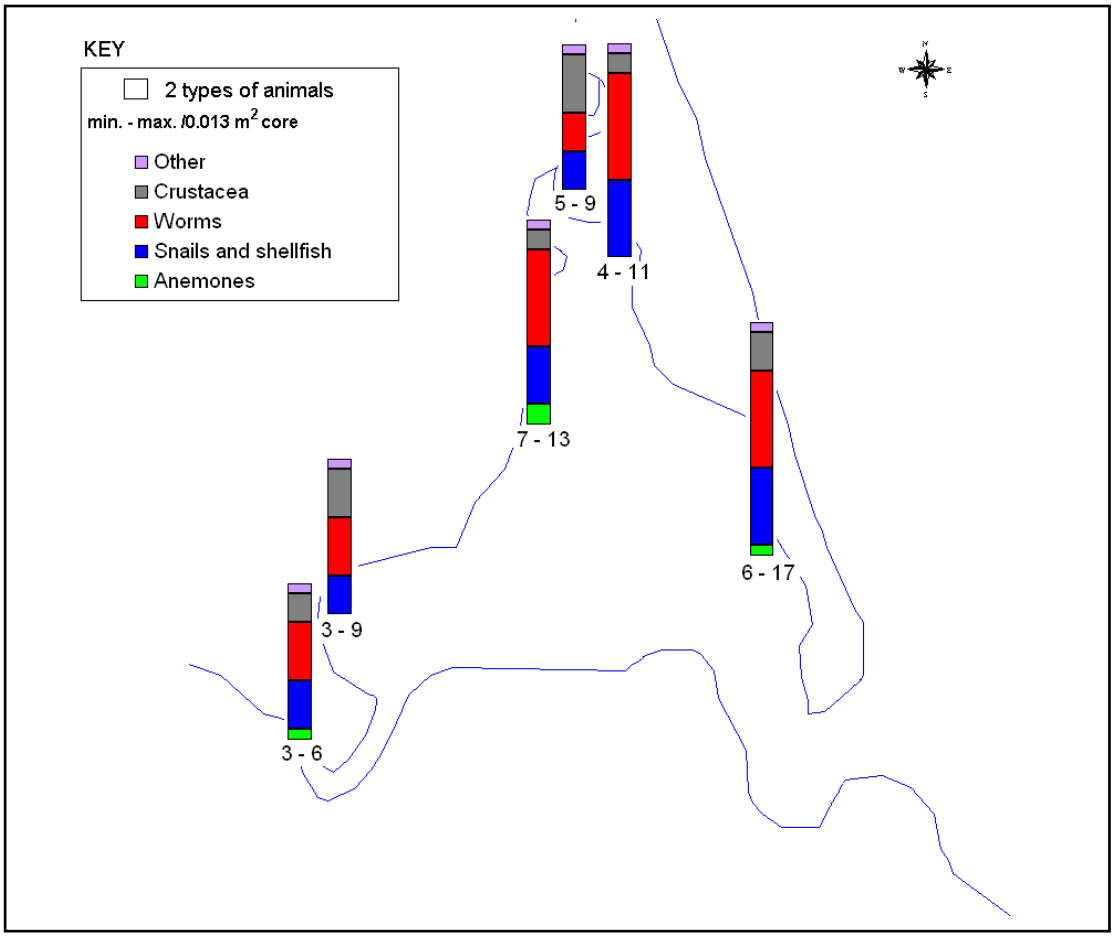

Figure 8: Number of different types of animals living in the sediment

Worms, snails and shellfish, crustacea and other were present at every site while anemones were present at Discharge Point, Plover Street and the Heathcote River site.

There were generally more different types of worms at each site than any other sort of animal. At the Avon River site there were more different types of crustacea than different types of worms.

There were generally more different types of animals at sites in the estuary than in the rivers. Within the estuary the highest number of different type of animals occurred at Plover Street with slightly fewer types of animals at Pleasant Point jetty and Discharge Point.

Number of animal individuals
The average number of animals per square metre is shown in Figure 9.

