AQUENAL PTY LTD

BASELINE ENVIRONMENTAL SURVEY

FOR THE MONITORING OF BIOLOGICAL IMPACT OF NUTRIENTS RELEASED FROM A PROPOSED AQUACULTURE OPERATION AT SNAKE BAY, MELVILLE ISLAND

AUGUST 2005

REPORT TO

MARINE HARVEST

BY

AQUENAL PTY LTD

Contents

List of Figures

List of Tables

1 Summary

Marine Harvest has proposed the establishment of a Barramundi Farm in Snake Bay, Northern Territory. The proposed farm location is inside the sheltered section of Snake Bay formed by the narrows between Johnson Point (locally know as Picnic Point) and Point Strath on the lower estuary of the Tjipripu River. It is in an area of deep water just inside the narrows on the centreline of the estuary. Snake Bay to seaward of the narrows is an area of shoal water and sandbars with a narrow channel scoured by tidal flows which follows the southern shore. The water passing through this channel flows at speeds exceeding 3 knots during spring tides. The proposed farm location is in a small area of deep water at the inner end of the channel in the wider waters inside the narrows and therefore subject to lower current velocities. It is within a wide area of shallow water consisting of intertidal mud flats and channels surrounded by mangroves, with various small creeks discharging into it. There is no influence from ocean swell inside the narrows but during the late dry season the waters have properties approaching those of marine waters. During the wet season there is large inflow of fresh water from the Tjipripu River and the surrounding catchment but this decreases to negligible during the dry season.

Aquenal Pty Ltd was commissioned to carry out a Baseline Environmental Survey to assess the baseline condition of several parameters expected to be sensitive to impact from elevated nutrient levels which may result from the proposed aquaculture operations. The adjacent and similar estuary, the Mirikauyunga Creek estuary, which discharges into Shark Bay 3 km to the west was selected as a control. This estuary is also protected by a shallow bay of sand bars and channels, fringed by mangroves subject to similar stressors as the Snake Bay estuary but the lower estuary is narrower and the catchment is smaller. However its proximity to Snake Bay and ease of access combined with the lack of any nearby estuary more similar to the proposed farm site justified its selection.

The main hydrological influences on these water bodies are the 6 m tidal range, which results in large daily flushing of the mangroves with seawater, and run-off from heavy rains during the wet season. Towards the end of the dry season, when terrestrial run-off has ceased and hot temperatures prevail, negligible net flushing occurs through the estuary, and evaporation results in increased salinity and potentially a net inflow into the estuary. During this period, nutrients from the aquaculture facility are most likely to accumulate in the estuary on intertidal flats and in deeper channels. This survey was therefore planned to coincide with this period of peak nutrient stress in the late dry season and was undertaken during the first week of October 2005. Should the aquaculture facility be established, follow-up monitoring and surveys will be carried out over the next five years to assess changes over time.

To locate areas where dissolved and suspended nutrients are most likely to accumulate in the late dry season, a drogue survey was undertaken. Unfortunately the survey was carried out during a period of stronger than typical north-easterly winds resulting in the shallow water drogues being blown southward of their presumed typical courses, often being stranded on shallow mud banks rather than following the main flow along channels. The winds of this season are typically calm in the morning with a northerly sea breeze rising in the afternoon. However experience in similar estuaries combined with local knowledge and the information provided by the drogues indicated 3 suitable shallow water sites and 3 deep water sites. A further defining characteristic of the shallow water sites was that they had to be accessible an hour after half tide on an outgoing spring tide to enable sampling. The drogue survey indicated waters passing through the proposed farm site on an incoming tide will be carried to all parts of the lower estuary within 8 km on a single tide cycle. Much of the mangrove shoreline near the farm site was made inaccessible by wide intertidal mud flats and the remainder was unsuitable as it rose rapidly therefore would not

be as susceptible to accumulation of nutrients by evaporation as mangrove flats. A small creek in a mangrove area near and to the north of the farm site (F1) and two more distant mangrove areas on the lower estuary, one in a site reached by early release drogues (F3) and another where the early release drogues may have gone in a no wind condition (F2), were chosen as the most appropriate shallow water sites. A deepwater site near F3 (F4) and two sites in soft sediments near the farm site, one inland (F5) and one to seaward (F6) were selected as most suitable for detecting accumulation of nutrients in deep water. Sites in the control estuary were selected to match as closely as possible the farm sites. Sites for mangrove transects were selected near the shallow water sites at places where the mud banks at low tide were narrow enough to allow access and where the mangrove flats were sufficiently wide to suggest evaporation may result in deposition of nutrients.

Maps showing the location of Snake Bay, the proposed farm site, Shark Bay and the farm and control sample sites are presented in Figure 2-1 and Figure 2-2, coordinates are listed in Table 8-1.

Sampling methodology involved the collection of triplicate or duplicate samples from each of the sample sites. For most parameters (sediment description, redox, particle size, photography of mangrove root assemblages and benthic infauna) three samples were collected – one from the specified GPS position, one from 20 m upstream in the same depth and one from 20 m downstream in the same depth. Where cost of analysis compared to additional information gained was considered too high – for water borne nutrients and chlorophyll – duplicate samples were collected. Water quality parameters were measured and sampled twice at five minute intervals at the site GPS position. Mangrove composition was recorded at 4 sweep sites along one transect near each of the three intertidal monitoring sites and two intertidal control sites.

The soft mud and unconsolidated organic material and shell grit present at the sites sampled is indicative that these sites are in deposition conditions. The presence of organic material and black streaking seen at a number of sites indicates moderately high natural organic loading and low permeability to oxygen. The numerous burrows present indicate prolific animal life, as was also found in the benthic cores. Macroscopic plants were absent due to the high attenuation of light in the muddy estuarine waters. A lack of gas bubbles and smell from the majority of cores indicates the natural organic loading is moderate rather than high and reduction of organic mater is proceeding apace with its deposition. The H_2S smell at C5 indicates deposition of organic material there is more rapid than aerobic decomposition so the sediments have become anoxic.

High surface and 1 cm redox values at F5, F6, C1 and C6 indicate these sediments are permeable, which normally correlates with sandier and more mobile sediments that are regularly disturbed by water movement. While this is expected in the sediments in mid channel near the estuary mouth it is unusual in the shallow mud bank at C1. The lower values at the 0 and 1 cm depths at the remaining sites indicate sediments of low permeability and moderate organic loading as is expected in mangrove mud. The mean 4 cm value at all sites except C5 is between 50 mV and 100 mV showing these sites to be poorly to moderately oxygenated indicating that reduction of organic matter is proceeding at a slightly higher rate than permeation of oxygen through the sediments. The anoxic conditions at C5-3 and 8 mV value at C5-2 indicate that an increased level of organic loading may readily cause the sedimentary environment to become anoxic. This can be a threat to the natural environment and aquaculture operations.

The noted difference in particle size distribution between farm and control sites reflects the difference between the more open water environment of the Snake Bay estuary compared to the narrower, more sheltered waters of the Shark Bay estuary. There would be more wave action

particularly at the shallow water farm site of F2 than at the remaining sites. Fine sediments at F5 indicate it is a depositional environment and will be a good site for assessing the impact of farm fallout. Coarse sediments found at F6 reflect its location in the rapid flowing section of the channel seaward of the proposed farm site. The coarse material at F4 consisted mainly of shells and wood material hence they do not reflect on the energy levels in the water. The normal trend to coarser sediments with greater water movement is masked at most sites by the occurrence of decayed plant material in the sediments. The preponderance of fines at shallow water sites reflects this trend with shells and plant material at F2 being the only exception. The occurrence of coarse sand and pebbles in sediments from channel sites also reflects this trend however there is no clear division between intertidal sheltered sites and deep water mid-channel sites on particle size analysis alone. The main use of these results will be in characterising the environment of the benthic infauna to assist in explaining similarities and differences between sites.

Water temperature, DO and salinity readings present only a snapshot, being useful primarily as part of a long term monitoring program. However they are within the range of those recorded over a 2 year monitoring program in Port Hurd so may be considered typical for this type of mangrove estuary. No significance can be placed on the small differences between estuaries based on this one set of data alone. However it is evident that the water in both estuaries is very warm, with salinity approaching that of seawater and minimal fresh water input. As the shallow and deep readings were taken at different locations no evidence of stratification was noted.

