





7.3 Appendix 3

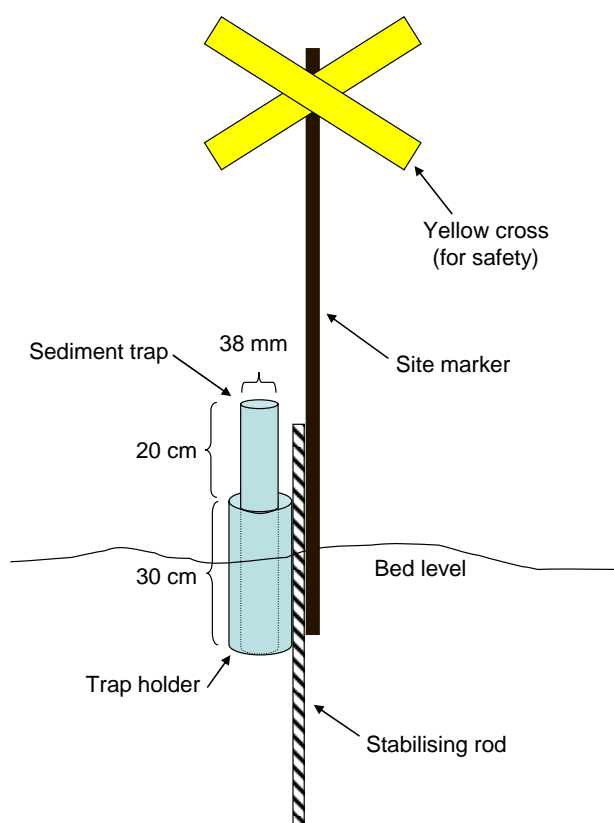
Summary timeline of the monitoring programme. Season and rainfall factors are not indicated prior to August 2002, due to differences in sampling design.

RAIN/DRY	D R R D R D R D							D R R D R D R D							D R R D R D R D							D R R D R D R D																				
SEASON	W	W	S	S	W	W	S	W	W	S	S	W	W	S	W	W	S	S	W	W	S	W	W	S	S	W	W	S														
TIME SERIAL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31											
MONTH SERIAL	1	4	9	10	13	18	19	20	21	23	24	29	31	36	37	41	43	47	48	53	55	59	61	65	66	71	73	77	78	83	85											
MONTH ACTUAL	Apr-00	Jul-00	Dec-00	Dec-00	Apr-01	Sep-01	Oct-01	Nov-01	Dec-01	Feb-02	Mar-02	Aug-02	Oct-02	Mar-03	Apr-03	Aug-03	Oct-03	Feb-04	Mar-04	Aug-04	Oct-04	Feb-05	Apr-05	Aug-05	Sep-05	Feb-06	Apr-06	Aug-06	Sep-06	Feb-07	Apr-07											
ESTUARY OR SITE																																										
PUHOI (10 SITES)																																										
WAIWERA (10 SITES)																																										
OREWA (10 SITES)																																										
OKURA1																																										
OKURA2																																										
OKURA3																																										
OKURA4																																										
OKURA5																																										
OKURA6																																										
OKURA7																																										
OKURA8																																										
OKURA9																																										
OKURA10																																										
MANGEMANGEROA (10 SITES)																																										
TURANGA (10 SITES)																																										
WAIKOPIUA (10 SITES)																																										

At each site  = 6 faunal cores taken,  plus ambient sediment samples,  plus trapped sediment samples,  plus bed height measures.

## 7.4 Appendix 4

Schematic diagram of a site marker, showing design of sediment traps.



## 7.5 Appendix 5

List of taxa. The column labeled " ARC " indicates whether the taxon is one of the variables used for benthic health modeling (BHM) or is unique to this monitoring programme (U).

No.	ARC	Abbrev.	Name	Group	Phylum
1	BHM	AgImac	<i>Aglaophamus macroura</i>	Nephtyidae	Annelida
2	BHM	Alphsp	<i>Alpheus sp.</i>	Decapod	Arthropoda
3	BHM	Amalsp	<i>Amalda sp.</i>	Gastropoda	Mollusca
5	BHM	Ampcre	<i>Amphibola crenata</i>	Gastropoda	Mollusca
4	U	Ampdae	Ampharetidae	Terebellidae	Annelida
6	BHM	Ampoth	Amphipod other	Amphipoda	Arthropoda
7	U	Aneoth	Anemone other	Anthozoa	Cnidaria
8	BHM	Antaur	<i>Anthopleura aureoradiata</i>	Anthozoa	Cnidaria
9	BHM	Antdae	Anthuridae	Isopoda	Arthropoda
10	U	Antisp	<i>Antiguraleus sp.</i>	Gastropoda	Mollusca
11	BHM	Aonoxy	<i>Aonides oxycephala</i>	Spionidae	Annelida
12	BHM	Aquauc	<i>Aquilaspio aucklandica</i>	Spionidae	Annelida
13	BHM	Aricsp	<i>Aricidea sp.</i>	Paraonidae	Annelida
14	BHM	Armmac	<i>Armandia maculata</i>	Opheliidae	Annelida
15	BHM	Arbif	<i>Arthritica bifurcata</i>	Bivalvia	Mollusca
16	BHM	Asyamp	<i>Asychis amphiglypta</i>	Maldanidae	Annelida
17	BHM	Ausstu	<i>Austrovenus stutchburyi</i>	Bivalvia	Mollusca
18	BHM	Barnac	Barnacles	Cirripedia	Arthropoda
19	BHM	Bulquo	<i>Bulla quoyi</i>	Opisthobranchia	Mollusca
20	BHM	Capoli	<i>Capitella</i> spp. and oligochaetes	Capitellids + Oligochaetes	Annelida
21	U	Chaeto	Chaetognath	Chaetognath	Chaetognatha
22	BHM	Chiton	Chiton	Polyplacophora	Mollusca
23	BHM	Cirdae	Cirratulidae	Cirratulidae	Annelida
24	U	Cirssp	<i>Cirsonella sp.</i>	Gastropoda	Mollusca
25	U	Cirzel	<i>Cirsotrema zeledori</i>	Gastropoda	Mollusca
26	BHM	Colssp	<i>Colurostylis</i> spp.	Cumacean	Arthropoda
27	BHM	Comads	<i>Cominella adspersa</i>	Gastropoda	Mollusca
28	BHM	Comgla	<i>Cominella glandiformis</i>	Gastropoda	Mollusca
29	U	Commac	<i>Cominella maculosa</i>	Gastropoda	Mollusca
30	U	Comquo	<i>Cominella quoyana</i>	Gastropoda	Mollusca
32	BHM	Cordae	Corophidae	Amphipoda	Arthropoda
31	U	Corzea	<i>Corbula zealandica</i>	Bivalvia	Mollusca
33	BHM	Coscon	<i>Cossura consimilis</i>	Cossuridae	Annelida
34	BHM	Cragig	<i>Crassostrea gigas</i>	Bivalvia	Mollusca
35	BHM	Dilsub	<i>Diloma subrostrata</i>	Gastropoda	Mollusca
36	U	Diopsp	<i>Diopatra sp.</i>	Onuphidae	Annelida
37	U	Dorvil	Dorvilleidae group1	Dorvilleidae	Annelida
38	U	Dosssp	<i>Dosinia</i> spp.	Bivalvia	Mollusca
39	BHM	Edwasp	<i>Edwardsia sp.</i>	Anthozoa	Cnidaria
40	U	Epiten	<i>Epitonium tenellum</i>	Gastropoda	Mollusca
41	BHM	Euchsp	<i>Euchone sp.</i>	Sabellidae	Annelida