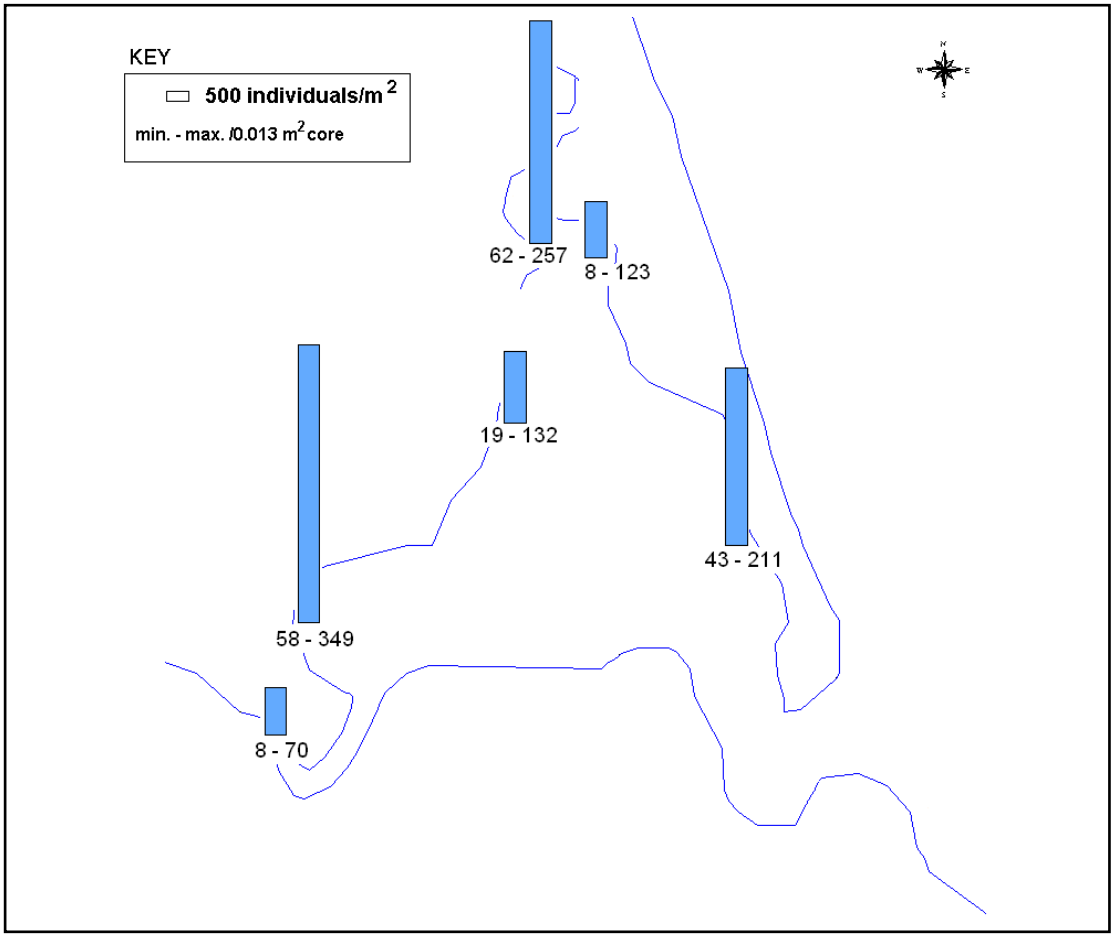

Figure 9: Average number of animal individuals per square metre living in the sediment

There were more animals living in the sediment at Humphreys Drive than at any other site. The average number of individuals at the Avon River site was around 80%, at Plover Street it was around 65%, at Discharge Point 25% and at Pleasant Point jetty 20%, of the average number of individuals at Humphreys Drive.

The average number of individuals at the Heathcote River site was about one fifth of that at the Avon River site.

The proportion of individuals of each type of animal present at each site is shown in Figure 10. The different types of animals are colour coded.
NOTE: At each site there were few individuals for four to eight different animals. For the purpose of graphing the proportion of these low abundance animals, the number of individuals of these four to eight animals was added together and this value graphed under the category called remaining taxa.