ANZECC draft guidelines for Interim Trigger Levels (ITL) for nutrients in slightly to moderately disturbed estuaries and coastal waters are given in Table 5-3 (ANZECC, 1999). Total N includes organic nitrogen which is not readily bioavailable so is normally greater than DIN. As Snake Bay is flushed by 3m to 7m tides twice per day and there is little or no freshwater input at this time of year, reference trigger levels should be somewhere between Estuarine and Coastal values, arguably nearer Coastal. ANZECC guidelines are generalised for all of Australia and New Zealand and need to be verified against locally collected data. Ideally the reference condition would be defined using up to 3 to 5 years of at least monthly sampling data collected from at least 5 to 10 reference locations in well functioning unmodified ecosystems (ANZECC, 1999). A monitoring program underway in Port Hurd is providing good reference data which at some stage may be combined with data collected in similar estuaries to generate more suitable guidelines for these estuaries. The results of this survey are at the high side of the range of those recorded over a 2 year monitoring program in Port Hurd so may be considered typical for this type of mangrove estuary.

Nutrients measured as NO_X and Ammonia exceeded the ANZECC draft guidelines for Interim Trigger Levels (ITL) for estuaries but not those for marine waters with the exception of C6 where ammonia levels did exceed those for marine waters. As both of these estuaries have little anthropogenic nutrient input there is justification for collecting control site data as a reference rather than using the ANZECC guidelines trigger levels. The main use for this data will be in monitoring trends over time.

Chlorophyll α levels were within the range of those recorded during the initial stages of monitoring at Port Hurd but approximately double those recorded at Channel Island and Doug Point. They were also double the results of studies within Darwin Harbour but consistent with records in the tidal creeks of Darwin. They were also within the range of those recorded over a 2 year monitoring program in Port Hurd so may be typical for this type of mangrove estuary. Chlorophyll α levels were generally well above draft ANZECC Interim Trigger Levels for slightly to moderately disturbed ecosystems.

Macroscopic epiphytic algal growth was not detected on intertidal mangrove root and rhizome assemblages, which appeared in excellent health.

Mangrove stand structure and composition was dominated by *Rhizophora* sp. at the Snake Bay sites reflecting the more gently sloping land surrounding that bay, while the more varied stand composition at the control sites on the Shark Bay estuary reflected the steeper banks found there. Communities at both sites were typical for similar estuaries (see Brocklehurst and Edmeades, 2003). Although additional analysis can be done using this data its main use is to provide a baseline for monitoring future change.

Benthic infaunal analysis found no obvious signs of existing impacts on macrobenthic communities in Snake Bay and the adjacent Shark Bay Estuary. Analysis of faunal similarities amongst samples from these two estuaries detected habitat-related variation, with intertidal and shallow subtidal communities distinct from deeper subtidal communities. Within the intertidal and shallow subtidal sites, differentiation was observed between Snake Bay and the Shark Bay Estuary, while deeper subtidal samples exhibited more variation and could not be clearly distinguished on the basis of estuary. Diversity indices and K-dominance calculations revealed no consistent trends in biodiversity or dominance on the basis of estuary or habitat, although several deeper subtidal sites recorded reduced diversity and elevated dominance compared with other sites. This finding may reflect reduced light penetration and primary production in some deeper sections of the estuaries, since results were not indicative of high levels of pollution or other environmental disturbance. The benthic infaunal data gathered in this survey will provide a useful baseline against which future biological change can be assessed.

This survey presents the results of a baseline study which can be used to asses the biological impact of nutrients released from Marine Harvest's proposed aquaculture facility in Snake Bay if it becomes operational. Follow-up monitoring over subsequent years is required at control sites and sites most likely to show impact to gain an understanding of natural variation and assess potential impact.

2 Operational Summary

2.1 Operational details

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Aquenal Personnel:	Derek Shields, Jeremy Dudding
Client:	Marine Harvest Barramundi Farms PO Box 117 Rosny Park Tasmania 7018 Phone: Tasmania (03) 6216 1207 Phone: Darwin (08) 8941 5651 Fax: Darwin 08 8941 5254
Field work:	Field work by Aquenal with assistance from Marine Harvest personnel
Date of fieldwork:	Drogue survey: 24th August 2005 Sampling: 25th-29th August 2005
Weather:	Hot, with clear skies. Strong (20 to 30 knots) northerly winds on 24th, 26th and 27th caused difficulties for the drogue survey and in sampling the exposed and remote sites in Snake Bay. On 25th and 28th calm mornings were followed by afternoon sea breezes from the north. No significant rain for several months prior to the survey.

2.2 Sampling rationale and nomenclature

Sample sites and parameters analysed were chosen to best detect organic pollution from the Marine Harvest Snake Bay aquaculture operations. (See *Barramundi Monitoring Proposal*, Aquenal 2005 for detailed discussion.) To this end a drogue survey was carried out prior to the biological survey. Organic output from fish farming occurs as either dissolved nutrients or suspended organic material so shallow and deep drogues were released and sample sites chosen to best represent the locations where the two different fractions accumulate. To assist in differentiating between natural variation and impacts of organic enrichment from farming activities, a similar estuary, the Mirikauyunga Creek estuary, which discharges into Shark Bay 3 km to the west of Snake Bay (Figure 2-1) was also sampled. Sample sites were labelled F1 to F6 in Snake Bay with F1 to F3 being intertidal sites in small creeks or on mangrove mud flats where nutrients might accumulate through evaporation, and F4 to F6 being deep water sites where suspended material was likely to be deposited when tidal flows slowed at the turn of the tides and at neap tide (Figure 2-2). Sample sites in the Shark Bay estuary were selected to reflect as closely as possible, based on visual assessment, sample sites in Snake Bay (labelled with similar site numbers; C1 to C3 for intertidal sites and C4 to C6 for deep water sites).

Mangrove transects were surveyed near the shallow water sites to enable any changes noted to be correlated to nutrient and benthic data. However to gain access to the shore without crossing extensive mud banks they were located near a relatively steep bank nearby the shallow water site. The mangrove sites are labelled FM1, FM2 and FM3 for the farm transects in the Snake Bay estuary and CM1 and CM2 for the control transects in the Shark Bay estuary.

2.3 Maps

Figure 2-1 Broad-scale map of the study area of Melville Island. Refer to Figure 2.2 for detailed maps of survey sites in the vicinity of Snake Bay and Shark Bay respectively