No.	ARC	Abbrev.	Name	Group	Phylum
42	U	Eundae	Eunicidae	Eunicidae	Annelida
43	BHM	Eurcoo	<i>Eurylana cookii</i>	Isopoda	Arthropoda
44	U	Evechl	<i>Evechinus chloroticus</i>	Echinoderm	Echinodermata
45	BHM	Exodae	Exogoninae	Syllidae	Annelida
46	BHM	Exospp	<i>Exosphaeroma</i> spp.	Isopoda	Arthropoda
47	BHM	Felaze	<i>Felaniella zelandica</i>	Bivalvia	Mollusca
48	U	Felzel	<i>Fellaster zelandiae</i>	Echinoderm	Echinodermata
49	BHM	Glyssp	<i>Glycera</i> spp.	Glyceriidae	Annelida
50	U	Gnathi	Gnathiidea	Isopoda	Arthropoda
51	U	Gnatho	Gnathostomulida	Gnathostomulida	Gnathostomulida
52	BHM	Gondae	Goniadidae	Glyceriidae	Annelida
53	BHM	Halspp	<i>Halicarcinus</i> spp.	Decapod	Arthropoda
54	BHM	Hamzel	<i>Haminoea zelandiae</i>	Opisthobranchia	Mollusca
55	BHM	Harmssp	<i>Harmothoe</i> sp. <i>Helice</i> , <i>Hemigrapsus</i> , <i>Macrophthalmus</i>	Polynoidae	Annelida
56	BHM	Helmac	<i>Hemigrapsus</i>	Decapod	Arthropoda
57	BHM	Hesdae	Hessionid	Hessionidae	Annelida
58	BHM	Hetfil	<i>Heteromastus filiformis</i>	Capitellidae	Annelida
59	U	Holoth	Holothuroidia other	Echinoderm	Echinodermata
60	U	Insect	Insect	Insect	Arthropoda
61	BHM	Isooth	Isopod other	Isopoda	Arthropoda
62	BHM	Lepdae	Lepidontidae	Polynoidae	Annelida
63	U	Leptsp	<i>Leptograpsus</i> sp.	Decapod	Arthropoda
64	U	Lignov	<i>Ligia novaezelandiae</i>	Isopoda	Arthropoda
67	BHM	Lumdae	Lumbrineridae	Lumbrineridae	Annelida
65	BHM	Macdae	Mactridae	Bivalvia	Mollusca
66	BHM	Maclil	<i>Macomona liliana</i>	Bivalvia	Mollusca
68	BHM	Macste	<i>Macroclymenella stewartensis</i>	Maldanidae	Annelida
69	BHM	Magspp	<i>Magelona</i> spp.	Magelonidae	Annelida
70	BHM	Manshr	Mantis shrimp	Decapod	Arthropoda
71	U	Melasp	<i>Melagraphia</i> sp.	Gastropoda	Mollusca
72	U	Melcyl	<i>Melanochlamys cylindrica</i>	Opisthobranchia	Mollusca
73	BHM	Micrsp	<i>Micrelenchus</i> sp.	Gastropoda	Mollusca
74	BHM	Minspp	<i>Minuspio</i> spp.	Spionidae	Annelida
75	U	Mite	Mite	Chelicaerata	Arthropoda
76	U	Modimp	<i>Modiolarca impacts</i>	Bivalvia	Mollusca
77	U	Mundae	Munnidae	Isopoda	Arthropoda
78	U	Murdae	Muricidae	Gastropoda	Mollusca
79	BHM	Mussen	<i>Musculista senhousia</i>	Bivalvia	Mollusca
80	U	Myastr	<i>Myadora striata</i>	Bivalvia	Mollusca
81	BHM	Mysida	Mysidacea	Mysidacea	Arthropoda
82	U	Mytadg	<i>Mytilus edulis galloprovincialis</i>	Bivalvia	Mollusca
83	BHM	Nebala	Nebalace	Nebalace	Arthropoda
84	BHM	Nemert	Nemertean	Nemertean	Nemertina
85	U	Neogsp	<i>Neoguraleus</i> sp.	Gastropoda	Mollusca
86	BHM	Nerdae	Nereidae	Nereidae	Annelida
88	U	Nodant	<i>Nodilittorina antipodium</i>	Gastropoda	Mollusca
87	BHM	Notosp	<i>Notomastus</i> sp.	Capitellidae	Annelida
89	BHM	Notssp	<i>Notoacmea</i> spp.	Gastropoda	Mollusca
95	BHM	Nuchar	<i>Nucula hartvigiana</i>	Bivalvia	Mollusca

No.	ARC	Abbrev.	Name	Group	Phylum
90	U	Nucoth	Other Nuculidae	Bivalvia	Mollusca
91	U	Odospp	<i>Odostomia</i> spp.	Gastropoda	Mollusca
92	U	Onudae	Onuphidae	Onuphidae	Mollusca
93	U	Ophoth	Opheliidae other	Opheliidae	Annelida
94	BHM	Opisto	Opistobranch (Philine type)	Opisthobranchia	Mollusca
96	BHM	Orbins	Orbinids	Orbiniidae	Annelida
97	BHM	Owefus	<i>Owenia fusiformis</i>	Oweniidae	Annelida
98	U	Pagosp	<i>Pagurus</i> sp.	Decapod	Arthropoda
99	BHM	Palaff	<i>Palaemon affinis</i>	Decapod	Arthropoda
100	BHM	Papaus	<i>Paphies australis</i>	Bivalvia	Mollusca
102	U	Papsub	<i>Paphies subtriangulata</i>	Bivalvia	Mollusca
103	BHM	Paramp	<i>Paralepidonotus ampulliferus</i>	Polynoidae	Annelida
101	BHM	Paroth	Paraonid other	Paraonidae	Annelida
104	BHM	Parspp	<i>Paracalliope</i> spp.	Amphipoda	Arthropoda
105	BHM	Pecaus	<i>Pectinaria australis</i>	Pectinariid	Annelida
106	U	Percan	<i>Perna canaliculus</i>	Bivalvia	Mollusca
107	U	Phitar	<i>Philinopsis taronga</i>	Opisthobranchia	Mollusca
108	BHM	Phoron	Phoronid	Phoronid	Phoronida
109	BHM	Phoxos	Phoxocephalids	Amphipoda	Arthropoda
110	BHM	Physpp	Phyllodocid	Phyllodocidae	Annelida
111	BHM	Pinnsp	<i>Pinnotheres</i> sp.	Decapod	Arthropoda
112	BHM	Platyh	Platyhelminth	Platyhelminth	Platyhelminth
113	BHM	Polyco	Polydorid complex	Spionidae	Annelida
114	BHM	Polyno	Polynoid	Polynoidae	Annelida
115	BHM	Ponaus	<i>Pontophilus australis</i>	Decapod	Arthropoda
116	U	Powesp	<i>Powellisetia</i> sp.	Gastropoda	Mollusca
117	U	Priapu	Priapulid	priapulid	Priapulida
118	U	Pycnog	Pycnogonid	Chelicaerata	Arthropoda
119	U	Risnae	Rissoninae	Gastropoda	Mollusca
120	BHM	Sabdae	Sabellidae	Sabellidae	Annelida
121	U	Scadae	Scalibregmatidae	Scalibregmatidae	Annelida
122	BHM	Scoben	<i>Scolecoides benhami</i>	Orbiniidae	Annelida
123	BHM	Scospp	<i>Scolecopsis</i> spp.	Spionidae	Annelida
124	U	Serdae	Serpulidae	Serpulidae	Annelida
125	BHM	Sipunc	Sipunculid	Sipunculid	Sipunculida
126	BHM	Solpar	<i>Solemya parkinson</i>	Bivalvia	Mollusca
127	U	Solsil	<i>Soletellina siliqua</i>	Bivalvia	Mollusca
128	U	Sphdae	Sphaerodoridae	Sphaerodoridae	Annelida
129	U	Sphguo	<i>Sphaeroma quoyanum</i>	Isopoda	Arthropoda
130	BHM	Spioth	Spionid other	Spionidae	Annelida
131	U	Spirsp	<i>Spirorbis</i> sp.	Serpulidae	Annelida
132	BHM	Syldae	Syllinae	Syllidae	Annelida
133	BHM	Tanaid	Tanaidacea	Tanaidacea	Arthropoda
134	U	Terdae	Terebellidae	Terebellidae	Annelida
135	U	Thashr	Thalassinoidia	Decapod	Arthropoda
136	BHM	Thelub	<i>Theora lubrica</i>	Bivalvia	Mollusca
137	BHM	Traole	<i>Travisa olens</i>	Opheliidae	Annelida
139	BHM	Troden	<i>Trochotodota dendyi</i>	Echinoderm	Echinodermata
138	BHM	Turbsp	<i>Turbonilla</i> sp.	Gastropoda	Mollusca
140	U	Turisma	<i>Turbo smaragdus</i>	Gastropoda	Mollusca