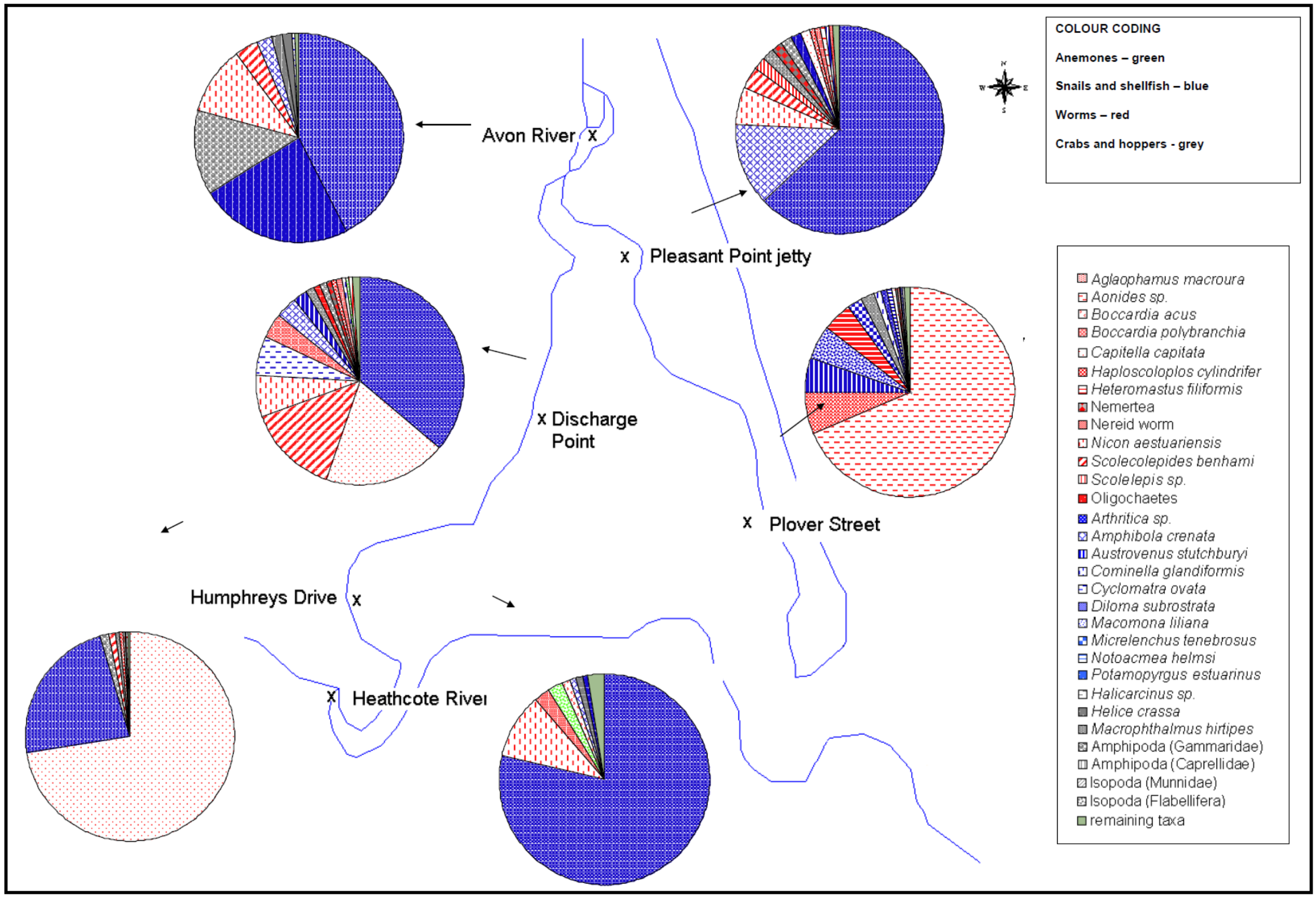

Figure 10: Proportion of individuals of each type of animal living in the mud

Size of cockles (Austrovenus stutchburyi)
The length distribution of the cockles present in the 15 quadrats at each site are shown in Figure 11. Note the different scales on the vertical axes.