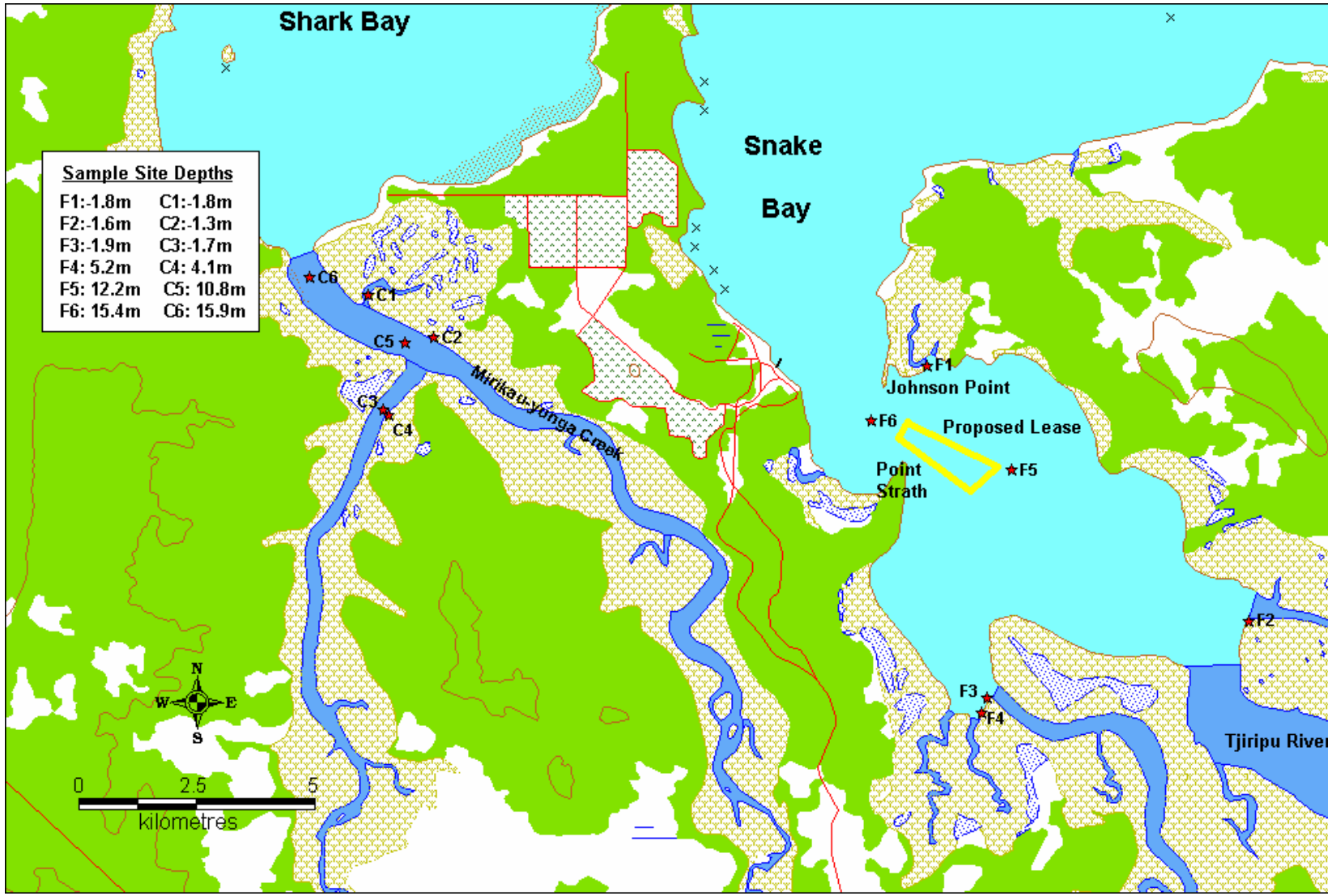


Figure 2-2 Survey map showing farm and control sample sites and the farm location.

Figure 2-3 Survey map showing farm and control mangrove transect sites and the farm location.

3 Nutrient Dispersion and Deposition

3.1 Drogue survey

Method

Pairs of drogues were released from the proposed farm site in Snake Bay and at two locations in the outer channel during the ebb tide on 24th August 2005. For logistical reasons it was not possible to release these at high tide so they were released 4 hours after high tide at locations approximating the positions they would have reached had they been released at high tide and two hours after high tide. Given that the seabed to seaward of the farm site consists of one main channel bounded by sandbars this was a reasonable approximation. At low tide (13:00 hours) a pair of drogues were released from the farm site and the drogues released on the ebb were tracked as they moved back up the channel. A further pair of drogues was released at the farm site at mid tide on the flood tide. All drogues were tracked as closely as possible and any that became grounded were shortened and re-released. All drogues were pulled at 17:00 to enable the boats to ashore before dark. Due to logistical constraints this was the only time available for the drogue survey.

Drogues were constructed of 200 mm styrofoam floats cut in half with a small orange flag on top and a cylinder of plastic mesh suspended below them at a depth of either 1m or 5m. A weight was attached to the plastic mesh to ensure it hung straight down from the float and to keep the flag upright so it could be seen. The plastic mesh caught the tide and dragged the float with the water flow at the set depth. Eight drogues were built for the survey, four 1m drogues and four 5m drogues. On the maps following, the codes read 1 or 5 for the depth of the drogue then 1 to 4 for the number on the drogue (Figure 3-1, Figure 3-2).

Results

The survey was carried out during a period of stronger than typical north-easterly winds of 20 to 30 knots, resulting in the shallow water drogues being blown south-westward of their presumed typical courses, often being stranded on shallow mud banks rather than following the main flow along channels. The deep water drogues were also affected to a lesser degree by the wave action on their float, often grounding on the south-western side of the channels instead of following the mid channel course as would be expected. The winds of this season are typically calm or light south-easterly in the morning with a northerly sea breeze rising in the after noon. The area of water inland of the farm site is mainly shallow with much of it less than the 5m of the deep water drogues, so the deep water drogues had to be shortened to imitate the path of the deep water as it flowed in with the tide.

Drogues released on the outgoing tide followed the deep channel through the narrows and out to sea with those released at 4 hours after high tide travelling 2.4 km in their first hour. Once the drogues entered the open waters of Snake Bay they became difficult to track due to the wind generated waves and white water. Several were lost until they returned with the incoming tide or were found grounded on the west side of the bay. Drogues 1-1 and 5-1 were released 4 hours after high tide and tracked from the farm site to 4.6 km seaward then pulled from the water an hour after the turn of the tide as they moved back up the channel. 1-2 and 5-2 were released in the channel 2.8 km to seaward of the farm and 1-3 and 5-3 were released in the channel 6.8 km to seaward. 1-2 was

found grounded on the western shore 2 hours later, 5-2 was found grounded 4.5 hours later and shortened. It was found grounded again shortly after and pulled. 1-3 and 5-3 were pulled at low tide to be released at the inner end of the farm site to track the incoming tide. Drogues 1-4 and 5-4 were released at the farm site 5 hours after high tide. 1-4 was blown ashore 2 km west of its release point and 5-4 was found grounded in shallows on the western side of the channel.

At low tide drogues 1-3 and 5-3 were released at the inner end of the proposed farm site. 5-3 became grounded so was shortened to 2m and released. It was pulled after 4 hours due to fading light but had spent some time grounded. 1-3 was found after 4 hours snagged on mangroves at the entrance to a creek 4.6 km south-east of the farm site. Drogues 1-1 and 5-1 were released again at the inner end of the farm site 3 hours after low tide. They both were washed and blown into shallow water to the south-east and 5-1 had to be shortened to 2m. They were pulled after one hour.

Interpretation

Movements of drogues gives a simplistic but reliable indication of the immediate fate of nutrient output from a point source without resorting to costly computer modelling of estuarine flows. In this case the drogues showed that much of the water passing the farm on the ebb will remain within the confines of the outer embayment of Snake Bay and be drawn back into the estuary with the incoming tide. They also indicated that waters passing through the proposed farm site on an incoming tide will be carried to all parts of the lower estuary within 10 km on a single tide cycle and their primary direction can be greatly influenced by strong winds.

Shallow waters carrying floating and dissolved nutrients as represented by the 1 m drogues were more subject to wind influences and the dispersion of water into intertidal beaches and mudflats. Deep waters as represented by the 5m drogues tended to follow the deeper channels until they shoaled up then moved with the shallow water.

Figure 3-1 Shallow water (1m) drogue survey showing positions of drogues during one spring tide cycle. Drogues to seaward of the farm site were released during the ebb tide at position X or the relevant RP site; those inland were released during the flood tide from point Y.