No.	ARC	Abbrev.	Name	Group	Phylum
141	BHM	Unbiva	Unidentified Bivalve	Bivalvia	Mollusca
142	U	Uncrab	Unidentified Crab	Decapod	Arthropoda
143	U	Uncrus	Unidentified Crustacean	Crustacean	Arthropoda
144	BHM	Ungast	Unidentified Gastropod	Gastropoda	Mollusca
145	U	Unpoly	Unidentified Polychaete	Polychaete	Annelida
146	BHM	Veniae	Venericardiae	Bivalvia	Mollusca
147	BHM	Waibre	<i>Waitangi brevirostris</i>	Amphipoda	Arthropoda
148	U	Xenspp	<i>Xenostrobis</i> spp.	Bivalvia	Mollusca
150	BHM	Xymsp	<i>Xymene</i> sp.	Gastropoda	Mollusca
149	BHM	Zealut	<i>Zeacumantus lutulentis</i>	Gastropoda	Mollusca
151	U	Zeaspp	<i>Zeacolpus</i> spp.	Gastropoda	Mollusca
152	BHM	Zegten	<i>Zegalerus tenius</i>	Gastropoda	Mollusca
153	U	Zenasp	<i>Zenatia</i> sp.	Bivalvia	Mollusca

## 7.6 Appendix 6

### Changes in the methods for sampling and processing of ambient sediments over time

Sediment sampling began in September 2001 and used a 38mm diameter corer to a depth of 15cm adjacent to each faunal core (i.e., n = 6 per site). Sediment was then analysed using standard laser grain-size analysis, which provided the percentage volume in different size classes. Due to the unreliability of the laser grain-size analyzer available at the time, a decision was made, in consultation with the ARC, to use wet-sieving instead. Wet-sieving provides a weight of sediment in each grain-size class. This change in methodology occurred in August 2002 (sampling time 12).

Thus, from August 2002 onwards, sample processing was done using wet-sieving after pre-treatment with Calgon. Sediment samples were sub-sampled to obtain a representative known weight of dry material (approximately 60 g). Subsamples were then deflocculated for at least 12 hours and wet sieved on a stack of sieves (500, 250, 125 and 63 $\mu$ m) and each fraction (>500, 250-499, 125-249, 63-124 and <63 $\mu$ m) was dried, weighed and calculated as a percentage of the total weight. The fraction less than 63  $\mu$ m was calculated by subtraction of all other dry weights from the initial dry weight due to the inherent difficulties in settling and drying these fine sediments.

In response to a review of methodology (Ford et al. 2003b), sample processing was changed again in August 2003 to include a pre-treatment of hydrogen peroxide. From this time onward, sub-samples were treated with 9% Hydrogen peroxide until fizzing ceased, to dissolve organic matter prior to the addition of Calgon. Calibration indicated that this change resulted in a small decrease (up to 8%) in the fine grain-size component of a sample (Ford et al. 2003b, pp. 14-16).

In August 2004, the field methods for sampling ambient sediments changed. One core of ambient sediment (20 mm diameter x 20 mm deep) was obtained adjacent to each faunal core and the contents of all six cores were bulked together to yield approximately 60 g wet weight prior to wet-sieving. This change was made in consultation with the ARC so that sampling would be: (i) consistent with the methods used by other ARC-funded programmes; (ii) more sensitive to surface fine sediment deposits than the previous methodology, (iii) integrating small-scale spatial variation within sites, and (iv) highly correlated with the previous sampling methodology.

As a consequence of the changes in sampling and processing methods outlined above, data on the texture of ambient sediments is only truly comparable from August 2004 (time 20) onwards.

## 7.7 Appendix 7

### Glossary of statistical terms

*AIC*: "An Information Criterion", described by Akaike (1973), this is a value which is used to compare models of differing complexity which counter-balances the amount of variation explained ( $R^2$ ) with the number of parameters (variables) used in the model. Smaller values of AIC indicate a better model for a given dataset.

*ANOVA*: "Analysis of Variance", a classical statistical method for comparing the means of several groups of samples, or examining the effects of treatment levels on a response variable.

*Bray-Curtis*: a dissimilarity measure, described by Bray and Curtis (1957), interpreted in ecology as a "percentage difference", calculated between two samples ( $i$  and  $j$ ) on the basis of  $k = 1, \dots, p$  variables. If the value for variable  $k$  in sample  $i$  is denoted by  $y_{ik}$ , then the Bray-Curtis dissimilarity between samples  $i$  and  $j$  is calculated as:

$$d_{ij} = \frac{\sum_{k=1}^p |y_{ik} - y_{jk}|}{\sum_{k=1}^p (y_{ik} + y_{jk})}$$

*CAP*: "Canonical Analysis of Principal Coordinates" (Anderson and Robinson 2003; Anderson and Willis 2003), a method of constrained ordination that finds an axis through a cloud of multivariate samples (on the basis of any distance or dissimilarity measure of choice) that is best at either discriminating *a priori* groups or at distinguishing positions of samples along a given (usually environmental) gradient.

*central limit theorem*: "CLT", a theorem stating that the distribution of sample means taken from a large population approaches a normal (Gaussian) curve with increases in sample size.

*centroid*: the multivariate analogue to an average or mean for a single variable. The centroid is a measure of the 'location' of a data cloud in multivariate space.

*dbRDA*: "Distance-based Redundancy Analysis" (Legendre and Anderson 1999; McArdle and Anderson 2001), a method of constrained ordination, which displays the relationships among sample points from a fitted model, on the basis of any distance or dissimilarity measure of choice. The ordination axes in a dbRDA are linear combinations of the predictor variables in the model that maximally explain variation in the data cloud.