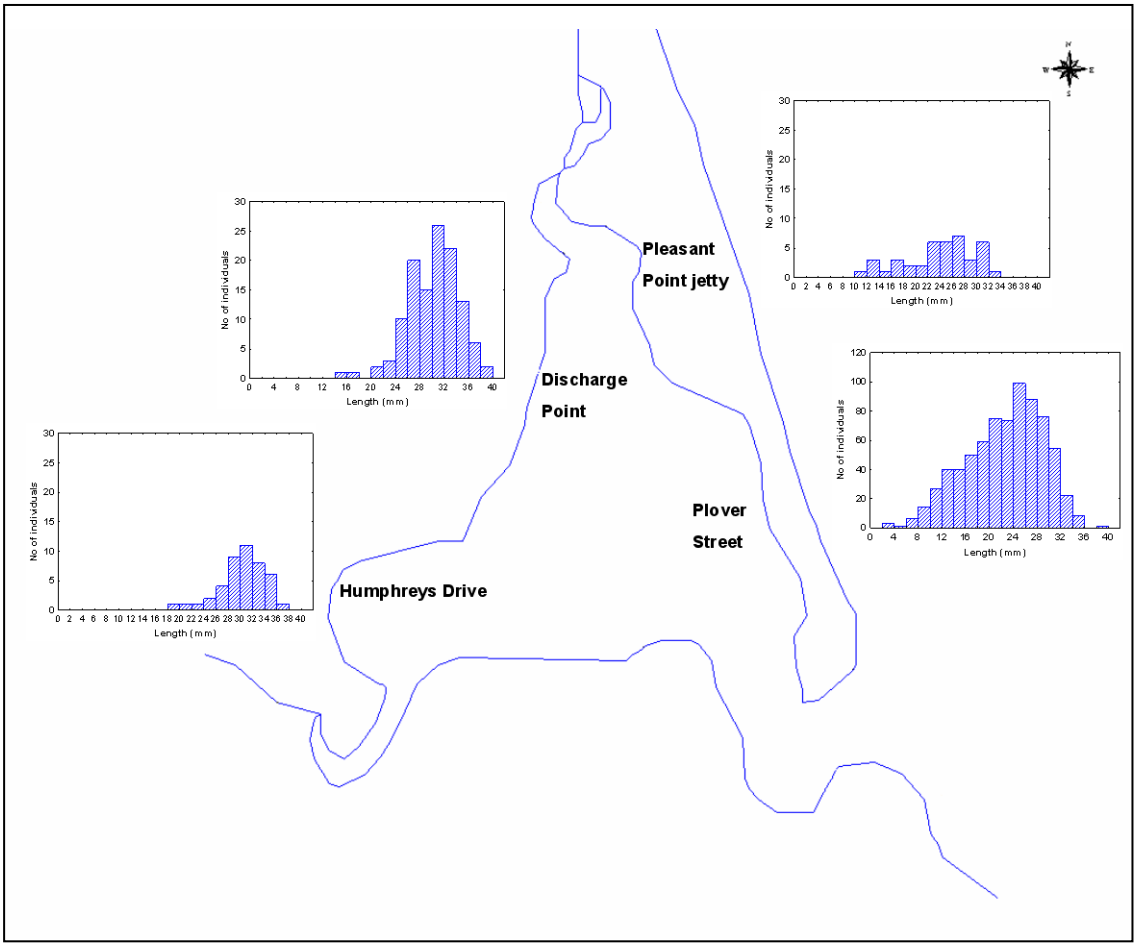

Figure 11: Length (mm) distribution of cockles

Cockles were not found at river sites but were present at all sites within the estuary. Cockles were most abundant at Plover Street, and there were more cockles at Discharge Point than at Humphreys Drive and Pleasant Point jetty.

The cockles sampled ranged in length from 3 – 38.5 mm. Cockles smaller than 15 mm, i.e. juveniles, were not present at Discharge Point and Humphreys Drive, but 10 % of the cockles at Pleasant Point jetty and 13 % at Plover Street were smaller than 15 mm. At both Discharge Point and Humphreys Drive most of the cockles were 26-36 mm in length. At Pleasant Point jetty and Plover Street there was a wide size range of cockles with no obvious size classes.

4 Conclusions

4.1 Sediments

The sediment in the tidal reaches of both rivers was mostly mud (mud = silt+clay) while in the estuary it was mostly sand. There were small differences in the grain size between sites in the estuary with less silt at the sites on the eastern side than those on the western side of the estuary.

4.2 Biota

There were differences in the types and abundance of animals living on and in the sediments between sites.

The typically lower number of different types of animals in the tidal reaches of the Avon and Heathcote rivers than in the estuary is likely because of the lower salinity at these sites. However, the difference in the sediment grain size between the river and estuary sites may also have a part to play.

It is likely that there were more types of animals living on the surface of the sediment at Humphreys Drive than at any estuary site because of the extensive seaweed coverage of the mudflat there. The people collecting and analysing the samples noted that there were lots of animals living on and under the seaweed.

At all sites there were a range of types of animals living in the sediment. The types of animals and their abundances differed between sites. That is, in terms of the type and abundance of animals present, each site was biologically different.

4.3 Overall

Annual monitoring of the sediments and biota at these estuary and river sites provides up to date information on their state and allow for comparisons over time. In particular it allows us to assess changes to the sediments and biota as a result of:

- cessation of the wastewater discharge to the estuary.
- the earthquakes, i.e. liquefaction and untreated sewage discharges.

An assessment of the changes will take place following five years of data collection.

5 References

Batcheler, L., Bolton-Ritchie, L., Bond, J., Dagg, D., Dickson, P., Drysdale, A., Handforth, D and Hayward, S. 2009. Healthy Estuary and Rivers of the City: Water quality and ecosystem health monitoring programme of Ihutai. Environment Canterbury Report No RO9/8. 60pp.

Robertson, B., Gillespie, P., Asher, R., Frisk, S., Keeley, N., Hopkins, G., Thompson, S and Tuckey, B. 2002. Estuarine environmental assessment and monitoring: A national protocol. Part A. Development, Part B. Appendices, and Part C. Application. Prepared for supporting Councils and the Ministry for the Environment, Sustainable Management Fund Contract No 5096. Part A. 93p. Part B 159p. Part C. 40p plus field sheets.

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