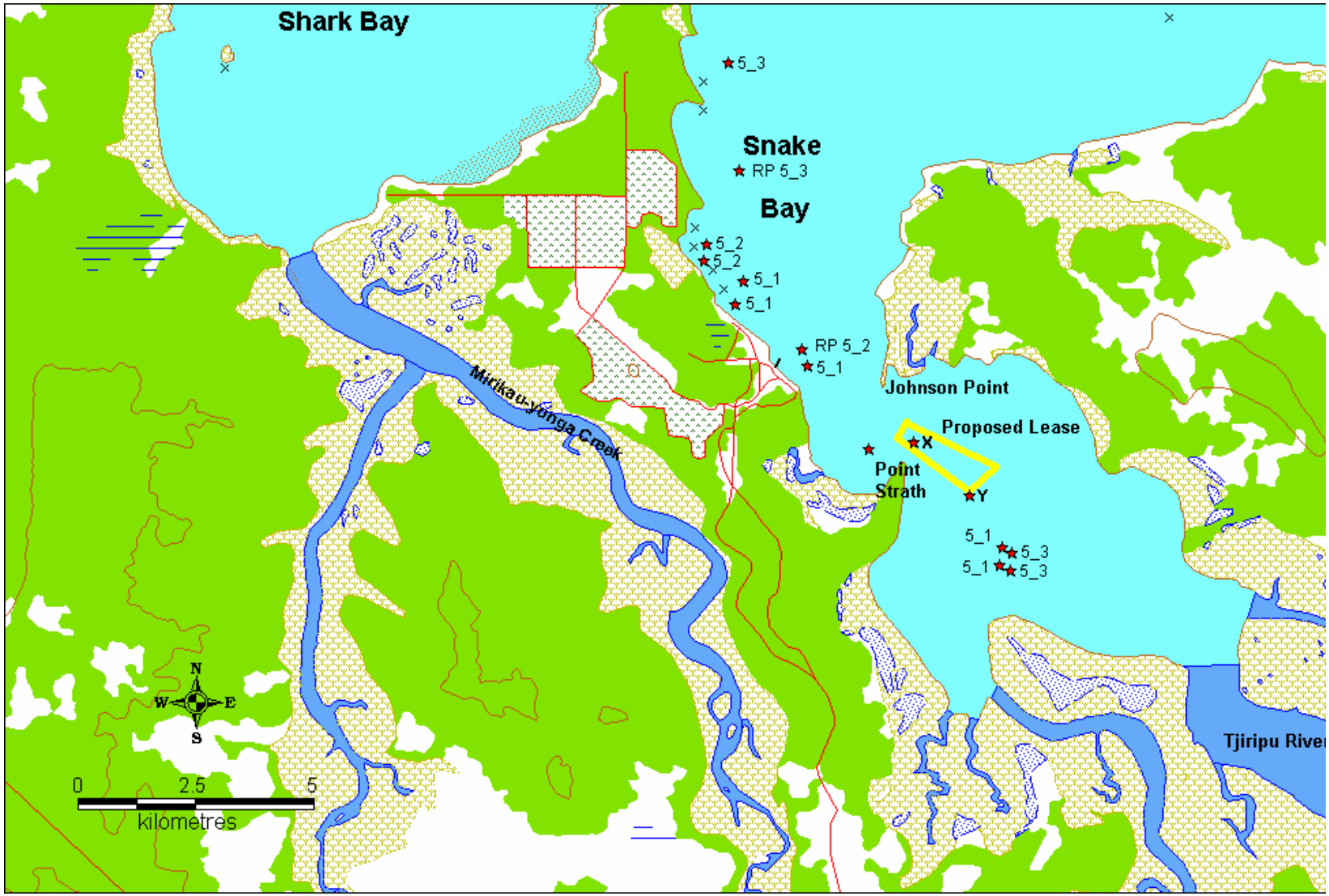


Figure 3-2 Deep water (5m) drogue survey showing positions of drogues during one spring tide cycle. Drogues to seaward of the farm site were released during the ebb tide at position X or the relevant RP site; those inland were released during the flood tide from point Y.

4 Sediment Analysis

4.1 Visual assessment

Method

At the intertidal sites, F1 to F3 and C1 to C3, sediment cores were collected by hand in 43 mm internal diameter transparent perspex tubes. These were collected when the water level was below mid tide on an outgoing spring tide, from undisturbed sediments about 0.3 m below the water level. Triplicate samples were collected; one from the specified GPS position, one from 20m upstream in the same depth and one from 20m downstream in the same depth. A Craib corer was used to collect similarly spaced sediment cores in 43 mm transparent perspex tubes at the deep water sample sites, F4 to F6 and C4 to C6.

Cores were handled carefully and retained in a vertical orientation to minimise disturbance of the sediment surface until they were described and redox readings taken. Their length, colour, plant and animal life, gas vesicles, and smell were described. The visual description was partially obstructed in the more muddy sediments by sediments adhering to the outside of the core barrel. Smell was noted after the water was removed from the core barrels.

Results

Sediments consisted predominantly of grey brown to grey mud. Shell grit, organic material and silt were also present at a number of sites. Cores ranged in length from 50 – 210 mm with most cores deeper than 140 being from soft mud and those shorter containing more shell grit or terminating in firmer mud. Sediment from the deep water farm sites F5 and F6 were mainly brown/grey soft mud. Cores from the deep-water control sites C5 and C6 consisted mainly of grey mud, with C5 containing additional fragments of shell grit and gravel. Stratification could be seen in the majority of sediments, with bottom layers consisting primarily of streaked mud and generally lacking in organic material. Organic material was present in the top layers of F1, F3, F4 and C1 and in the bottom layer of C2. Animal burrows were observed in one or more cores from all sites except F1 and C2. There was no plant life recorded from any of the cores. The smell of hydrogen sulphide was detected from C5 only (Table 4-1).

Interpretation

The intention of this survey is to study sites where nutrients are likely to be deposited. Sediments at such sites will be soft mud or unconsolidated material. The soft mud and unconsolidated organic material and shell grit present at the sites sampled is therefore indicative that these sites are in deposition conditions and should be suitable for their purpose. The presence of organic material and black streaking seen at a number of sites indicates moderately high natural organic loading and low permeability to oxygen. The numerous burrows present indicate prolific animal life, as was also found in the benthic cores. Macroscopic plants were absent due to the high attenuation of light in the muddy estuarine waters. A lack of gas bubbles and smell from the majority of cores indicates the natural organic loading is moderate rather than high and reduction of organic mater is proceeding apace with its deposition. The H_2S smell at C5 indicates deposition of organic material there is more rapid than aerobic decomposition so the sediments have become anoxic. This is reflected in the Redox values at 4 cm.

Table 4-1 Visual description of sediment cores at farm and control sites. Abbreviations used in the table are: blk=black, brn=brown, f=fine, gvl=gravel, gy=grey, lt=light, matt=matter, md=mud, mott=mottled, org=organic, sd=sand, sft=soft, sg=shell grit, slt=silt, spk=speckled, stk=streaked

Core No	Length mm	Colour 1	Depth 1 mm	Colour 2	Depth 2 mm	Colour 3	Plants	Animals	Gas Bubbles	Smell
F1-1	140	gy brn md stk blk & org matt					nil	nil	nil	nil
F1-2	160	gy brn md spk org matt	80	gy brn md stk blk			nil	nil	nil	nil
F1-3	80	gy brn md spk sg & org matt					nil	nil	nil	nil
F2-1	140	gy brn md					nil	few burr to 50	nil	nil
F2-2	160	gy brn md stk blk					nil	nil	nil	nil
F2-3	140	gy brn md stk blk					nil	few burr to 40	nil	nil
F3-1	140	lt brn md stk gy/blk & spk sg	20	gy/bn md stk blk			nil	few burr to 20	nil	nil
F3-2	120	lt brn md stk blk	40	gy/bn md stk blk			nil	nil	nil	nil
F3-3	140	lt brn md spk org matt & sg	10	gy/brn md p blk			nil	few burr to 30	nil	nil
F4-1	100	gy/brn md spk sg & org matt					nil	few burr to 50	nil	nil
F4-2	80	gy/brn md spk sg & org matt					nil	nil	nil	nil
F4-3	80	gy/brn md spk sg & org matt					nil	few burr to 50	nil	nil
F5-1	210	brn/gy sft md	30	gy md			nil	sev burr to 40 & 1 burr to 110	nil	nil
F5-2	190	brn/gy sft md	50	gy md			nil	sev burr to 70	nil	nil
F5-3	210	brn/gy sft md	50	gy md			nil	nil	nil	nil
F6-1	85	brn gy sft md	5	brn spk sd	25	gy brn md	nil	1 burr to 40	nil	nil
F6-2	160	brn gy sft md	10	brn spk sd	40	gy brn md	nil	sev burr to 70	nil	nil
F6-3	125	brn gy sft md	5	brn spk sd			nil	sev burr to 80	nil	nil
C1-1	100	brn gy mud spk org matt					nil	nil	nil	nil
C1-2	140	brn gy mud spk org matt	100	brn/gy md stk blk			nil	sev burr to 100	nil	nil
C1-3	50	brn gy mud spk org matt	20	gy md stk blk			nil	sev burr to 20	nil	nil
C2-1	200	gy/brn spk md	40	gy stk blk md	120	gy md	nil	nil	nil	nil
C2-2	155	gy/brn spk md	20	gy stk blk md	40	gy md spk org matt	nil	nil	nil	nil
C2-3	145	brn md spk blk	15	gy stk blk md			nil	nil	nil	nil
C3-1	170	gy brn spk blk md	70	brn gy md stk blk			nil	nil	nil	nil
C3-2	180	gy brn spk blk md					nil	sev burr to 90	nil	nil
C3-3	190	brn spk md	5	gy md stk blk			nil	nil	nil	nil
C4-1	125	brn f sd/slt	10	gy spk md	50	gy stk blk md	nil	1 burr to 40	nil	nil
C4-2	110	brn f sd/slt spk blk org matt	15	gy stk blk md			nil	1 burr to 70	nil	nil
C4-3	145	brn gy slt	15	gy stk blk md			nil	1 burr to 60	nil	nil
C5-1	95	gy md stk blk & sg & gvl	10	gy md mott blk			nil	1 burr to 50	nil	nil
C5-2	60	gy md stk blk & sg & gvl					nil	1 burr to 60	nil	H2S
C5-3	50	gy md spk sg					nil		nil	H2S
C6-1	105	gy brn sft md	40	gy md			nil	1burr to 40	nil	nil
C6-2	110	gy brn sft md	30	gy md			nil	1 burr to 30	nil	nil
C6-3	105	gy brn sft md	40	gy md			nil	sev burr to 50	nil	nil