*df*: "degrees of freedom": (1) *df of a model*: a value which indicates the complexity of a model. The greater the degrees of freedom of the model, the more parameters there are in the model and the more complex it is. (2) *residual df*: a value which indicates the number of pieces of information in a system that are free to vary. Generally, the greater the residual df, the greater the power of a test. Also, as model df go up, residual df go down.

*dispersion*: a measure of variability or how 'spread out' a set of points are in multivariate space.

*distance (or dissimilarity) matrix*: a matrix whose entries  $d_{ij}$  are the distance (or dissimilarity) values between every pair of  $N$  samples ( $i = 1, \dots, N$  rows and  $j = 1, \dots, N$  columns). This matrix is *square* (the number of rows equals the number of columns =  $N$ ) and *symmetric* (because  $d_{ji} = d_{ij}$ ) and each of the values along the diagonal,  $d_{ii}$  (denoting the distance from a given sample to itself), is equal to zero.

*DISTLM*: "Distance-based linear model" (McArdle and Anderson 2001), a method of fitting one or more predictor variables (usually environmental variables) to a set of response variables (usually biotic or species data) on the basis of a distance or dissimilarity measure of choice (e.g., Bray-Curtis). If the distance measure chosen is Euclidean distance, then the method does classical redundancy analysis (RDA). Although these models are linear in the predictor variables, they are generally non-linear in the responses (depending on the distance measure chosen as the basis for the analysis). DISTLM is a modeling tool, while dbRDA is a graphical tool for doing multivariate multiple regression on the basis of a dissimilarity matrix.

*drafstman plots*: a set of scatterplots, set out in a triangular fashion, where each pair of a set of variables on a single set of samples are plotted against each other in order to examine the patterns of relationship (correlations) among the variables and to look for outliers.

*error rate*: the rate at which a mistake is made when testing a null hypothesis using a given significance level. There are two kinds of error: Type I and Type II. A Type I error is the rejection of a true null hypothesis. A Type II error is the retention of a false null hypothesis.

*Euclidean distance*: the straight-line distance in Euclidean space between two sample points,  $i$  and  $j$ , where each variable  $k = 1, \dots, p$  defines an independent (orthogonal) dimension. If the value for variable  $k$  in sample  $i$  is denoted by  $y_{ik}$ , then the Euclidean distance between samples  $i$  and  $j$  is calculated as:

$$d_{ij} = \sqrt{\sum_{k=1}^p (y_{ik} - y_{jk})^2}$$

*exact test*: a test whose Type I error rate matches exactly the *a priori* chosen significance level (e.g., a test that rejects the null hypothesis at a rate of 5% when the significance level chosen is  $\alpha = 0.05$ ).

*family-wise error rate*: the rate of Type I error (rejecting a true null hypothesis) when performing multiple simultaneous tests at a given significance level.

*GAM*: "Generalized Additive Model" (Hastie and Tibshirani 1990), a flexible modeling approach that modifies the usual linear regression model of variable  $Y$  versus a set of  $q$  predictor variables  $X_1 \dots X_q$ , as follows:

$$E(Y) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_q X_q$$

to something more flexible, by replacing the linear parameter terms,  $\beta_i X_i$ , with more general functions  $f(X_i)$ :

$$E(Y) = \beta_0 + f(X_1) + f(X_2) + \dots + f(X_q)$$

GAMs are generally used for predictive modeling, but some caution is needed to avoid over-fitting.

*homogeneity*: equality of variances or dispersions.

*MDS*: non-metric "Multi-Dimensional Scaling", a method of ordination on the basis of a distance (or dissimilarity) matrix. The aim is to produce a pattern of points (samples) in a small number of dimensions (usually 2, but sometimes more), which retains the rank-order values of distances between those points as given in the original matrix. The relative proximity of the points on the resulting ordination diagram are interpretable as the relative similarities among the samples (e.g., sample A is more similar to sample B than it is to sample C, etc.).

*percentile*: see *quantile*.

*PERMANOVA*: "Permutational Multivariate Analysis of Variance", a method for partitioning multivariate variability on the basis of a chosen dissimilarity measure and performing tests of individual terms in ANOVA models, using permutation procedures (Anderson 2001, McArdle and Anderson 2001).

*PERMANOVA+*: an add-on package to the PRIMER computer program (Anderson and Gorley 2008), allowing the analysis of multivariate data in response to complex experimental designs or quantitative (e.g., environmental) variables and including routines for CAP, dbRDA, DISTLM, PERMANOVA and PERMDISP.

*PERMDISP*: "Permutational test of Dispersions", a method for testing the homogeneity of multivariate dispersions (the relative spread or variability) among *a priori* groups (Anderson 2006).

*permutation test*: a statistical test performed by calculating a test-criterion (such as  $F$  or  $t$ ), then re-calculating its value after random re-allocation of observation units, either to groups in an experimental design or to values of a predictor variable (e.g., percentage mud) along a gradient, under a true null hypothesis of either no effect of groups, or no relationship with the gradient. Repeating the permutation procedure a large number of times allows a p-value to be calculated as the proportion of values of the test-criterion obtained under permutation that equal or exceed (are more extreme than) the original value.

*PRIMER*: "Plymouth Routines in Multivariate Ecological Research", a computer program by Bob Clarke and Ray Gorley from Plymouth Marine Laboratory, UK, specialising in the analysis of multivariate ecological data, including analyses based on Bray-Curtis and MDS ordination.

*P-value*: the probability, when the null hypothesis is true, of obtaining a statistical test-criterion (such as  $t$  or  $F$ ) that is equal to or more extreme than the value of that test-criterion that was actually obtained for a given set of data.

*quantile*: a value for a variable that divides the total frequency of a sample or population into specified proportions. For example, the 0.25 quantile is the value that has 25% of the data below it and 75% of the data above it. A synonymous concept is the *percentile*,

which is expressed as a percentage, rather than a proportion (e.g., the 0.25-quantile is the 25<sup>th</sup> percentile). For more examples: (i) the 0.5 quantile is the median (middle) of a data set; (ii) five percent of the data lie above the 95<sup>th</sup> percentile.

*quantile regression*: an analysis of a variable's specified quantile in response to one or more predictor variables (Koenker 2005; 2007). Ordinary regression is the analysis of a variable's mean value in response to one or more predictor variables.

*R*: a language and programming environment for statistical computing and graphics (Ihaka and Gentleman 1996; R Development Core Team 2007).

$R^2$ : coefficient of multiple determination, the proportion of the total variation in one or more response variables that is explained by a given set of one or more predictor variables. The value of  $R^2$  increases monotonically with increases in the number of predictor variables included in the model.

*significance level*: commonly denoted by  $\alpha$  and used in testing hypotheses, a value which is set *a priori* (at the beginning) as the level of probability below which one is prepared to reject a null hypothesis. For example, if a significance level is set at  $\alpha = 0.05$ , then one would reject the null hypothesis for any *P*-value obtained that is smaller than 0.05 in value.

*spline*: a function defined by piece-wise polynomials that interpolates a smooth curve through a set of (X, Y) points. The higher the degree of the polynomial (i.e., the higher the degrees of freedom of the model), the more complex the spline shape will be, as a fit the data.