4.2

4.2 Redox potential

Method

Redox potential was measured in millivolts at the surface of the sediment and 1 cm and 4 cm below the sediment surface using a WTW pH 320 meter with a Mettler Toledo Ag/AgCl combination pH / Redox probe. The standard potential of the Ag/AgCl reference cell of the probe is 207 mV at 25°C, the approximate temperature of the samples during measurement. Calibration and functionality of the meter were checked before each test using a Redox Buffer Solution (220 mV at 25 °C). Measurements were made within 3 hours of the samples being collected. Corrected redox potential values were calculated by adding the standard potential of the reference cell to the measured redox potential and are reported in millivolts.

In all cases the lowest reading observed is recorded as the redox value. In low permeability, muddy sediments this is recorded when the reading is stable or dropping at less than 1 mV per second. In permeable, sandy sediments the lowest reading is often observed while the probe is being worked to the measurement depth. As soon as the probe stops moving in sandy sediments with low redox values, the readings normally start to increase due to water drawn down by the probe diluting the interstitial fluids.

Results

Corrected surface redox values covered a wide range, from 59 mV at C4-1 to 459 mV at F5-2 with mean site values ranging from 96mV at C5 to 436 mV at F5 and standard deviations from 11 to 164. At 1 cm depth values ranged from 34 mV at C5-3 to 452 at F5-2 with site means ranging from 50 mV at C5 to 350 at F5 with standard deviations from 15 to 181. Values at 4 cm were more consistent with values ranging from -39 mV at C5-3 to 139 mV at C1-2 and site means from 51 mV at C6 to 100 mV at C1 with standard deviations from 9 to 45. Only at C5-3 were anoxic sediments encountered at depths of 4 cm or less resulting in a mean redox value of 3 mV for the site. Summarised data is presented in Table 4-2 and raw data in Table 8-2. Data is presented graphically in Figure 4-1 and Figure 4-2.

Interpretation

Redox values at the sediment surface reflect ongoing organic loading and water movement. However it is notoriously difficult to avoid disturbing the surface while taking this reading so it is very unreliable. Generally coarser sediments in areas of high water flow have values above 400 mV while muddy sediments with moderate flow have values between 100 and 250 mV. The 1 cm value is a more reliable indicator of short term organic loading and sediment permeability but is often confounded by the oxygenating effects of animal burrows. The redox potential at 4 cm is considered to be the most reliable indicator of sediment redox condition in soft or poorly consolidated sediments (Pearson and Stanley, 1979).

Higher surface and 1 cm values at F5, F6, C1 and C6 indicate these sediments are more permeable, which normally correlates with sandier and more mobile sediments that are regularly disturbed by water movement. While this is expected in the sediments in mid channel near the estuary mouth it is unusual in the shallow mud bank at C1. The lower values at the 0 and 1 cm depths at the remaining sites indicate sediments of low permeability and moderate organic loading as is expected in mangrove mud.

The mean 4 cm value at all sites except C5 is between 50 mV and 100 mV showing these sites to be poorly to moderately oxygenated indicating that reduction of organic matter is proceeding at a slightly higher rate than permeation of oxygen through the sediments. The anoxic conditions at C5-3 and 8 mV value at C5-2 indicate that an increased level of organic loading may readily cause the sedimentary environment to become anoxic. This can be a threat to the natural environment and aquaculture operations.

Table 4-2 Corrected redox potential of sediments at farm and control sites

		Depth (cm)		
Site No.		0	1	4
F1	Corrected Mean	112	81	58
	Standard Deviation	16	15	9
F2	Corrected Mean	113	76	63
	Standard Deviation	36	26	15
F3	Corrected Mean	128	85	54
	Standard Deviation	19	6	15
F4	Corrected Mean	109	95	76
	Standard Deviation	30	21	24
F5	Corrected Mean	436	350	77
	Standard Deviation	24	139	9
F6	Corrected Mean	402	255	97
	Standard Deviation	11	136	26
C1	Corrected Mean	356	205	100
	Standard Deviation	77	139	45
C2	Corrected Mean	147	98	71
	Standard Deviation	48	23	21
C3	Corrected Mean	222	83	70
	Standard Deviation	164	17	20
C4	Corrected Mean	103	72	55
	Standard Deviation	45	30	17
C5	Corrected Mean	96	50	3
	Standard Deviation	15	18	38
C6	Corrected Mean	355	173	51
	Standard Deviation	37	181	22

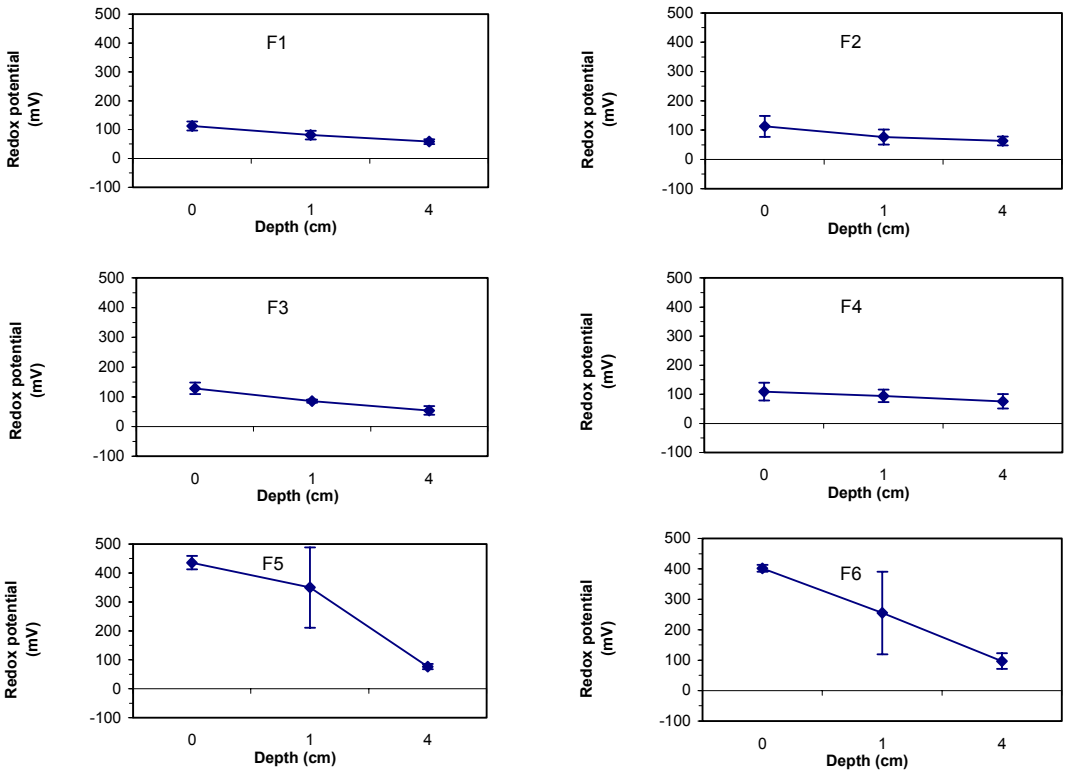


Figure 4-1 Redox potential in the top 4 cm of sediment cores at farm sites.

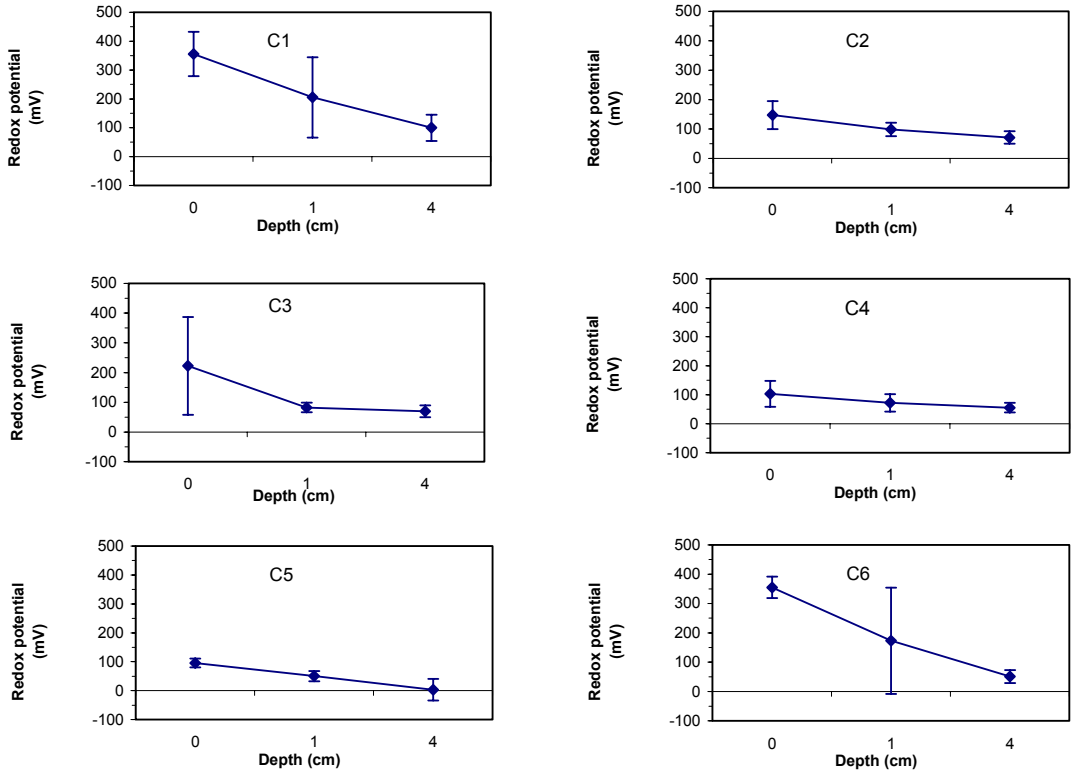


Figure 4-2 Redox potential in the top 4 cm of sediment cores at control sites.

4.3 Particle size analysis

Method

The two samples comprising the top 100 mm of each sediment core were combined and analysed as follows. The 30 - 100 mm sample was homogenised then 35 ml was divided out and discarded. This is an equal proportion to the 15 ml sample which was removed from the 0 - 30 mm sample earlier. The remaining material from these two samples was combined and homogenised to give a sample representing the top 100 mm of sediment. To obtain an accurate and consistent volume of sample, a container of known volume (50 ml) was filled with the sample material which was then packed down and scraped level with a ruler. This was washed through a stack of sieves by shaking them under a moderate water spray. The sieve aperture sizes were 4mm, 2mm, 1mm, 500 μm, 250 μm, 125 μm and 63 μm. The contents of each sieve were drained then transferred to a 100 ml measuring cylinder containing 20 ml of water, starting with the coarsest fraction and working through to the finest. The cumulative volume in the measuring cylinder was recorded after each sieve's contents were transferred. These volumes were entered into a spreadsheet and the fraction's percentage by volume of the original sample calculated. The percentage by volume of the fraction of less than 63 μm diameter was calculated to make the total up to 100%.

Results

Sediments from both mangrove estuaries contained significant percentages of both inorganic and organic material. The inorganic proportions of mud, silt sand and pebbles reflected the energy of the water passing over them with most intertidal sediments comprising over 50% fines (material less than 63 μm) and little or no coarse sand or gravel. The deep water, mid channel sites varied from those in areas of high energy, such as F6, C5 and C6 to those in depositional traps with low energy, such as F5, the intertidal control sites and C6. High energy sites contained sand and gravel, low energy contained mainly fines. However significant fractions of decaying organic material and shell material were also present in most cores as is typical for mangrove environments and masked water energy level effects.

Sediments at C1 and C2 were the finest of the intertidal sites with only 23% and 14% material coarser than 63 μm. Sediment from the subtidal site F5 was clearly the finest of all, with only 6% of material coarser than 63 μm. In subtidal sediments the percentage of fines ranged from 30% to 94%, with intertidal sediments comprising between 42% and 86% fines (Table 8-3).

Sediments from farm sites contained more coarse material and shells than those from control sites in general with the notable exception of F5.

Table 4-3 Description of sediments retained in sieves during particle size analysis

Site	Description of sediment remaining in sieves
F1	Sand, fine shell grit and woody plant material
F2	Shells, fine shell grit and sand, woody plant material
F3	Shells, shell grit, sand and large amounts of woody plant material
F4	Shells, shell grit, sand and woody plant material
F5	Fine sand and very fine plant material
F6	Coarse sand, shell grit and fine sand
C1	Fine sand and plant material
C2	Fine sand, shell grit and plant material
C3	Fine sand and plant material
C4	Sand, fine sand and plant material
C5	Sand, shell grit, pebbles and plant material
C6	Silt, sand, plant material, pebbles and shell grit

Interpretation

The noted difference between farm and control sites reflects the difference between the more open water environment of the Snake Bay estuary compared to the narrower, more sheltered waters of the Shark Bay estuary. There would be more wave action particularly at the shallow water farm site of F2 than at the remaining sites. Fine sediments at F5 indicate it is a depositional environment and will be a good site for assessing the impact of farm fallout. Coarse sediments found at F6 reflect its location in the rapid flowing section of the channel seaward of the proposed farm site. However it was judged to be the best site available for assessing nutrient build-up and impact from out-flowing waters. The coarse material at F4 consisted mainly of shells and wood material hence they do not reflect on the energy levels in the water.

The normal trend to coarser sediments with greater water movement is masked at most sites by the occurrence of decayed plant material in the sediments. In sites remote from mangroves, sediments are transported either in from the ocean or down rivers and deposited. In these cases the size of the particles reflects the energy of normal ambient water movement with fine sediments indicating low energy movement and coarse indicating high. The more mixed the particle size distribution the greater the range of water movement from calm to rough. The preponderance of fines at shallow water sites reflects this trend with shells and plant material at F2 being the only exception. The occurrence of coarse sand and pebbles in sediments from channel sites also reflects this trend however there is no clear division between intertidal sheltered sites and deep water mid-channel sites on particle size analysis alone. The main use of these results will be in characterising the environment of the benthic infauna to assist in explaining similarities and differences between sites.

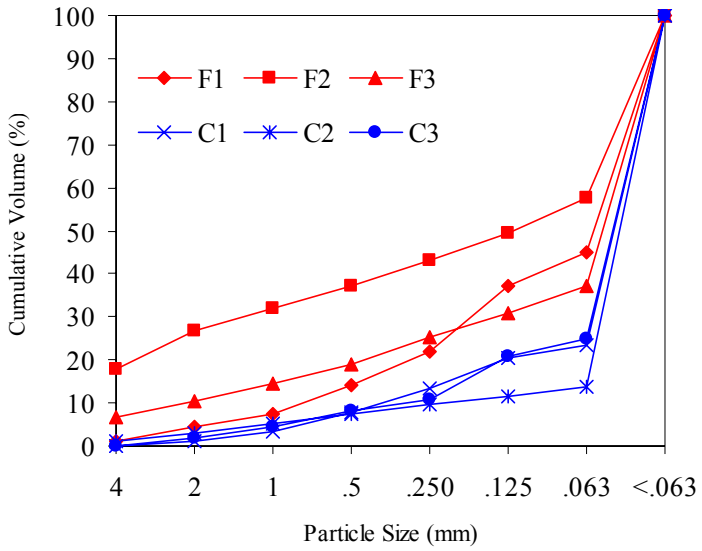


Figure 4-3 Particle size analysis of the top 100 mm of sediment cores from the intertidal farm and control sites.