*stress*: a value used to assess the adequacy of an MDS plot to represent the relative dissimilarities among sample points in a reduced number of dimensions. As a rule of thumb: values of stress < 0.05 are excellent representations; values < 0.10 are very good; < 0.20 yields an interpretable plot, but values > 0.20 are suspect. A stress value as high as 0.30 indicates that the ordination diagram is really no better than a random smattering of points.

*t-test*: a classical statistical test for comparing the means of two groups of samples.

*variance component*: a measure of the amount of variation attributable to a given factor or a given spatial or temporal scale in an experimental design.

## 7.8 Appendix 8

Tables showing the top ten taxa in terms of rank proportional abundances (on average, through time) for each site, with a separate table for each of the estuaries. The names of taxa are given as abbreviations according to Appendix 5. Also provided are the averages (and ranges) for the number of taxa ("Avnosp") and the total abundance ("Avabund") at each site through time. The time points included in the calculations were the 20 time points from time 12 (August 2002) onwards for Puhoi, Waiwera, Orewa, Okura and Mangemangeroa, and the 12 time points from time 20 (August 2004) onwards for Turanga and Waikopua. The proportion of the total abundance accounted for by the top 5 and the top 10 listed taxa are also given, providing an indication of evenness for the communities at each site.

PUHOI

Puhoi	Rank proportional abundance										Avnosp	Avabund	Total proportions	
	1	2	3	4	5	6	7	8	9	10			First 5	First 10
<b>P1</b>	Papaus 0.530	Waibre 0.205	Colsp 0.083	Paroth 0.046	Ausstu 0.039	Exospp 0.027	Barnac 0.019	Eurcoo 0.005	Magspp 0.005	Macill 0.005	18.2 (12-25)	112 (56-167)	0.905	0.967
<b>P2</b>	Cordae 0.233	Capoli 0.226	Coscon 0.164	Polyco 0.124	Aquauc 0.048	Ausstu 0.029	Helmac 0.029	Nerdae 0.028	Hefil 0.026	Parspp 0.016	17.95 (10-26)	57 (10-132)	0.795	0.923
<b>P3</b>	Cordae 0.263	Capoli 0.157	Ausstu 0.152	Polyco 0.146	Orbins 0.075	Helmac 0.030	Aquauc 0.022	Nerdae 0.021	Hefil 0.021	Macill 0.015	20 (12-30)	49 (16-96)	0.793	0.901
<b>P4</b>	Barnac 0.459	Ausstu 0.177	Waibre 0.107	Papaus 0.069	Colsp 0.040	Nuchar 0.038	Exospp 0.024	Scospp 0.017	Macill 0.013	Notssp 0.012	25.6 (19-34)	220 (81-491)	0.851	0.954
<b>P5</b>	Capoli 0.207	Coscon 0.182	Nerdae 0.181	Polyco 0.145	Aquauc 0.111	Hefil 0.032	Orbins 0.023	Pecaus 0.021	Parspp 0.017	Cordae 0.010	20.9 (14-30)	91 (41-202)	0.826	0.930
<b>P6</b>	Ausstu 0.211	Aquauc 0.112	Hefil 0.089	Exodae 0.082	Macill 0.062	Polyco 0.053	Nuchar 0.053	Barnac 0.046	Antaur 0.044	Colsp 0.036	28.8 (24-34)	84 (49-141)	0.555	0.787
<b>P7</b>	Capoli 0.236	Polyco 0.242	Colsp 0.102	Aquauc 0.087	Ausstu 0.067	Macill 0.057	Nerdae 0.045	Papaus 0.045	Hefil 0.026	Magspp 0.025	25.9 (18-33)	80 (22-214)	0.669	0.867
<b>P8</b>	Capoli 0.421	Polyco 0.242	Cordae 0.120	Nerdae 0.058	Hefil 0.044	Helmac 0.040	Aquauc 0.038	Ausstu 0.018	Pecaus 0.016	Parspp 0.013	17.6 (10-27)	51 (17-141)	0.787	0.911
<b>P9</b>	Cordae 0.421	Capoli 0.169	Polyco 0.117	Papaus 0.060	Nerdae 0.051	Waibre 0.023	Helmac 0.022	Ausstu 0.021	Colsp 0.014	Macill 0.012	15.9 (6-27)	52 (10-141)	0.817	0.909
<b>P10</b>	Papaus 0.248	Cordae 0.160	Capoli 0.148	Colsp 0.117	Waibre 0.063	Ausstu 0.055	Nerdae 0.043	Macill 0.027	Scospp 0.027	Polyco 0.025	18.2 (10-27)	55 (13-201)	0.735	0.912

Appendix 8, continued.

WAIWERA

Waiwera	Rank proportional abundance										Avabund	Total proportions		
	1	2	3	4	5	6	7	8	9	10		Avnosp	First 5	First 10
<b>W1</b>	Capoli 0.166	Aquauc 0.166	Polyco 0.114	Cordae 0.104	Ausstu 0.084	Nerdae 0.077	Helmac 0.066	Heffil 0.041	Macil 0.037	Parspp 0.021	19.6 (12-28)	51 (11-102)	0.634	0.875
<b>W2</b>	Ausstu 0.364	Cordae 0.191	Capoli 0.130	Helmac 0.069	Nerdae 0.037	Polyco 0.035	Parspp 0.034	Eurcoo 0.017	Papaus 0.013	Arfbf 0.013	13.5 (6-20)	24 (6-52)	0.791	0.903
<b>W3</b>	Papaus 0.475	Waibre 0.219	Colsppl 0.161	Exospp 0.037	Barnac 0.026	Ausstu 0.019	Cordae 0.011	Mysida 0.006	Phoxos 0.006	Orbins 0.006	8-27 (8-27)	88 (26-196)	0.918	0.966
<b>W4</b>	Capoli 0.208	Cordae 0.184	Eurcoo 0.080	Parspp 0.076	Papaus 0.075	Helmac 0.069	Exospp 0.053	Scoben 0.051	Ausstu 0.045	Waibre 0.030	12.8 (8-20)	19 (6-56)	0.623	0.871
<b>W5</b>	Ausstu 0.281	Capoli 0.135	Aquauc 0.127	Exodae 0.080	Cordae 0.060	Nuchar 0.044	Polyco 0.044	Barnac 0.039	Macil 0.032	Heffil 0.030	27.2 (21-33)	107 (42-181)	0.684	0.873
<b>W6</b>	Ausstu 0.196	Papaus 0.193	Waibre 0.174	Colsppl 0.092	Exospp 0.082	Macil 0.047	Barnac 0.044	Nuchar 0.024	Nerdae 0.021	Aquauc 0.018	23.9 (16-36)	94 (59-167)	0.737	0.890
<b>W7</b>	Ausstu 0.410	Barnac 0.162	Capoli 0.098	Nuchar 0.070	Colsppl 0.031	Macil 0.028	Exodae 0.026	Orbins 0.025	Notsppl 0.024	Aquauc 0.023	22.6 (17-29)	84 (45-133)	0.771	0.897
<b>W8</b>	Papaus 0.324	Colsppl 0.232	Waibre 0.177	Ausstu 0.065	Exospp 0.041	Macil 0.022	Nerdae 0.019	Barnac 0.017	Aquauc 0.013	Mysida 0.012	22.4 (17-29)	97 (54-239)	0.839	0.920
<b>W9</b>	Ausstu 0.180	Aquauc 0.156	Nerdae 0.112	Colsppl 0.085	Capoli 0.073	Aonoxyl 0.051	Macil 0.051	Polyco 0.043	Heffil 0.036	Antaur 0.028	28.9 (24-35)	100 (62-205)	0.607	0.816
<b>W10</b>	Ausstu 0.325	Capoli 0.248	Cordae 0.117	Helmac 0.047	Aquauc 0.042	Barnac 0.041	Polyco 0.031	Macil 0.024	Nerdae 0.020	Orbins 0.014	18.6 (10-27)	52 (19-114)	0.777	0.906