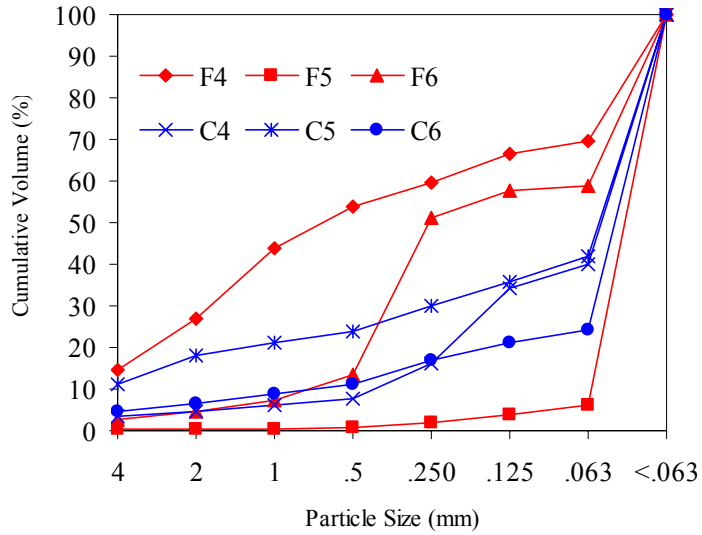


Figure 4-4 Particle size analysis of the top 100 mm of sediment cores from the subtidal farm and control sites.

5 Water Quality Analysis

5.1 Physico-chemical properties

Method

A number of physico-chemical properties were measured to enable detection of significant run-off during on-going monitoring, particularly as the wet season set in. Parameters measured were temperature, salinity, pH and dissolved oxygen (DO). Measurements were made using an electronic data logger (Yeo-Kal YK-611 Water Quality Analyser) mid way through the ebbing tide at 0.3 m depth at sheltered shallow waters sites and 0.5 m above the seabed near the turn of the tide at deep water sites. Two series of readings were taken 5 minutes apart at each site to assess in-site variability.

Results

Temperature was fairly consistent across all sites, ranging between 26.4 °C at C4 and 27.8 °C at F3. Salinity measurements varied slightly between farm and control sites with higher values recorded from most farm sites (Figure 5-1and Table 5-1). The pH of water from all sites was consistent, with a range of 7.3 to 7.8. Dissolved oxygen (DO) levels were greatest at F6 (80.6%) with the remaining sites recording mean DO levels of between 58.4% (C3) and 74.2% (F3). Low standard deviations were calculated for all parameters at all sites with the exception of DO at F5 (Table 5-1). The standard deviation of ±36.1 was due to large variability between replicate readings.

Interpretation

These readings provide only a snapshot view so little should be drawn from them without additional information. Their main use will be as part of a long term monitoring program. However they are within the range of those recorded over a 2 year monitoring program in Port Hurd so may be considered typical for this type of mangrove estuary. No significance can be placed on the small differences between estuaries based on this one set of data alone. However it is evident that the water in both estuaries is very warm, with salinity approaching that of seawater and minimal fresh water input. As the shallow and deep readings were taken at different locations no evidence of stratification was noted.

Table 5-1 Physico-chemical data from surface waters at intertidal and subtidal farm and control sites.

Site	Temperature °C	Conductivity ms/cm	Salinity ppt	DO % sat	DO mg/L	pH
F1	27.4 ± 0.1	50.4 ± 0.2	33.0 ± 0.1	66.6 ± 3.3	4.4 ± 0.2	7.5 ± 0.0
F2	27.2 ± 0.1	49.9 ± 0.1	32.6 ± 0.0	71.7 ± 0.9	4.7 ± 0.1	7.5 ± 0.0
F3	27.8 ± 0.1	49.7 ± 0.2	32.5 ± 0.1	74.2 ± 6.3	4.8 ± 0.4	7.5 ± 0.0
F4	26.9 ± 0.0	50.3 ± 0.1	33.0 ± 0.0	58.7 ± 2.7	3.9 ± 0.2	7.4 ± 0.0
F5	26.7 ± 0.1	48.7 ± 1.4	31.8 ± 1.0	58.9 ± 36.1	4.0 ± 2.4	7.7 ± 0.0
F6	26.7 ± 0.0	49.4 ± 0.0	32.3 ± 0.0	80.6 ± 0.2	5.4 ± 0.0	7.8 ± 0.0
C1	27.1 ± 0.2	49.4 ± 0.3	32.3 ± 0.2	66.4 ± 2.4	4.4 ± 0.2	7.4 ± 0.0
C2	26.4 ± 0.1	49.3 ± 0.0	32.2 ± 0.0	59.6 ± 3.5	4.0 ± 0.3	7.4 ± 0.0
C3	26.5 ± 0.1	49.0 ± 0.1	32.0 ± 0.0	58.4 ± 2.9	3.9 ± 0.2	7.4 ± 0.0
C4	26.4 ± 0.0	48.3 ± 0.0	31.5 ± 0.0	64.4 ± 0.2	4.3 ± 0.1	7.3 ± 0.0
C5	26.5 ± 0.0	48.9 ± 0.0	31.9 ± 0.0	63.6 ± 0.1	4.3 ± 0.0	7.4 ± 0.0
C6	26.8 ± 0.2	49.3 ± 0.2	32.2 ± 0.2	71.6 ± 4.6	4.8 ± 0.3	7.6 ± 0.1

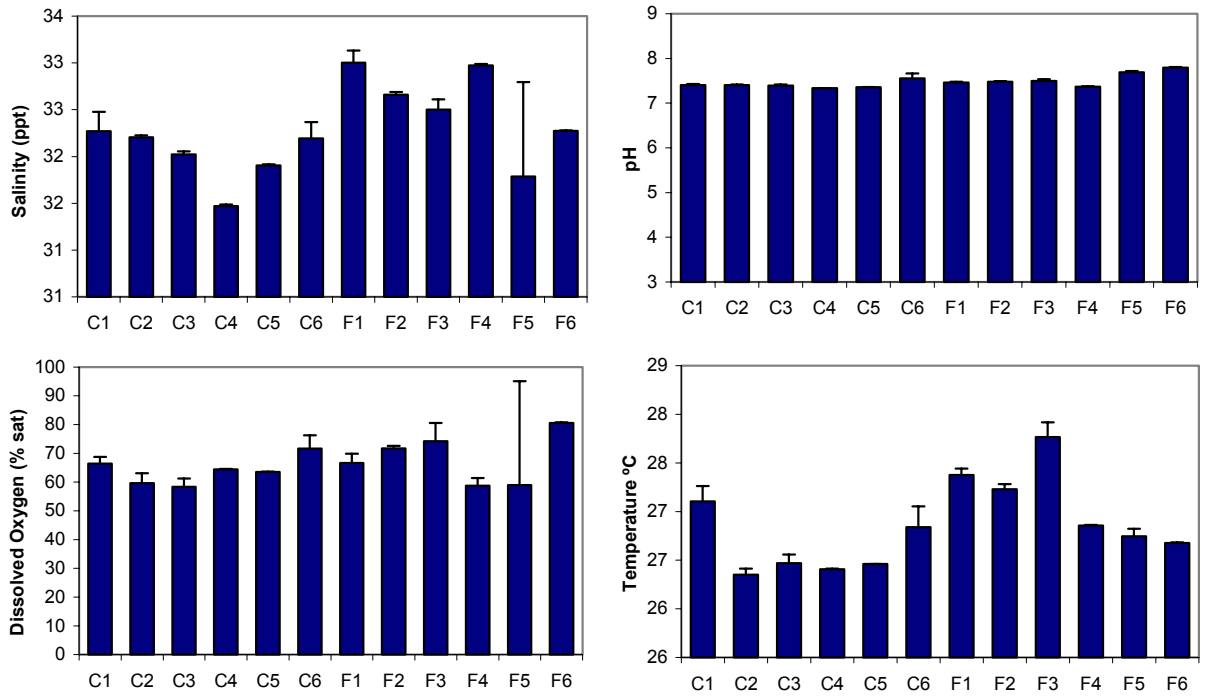


Figure 5-1 Physico-chemical data from surface waters at intertidal and subtidal farm and control sites.