## OREWA

	Rank proportional abundance										Avabund	Total proportions		
	1	2	3	4	5	6	7	8	9	10		Avnosp	First 5	First 10
<b>R1</b>	Papaus 0.547	Exospp 0.179	Waibre 0.154	Colsp 0.037	Ausstu 0.034	Barnac 0.014	Eurcoo 0.010	Macill 0.008	Aquauc 0.003	Nemert 0.002	14.3 (10-18)	156 (67-310)	0.951	0.989
<b>R2</b>	Barnac 0.453	Ausstu 0.219	Aquauc 0.122	Notssp 0.034	Macill 0.033	Nuchar 0.014	Exodae 0.014	Orbins 0.011	Papaus 0.010	Aonoxy 0.009	28.8 (21-35)	215 (92-777)	0.861	0.920
<b>R3</b>	Barnac 0.393	Papaus 0.354	Ausstu 0.072	Waibre 0.045	Colsp 0.039	Aonoxy 0.024	Exospp 0.014	Notssp 0.012	Macill 0.009	Eurcoo 0.004	22.1 (13-34)	246 (43-668)	0.903	0.966
<b>R4</b>	Waibre 0.374	Exospp 0.190	Papaus 0.182	Cordae 0.110	Eurcoo 0.054	Ausstu 0.031	Barnac 0.016	Colsp 0.011	Capoli 0.005	Helmac 0.004	13.3 (8-23)	72 (19-135)	0.909	0.975
<b>R5</b>	Ausstu 0.382	Aquauc 0.135	Barnac 0.069	Orbins 0.056	Macill 0.055	Exodae 0.049	Nuchar 0.044	Antaur 0.037	Aonoxy 0.025	Notssp 0.025	25.8 (17-32)	107 (48-182)	0.696	0.877
<b>R6</b>	Aquauc 0.331	Orbins 0.082	Pecaus 0.076	Heffil 0.065	Capoli 0.065	Parspp 0.059	Nerdac 0.043	Mysida 0.039	Macill 0.037	Polyco 0.037	22.4 (15-27)	54 (19-150)	0.619	0.835
<b>R7</b>	Ausstu 0.339	Barnac 0.122	Macill 0.086	Aquauc 0.082	Colsp 0.072	Nuchar 0.059	Capoli 0.028	Papaus 0.019	Heffil 0.019	Nerdac 0.019	26.6 (19-33)	79 (27-122)	0.701	0.844
<b>R8</b>	Cordae 0.191	Orbins 0.150	Capoli 0.149	Aquauc 0.088	Macill 0.078	Ausstu 0.076	Polyco 0.025	Parspp 0.024	Barnac 0.023	Antaur 0.020	21.5 (14-31)	49 (17-122)	0.656	0.825
<b>R9</b>	Cordae 0.290	Capoli 0.232	Orbins 0.145	Macill 0.070	Ausstu 0.065	Aquauc 0.034	Nerdac 0.033	Parspp 0.028	Edwasp 0.012	Polyco 0.012	21.1 (11-26)	81 (30-282)	0.800	0.919
<b>R10</b>	Cordae 0.252	Nerdac 0.163	Polyco 0.136	Capoli 0.121	Aquauc 0.095	Parspp 0.073	Orbins 0.043	Macill 0.015	Glysp 0.014	Heffil 0.014	20.9 (16-29)	75 (12-242)	0.767	0.925

OKURA

	Rank proportional abundance										Avnosp	Avabund	Total proportions	
	1	2	3	4	5	6	7	8	9	10			First 5	First 10
<b>O1</b>	Ausstu 0.252	Aonoxy 0.119	Nuchar 0.084	Antaur 0.074	Papaus 0.074	Colsp 0.057	Parssp 0.053	Barnac 0.048	Phoxos 0.037	Hetfil 0.034	27.9 (21-35)	130.8 (92-184)	0.603	0.832
<b>O2</b>	Hetfil 0.210	Coscon 0.193	Aquauc 0.138	Nuchar 0.083	Polyco 0.065	Ausstu 0.061	Maclil 0.047	Nerdae 0.035	Glyssp 0.023	Pecaus 0.021	29.1 (22-39)	103.8 (64-179)	0.689	0.876
<b>O3</b>	Ausstu 0.459	Barnac 0.229	Colsp 0.062	Papaus 0.040	Sipunc 0.019	Hetfil 0.019	Waibre 0.017	Notssp 0.015	Maclil 0.013	Helmac 0.012	26.1 (15-34)	95.2 (57-149)	0.809	0.883
<b>O4</b>	Ausstu 0.199	Barnac 0.148	Colsp 0.138	Nuchar 0.103	Aonoxy 0.057	Phoxos 0.057	Antaur 0.053	Hetfil 0.041	Maclil 0.039	Aquauc 0.030	29.6 (23-36)	124.5 (87-179)	0.646	0.865
<b>O5</b>	Ausstu 0.171	Cordae 0.132	Hetfil 0.119	Nuchar 0.089	Aquauc 0.053	Capoli 0.050	Orbins 0.044	Colsp 0.041	Barnac 0.040	Maclil 0.038	29.0 (19-39)	80.4 (42-136)	0.563	0.777
<b>O6</b>	Ausstu 0.233	Barnac 0.167	Nuchar 0.120	Antaur 0.091	Aquauc 0.083	Hetfil 0.065	Notssp 0.052	Colsp 0.033	Maclil 0.028	Phoxos 0.020	33.0 (27-44)	190.0 (125-275)	0.693	0.890
<b>O7</b>	Ausstu 0.253	Barnac 0.100	Orbins 0.075	Aonoxy 0.054	Cordae 0.053	Colsp 0.049	Capoli 0.048	Aquauc 0.047	Nuchar 0.047	Maclil 0.036	24.9 (19-31)	56.7 (31-152)	0.536	0.764
<b>O8</b>	Hetfil 0.170	Orbins 0.141	Ausstu 0.102	Aquauc 0.096	Cordae 0.073	Capoli 0.070	Maclil 0.062	Nerdae 0.036	Polyco 0.030	Helmac 0.026	23.9 (17-34)	50.3 (30-91)	0.581	0.804
<b>O9</b>	Hetfil 0.201	Nuchar 0.108	Aquauc 0.105	Ausstu 0.091	Maclil 0.082	Capoli 0.053	Pecaus 0.047	Polyco 0.044	Nerdae 0.041	Coscon 0.037	27.1 (15-37)	80.6 (40-171)	0.587	0.809
<b>O10</b>	Hetfil 0.194	Capoli 0.122	Cordae 0.102	Polyco 0.090	Aquauc 0.086	Nerdae 0.085	Coscon 0.073	Pecaus 0.048	Glyssp 0.035	Maclil 0.026	20.8 (14-28)	55.5 (30-110)	0.594	0.861

Appendix 8, continued.

MANGEMANGEROA

		Mangemangeroa										Total proportions			
		Rank proportional abundance										Avnosp	Avabund	First 5	First 10
		1	2	3	4	5	6	7	8	9	10				
<b>M1</b>	Nuchar	0.345	0.191	0.127	0.080	0.031	0.028	0.027	0.018	0.017	0.016	29.0 (24-34)	110 (71-144)	0.773	0.879
<b>M2</b>	Nuchar	0.250	0.152	0.132	0.102	0.100	0.049	0.021	0.020	0.020	0.017	31.1 (22-37)	126 (82-172)	0.734	0.861
<b>M3</b>	Barnac	0.319	0.147	0.130	0.084	0.073	0.063	0.047	0.030	0.021	0.014	35.1 (29-42)	296 (147-652)	0.753	0.929
<b>M4</b>	Barnac	0.181	0.143	0.104	0.099	0.095	0.048	0.046	0.037	0.035	0.026	26.6 (21-36)	60 (22-152)	0.621	0.812
<b>M5</b>	Aquauc	0.175	0.136	0.115	0.088	0.086	0.068	0.067	0.045	0.033	0.026	25.9 (22-32)	55 (24-103)	0.599	0.837
<b>M6</b>	Hetfil	0.274	0.122	0.099	0.094	0.098	0.038	0.037	0.034	0.029	0.017	32.2 (25-47)	96 (54-222)	0.676	0.830
<b>M7</b>	Barnac	0.222	0.199	0.139	0.084	0.053	0.039	0.039	0.038	0.024	0.022	25.8 (21-36)	67 (36-125)	0.696	0.858
<b>M8</b>	Hetfil	0.399	0.194	0.062	0.040	0.039	0.038	0.034	0.031	0.023	0.018	21.9 (14-28)	51 (28-98)	0.733	0.877
<b>M9</b>	Hetfil	0.380	0.142	0.081	0.058	0.053	0.042	0.031	0.030	0.028	0.025	22.2 (16-29)	51 (27-113)	0.714	0.870
<b>M10</b>	Hetfil	0.410	0.175	0.057	0.043	0.042	0.040	0.034	0.026	0.023	0.020	22.0 (17-32)	52 (27-93)	0.727	0.870

## TURANGA

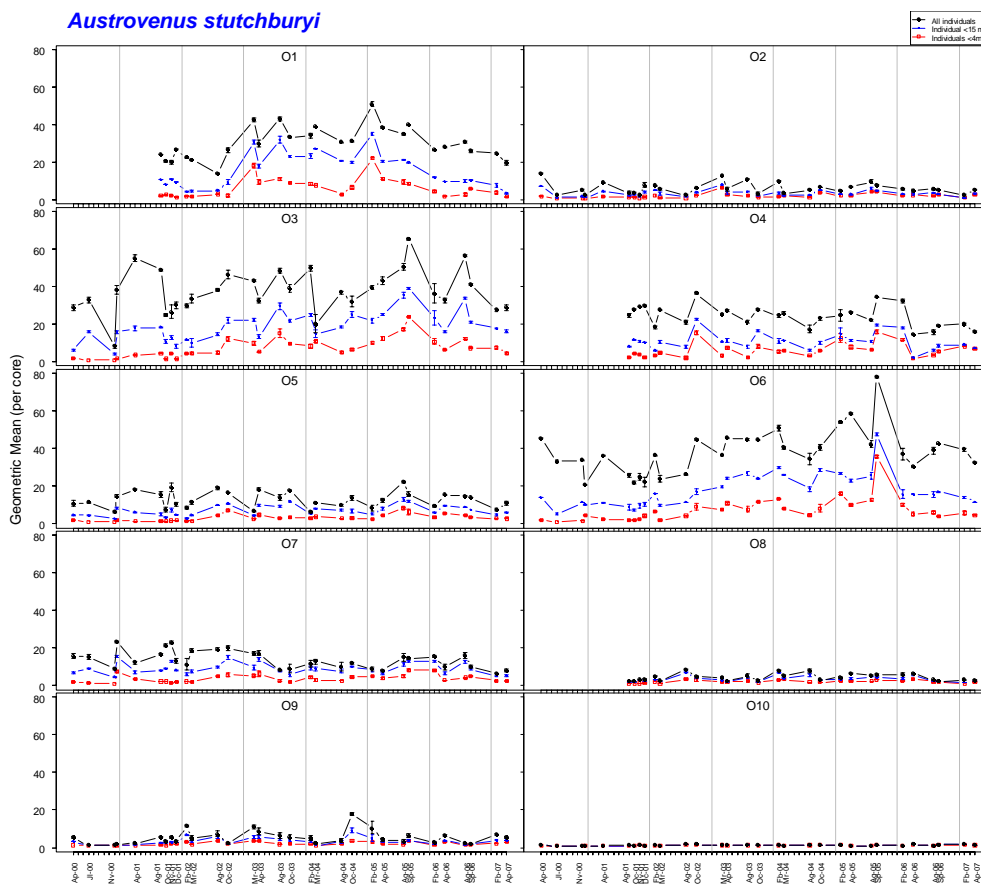
	Rank proportional abundance										Avabund	Total proportions		
	1	2	3	4	5	6	7	8	9	10		Avnospp	First 5	First 10
<b>T1</b>	Aquac 0.194	Aonoxy 0.152	Parspp 0.124	Nuchar 0.088	Macil 0.066	Ausstu 0.058	Orbins 0.056	Barnac 0.044	Antaur 0.032	Not spp 0.029	24.8 (20-29)	56 (20-90)	0.624	0.843
<b>T2</b>	Papaus 0.258	Parspp 0.216	Nuchar 0.093	Orbins 0.083	Aonoxy 0.082	Not spp 0.045	Ausstu 0.033	Macil 0.030	Scospp 0.030	Aquac 0.028	21.3 (17-27)	51 (14-83)	0.733	0.898
<b>T3</b>	Barnac 0.257	Nuchar 0.201	Not spp 0.108	Orbins 0.103	Parspp 0.076	Papaus 0.066	Aquac 0.034	Aonoxy 0.034	Ausstu 0.017	Macil 0.017	22.9 (14-29)	66 (44-97)	0.746	0.914
<b>T4</b>	Artbif 0.201	Aquac 0.145	Hetfil 0.130	Nerdae 0.100	Ausstu 0.098	Helmac 0.072	Capoli 0.049	Polyco 0.026	Nemert 0.025	Nuchar 0.023	18.2 (12-29)	22 (11-50)	0.674	0.869
<b>T5</b>	Helmac 0.149	Hetfil 0.149	Aquac 0.142	Capoli 0.114	Artbif 0.080	Ausstu 0.063	Nerdae 0.052	Nuchar 0.051	Nemert 0.031	Cordae 0.030	18.8 (8-27)	20 (7-38)	0.633	0.859
<b>T6</b>	Barnac 0.514	Nuchar 0.092	Ausstu 0.083	Aquac 0.083	Hetfil 0.053	Artbif 0.036	Antaur 0.028	Nerdae 0.015	Polyco 0.011	Helmac 0.011	30.6 (17-38)	188 (16-307)	0.825	0.927
<b>T7</b>	Barnac 0.525	Ausstu 0.078	Nuchar 0.075	Aquac 0.068	Hetfil 0.061	Artbif 0.030	Antaur 0.029	Polyco 0.019	Capoli 0.015	Nerdae 0.014	33.4 (25-37)	201 (68-328)	0.807	0.914
<b>T8</b>	Capoli 0.267	Hetfil 0.250	Aquac 0.097	Cordae 0.062	Helmac 0.061	Nerdae 0.051	Thelub 0.042	Nemert 0.024	Artbif 0.020	Barnac 0.019	21.5 (15-27)	52 (20-115)	0.737	0.893
<b>T9</b>	Cordae 0.531	Capoli 0.207	Helmac 0.171	Aquac 0.021	Hetfil 0.016	Nerdae 0.011	Polyco 0.009	Barnac 0.007	Nemert 0.005	Ampcre 0.003	10.3 (5-18)	38 (7-107)	0.946	0.980
<b>T10</b>	Cordae 0.606	Capoli 0.182	Helmac 0.127	Aquac 0.014	Hetfil 0.010	Polyco 0.010	Nerdae 0.010	Macdae 0.007	Nemert 0.005	Parspp 0.003	11.9 (6-18)	55 (8-105)	0.939	0.974

## WAIKOPUA

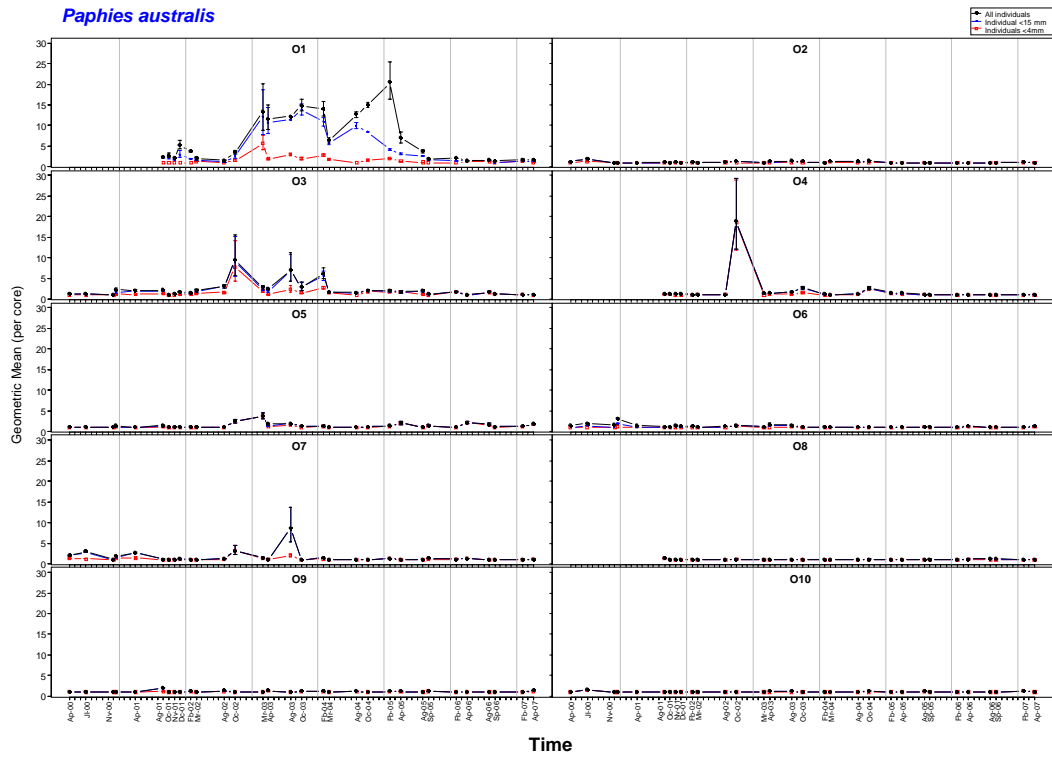
	Rank proportional abundance										Avabund	Total proportions		
	1	2	3	4	5	6	7	8	9	10		Avnospp	First 5	First 10
<b>K1</b>	Aricsp 0.113	Macste 0.093	Colsppp 0.083	Parspp 0.064	Syidae 0.058	Ausstu 0.049	Nuchar 0.037	Aglmac 0.037	Sabdae 0.036	Exodae 0.036	30.0 (21-38)	27 (18-56)	0.411	0.605
<b>K2</b>	Nuchar 0.294	Aquauc 0.096	Ausstu 0.078	Hetfil 0.066	Exodae 0.053	Mussen 0.052	Nerdae 0.052	Macfil 0.050	Artbif 0.033	Orbins 0.027	37.1 (32-43)	110 (83-155)	0.587	0.801
<b>K3</b>	Nuchar 0.284	Hetfil 0.172	Aquauc 0.129	Ausstu 0.053	Artbif 0.041	Exodae 0.040	Nerdae 0.036	Nemert 0.029	Macfil 0.023	Macste 0.016	35.4 (28-41)	118 (80-176)	0.679	0.822
<b>K4</b>	Nuchar 0.306	Aquauc 0.145	Hetfil 0.127	Nerdae 0.057	Ausstu 0.043	Artbif 0.032	Exodae 0.031	Macfil 0.029	Nemert 0.021	Polyco 0.019	34.2 (27-41)	86 (59-134)	0.679	0.810
<b>K5</b>	Nuchar 0.226	Hetfil 0.203	Aquauc 0.151	Ausstu 0.052	Artbif 0.045	Nerdae 0.044	Exodae 0.042	Macfil 0.029	Macste 0.020	Polyco 0.020	32.7 (26-36)	109 (76-167)	0.676	0.832
<b>K6</b>	Aquauc 0.281	Nuchar 0.227	Hetfil 0.066	Artbif 0.055	Ausstu 0.053	Aonoxy 0.051	Nerdae 0.031	Orbins 0.028	Notsppp 0.022	Parspp 0.020	29.9 (28-35)	84 (58-117)	0.681	0.834
<b>K7</b>	Aonoxy 0.357	Nuchar 0.212	Aquauc 0.107	Ausstu 0.040	Hetfil 0.037	Orbins 0.028	Macfil 0.025	Nerdae 0.023	Capoli 0.021	Colsppp 0.020	28.2 (22-33)	100 (56-162)	0.752	0.869
<b>K8</b>	Orbins 0.180	Aquauc 0.118	Helmac 0.115	Capoli 0.089	Hetfil 0.082	Artbif 0.074	Ausstu 0.070	Nerdae 0.067	Cordae 0.055	Polyco 0.029	17.4 (14-21)	24 (17-57)	0.584	0.879
<b>K9</b>	Cordae 0.169	Capoli 0.161	Helmac 0.147	Artbif 0.109	Ausstu 0.107	Nerdae 0.070	Aquauc 0.049	Hetfil 0.033	Macdae 0.021	Parspp 0.018	13.9 (9-18)	15 (5-27)	0.692	0.883
<b>K10</b>	Capoli 0.390	Helmac 0.223	Cordae 0.097	Polyco 0.064	Artbif 0.038	Ausstu 0.024	Nerdae 0.023	Macfil 0.022	Macdae 0.021	Hetfil 0.017	11.6 (8-18)	19 (10-45)	0.812	0.919

## 7.9 Appendix 9

Time series of typical abundances of bivalves (*Austrovenus*, *Paphies* and *Macomona*, each shown separately) of different sizes classes at individual sites within Okura. The abundance of the smallest size class (individuals <4mm) is shown in red, the mid-size class (4-15 mm) is depicted by the distance between the red and blue lines and the largest size class (>15mm) is depicted by the distance between blue and black lines.



Appendix 9, continued



Appendix 9, continued