5.2 Nutrients

Method

Water samples were collected mid way through the ebbing tide from sheltered shallow waters sites and near the turn of the tide at the deep water sites along with the other water quality parameters. Water samples were collected for laboratory analysis of chlorophyll and dissolved inorganic nitrogen – measured as nitrate and nitrite (NO_X) and total ammonia nitrogen (TAN) – from 0.3 m below the surface in clean plastic bottles at shallow water sites and 0.5 m above the seabed in a Nisken bottle then transferred to clean plastic bottles at deep water sites. As soon as the water samples were collected they were sealed and placed in an esky on ice to stay chilled until they could be frozen at the shore base. They were delivered frozen to Northern Territory Environmental Analysis Laboratories for analysis.

NO_X is measured by reducing all nitrates to nitrite and analysing the nitrite. To measure nitrate NO_X is analysed as described above, then nitrite is analysed and subtracted from NO_X. The nitrate to nitrite ratio normally approximates 10:1. Total dissolved inorganic nitrogen (DIN) consists of nitrates, nitrites and total ammonia nitrogen (TAN). The occurrence of different forms of ammonia depends on pH. At the pH of average seawater ~95% of ammonia is in the cationic form of ammonium (NH_4^+) (Millero, 1996). It is NH_4^+ that is measured in the *APHA 4500 Ammonia Nitrogen* analysis, so effectively TAN and NH_4^+ are equivalent in seawater. DIN gives a better indication of bioavailable nutrient concentration than Total N which includes bound organic nitrogen, making DIN a better indicator of conditions conducive to algal blooms (Eyre, 2000; Harris, 1994). For further information see the footnotes and reference to bioavailable nutrient concentrations in the ANZECC guidelines Interim Trigger Levels in their Table 3.3.2.

Results

Ammonia levels ranged from 0.02 to 0.04 at all sites except C6 were it was 0.06 and 0.07. Nitrite levels were below detection threshold values for all farm sites and at the threshold level of 0.005 mg/L at control sites other than C5-2 and C6 where they were 0.010 mg/L. Nitrate levels were 0.01 mg/L at farm sites and 0.02 to 0.03 mg/L at control sites.
Results of the Baseline survey are given in

Table 5-2.

Interpretation

ANZECC draft guidelines for Interim Trigger Levels (ITL) for nutrients in slightly to moderately disturbed estuaries and coastal waters are given in Table 5-3 (ANZECC, 1999). Total N includes organic nitrogen which is not readily bioavailable so is normally greater than DIN. As Snake Bay is flushed by 3m to 7m tides twice per day and there is little or no freshwater input at this time of year, reference trigger levels should be somewhere between Estuarine and Coastal values, arguably nearer Coastal. ANZECC guidelines are generalised for all of Australia and New Zealand and need to be verified against locally collected data. Ideally the reference condition would be defined using up to 3 to 5 years of at least monthly sampling data collected from at least 5 to 10 reference locations in well functioning unmodified ecosystems (ANZECC, 1999). A monitoring program underway in Port Hurd is providing good reference data which at some stage may be combined with data collected in similar estuaries to generate more suitable guidelines for these estuaries. The results of this survey are at the high side of the range of those

recorded over a 2 year monitoring program in Port Hurd so may be considered typical for this type of mangrove estuary.

Given the above all NO_X and Ammonia levels exceeded the ITL for estuaries but not those for marine waters with the exception of C6 where ammonia levels did exceed those for marine waters. As both of these estuaries have little anthropogenic nutrient input there is further justification for using either levels nearer those for coastal waters or collecting control site data as a reference. The main use for this data will be in monitoring trends over time.

Table 5-2 Snake Bay dissolved inorganic nitrogen analysis

Site	Ammonia (mg/L)	Nitrite (mg/L)	Nitrate (mg/L)	NOX (mg/L)
F1-1	0.03	<0.005	0.01	<0.015
F1-2	0.03	<0.005	0.01	<0.015
F2-1	0.03	<0.005	0.01	<0.015
F2-2	0.02	<0.005	0.01	<0.015
F3-1	0.04	<0.005	0.01	<0.015
F3-2	0.02	<0.005	0.01	<0.015
F4-1	0.03	<0.005	0.01	<0.015
F4-2	0.04	<0.005	0.01	<0.015
F5-1	0.02	<0.005	0.01	<0.015
F5-2	0.02	<0.005	0.01	<0.015
F6-1	0.02	<0.005	0.01	<0.015
F6-2	0.02	<0.005	0.02	<0.015
C1-1	0.03	0.005	0.02	0.025
C1-2	0.04	0.005	0.02	0.025
C2-1	0.04	0.005	0.02	0.025
C2-2	0.03	0.005	0.02	0.025
C3-1	0.03	0.005	0.02	0.025
C3-2	0.04	0.005	0.03	0.030
C4-1	0.03	0.005	0.02	0.025
C4-2	0.03	0.005	0.02	0.025
C5-1	0.03	0.005	0.03	0.030
C5-2	0.03	0.01	0.03	0.035
C6-1	0.07	0.01	0.03	0.040
C6-2	0.06	0.01	0.03	0.040

Table 5-3 ANZECC (1999) draft guidelines for interim trigger values for nutrients in estuaries and coastal waters

Ecosystem type	Total N mg/L	NO_X mg/L	NH_4 mg/L
Estuaries	0.08	0.005	0.02
Coastal & marine	0.35	0.06	0.04

5.3 Phytoplankton - Chlorophyll α

Method

Abundance of phytoplankton in the water column was monitored through measurement of Chlorophyll α, the main light absorbing pigment used in photosynthesis, in the water column. Water samples were collected mid way through the ebbing tide from sheltered shallow waters sites and near the turn of the tide at the deep water sites at the same time as other water quality parameters. Water samples were collected for laboratory analysis of chlorophyll and organic nitrogen from 0.3 m below the surface at shallow water sites and 0.5 m above the seabed at deep water sites. As soon as the water samples were collected they were sealed and placed in an esky on ice to stay chilled until they were processed. The samples were filtered at the shore facility as soon as possible after collection using sterile techniques. 250 ml of sample was drawn through a 0.7 μm glass microfibre filter paper using a Buchner funnel. The filter paper was removed, rolled up and placed in a small glass vial using forceps. This was then chilled and kept on ice until it was analysed for Chlorophyll α at Northern Territory Berrimah Farm Water laboratories.

Results

Chlorophyll α levels at farm sites were generally 3 μg/L or 4 μg/L, with the exception of F1-1 which recorded 2 μg/L. Control sites recorded slightly lower chlorophyll α levels of 2 or 3 μg/L only (Table 5-4). Levels of chlorophyll α at deep water sites were not noticeably different from those at shallow water sites. Detailed results are given in Table 5-4.

Interpretation

Chlorophyll α levels found in this survey were within the range of those recorded during the initial stages of monitoring at Port Hurd (1.1 - 4.6 μg/L) but approximately double those recorded at Channel Island (<2 μg/L) and Doug Point (up to 2 μg/L). They were also double the results of studies within Darwin Harbour which found values of 1 – 2 μg/L in the main harbour but consistent with records of 1 – 199 μg/L in the tidal creeks (Wrigley *et al*. 1990, Pardovan 1997, Parry and Munksgaard 1999, Pardovan 2002, Sly *et al*. 2002). Once again, the results of this survey are within the range of those recorded over a 2 year monitoring program in Port Hurd so may be typical for this type of mangrove estuary. The value in this analysis will be in monitoring changes with time and assessing natural variation and gain an understanding of normally prevailing in mangrove estuaries.

Chlorophyll α levels found in this study were generally well above draft ANZECC Interim Trigger Levels for slightly to moderately disturbed ecosystems (2 μg/L for estuaries and 0.3 μg/L for coastal and marine waters; Table 3.3.2, ANZECC 1999).

Table 5-4 Snake Bay chlorophyll α data

Site	Chlorophyll α (mg/L)
F1-1	2
F1-2	3
F2-1	4
F2-2	3
F3-1	3
F3-2	3
F4-1	3
F4-2	3
F5-1	4
F5-2	4
F6-1	3
F6-2	3
C1-1	2
C1-2	3
C2-1	3
C2-2	3
C3-1	2
C3-2	2
C4-1	3
C4-2	3
C5-1	2
C5-2	3
C6-1	2
C6-2	2

6 Biological Analysis

6.1 Mangrove stand structure and composition

Method

Mangrove stand structure and composition were recorded at three sites around Snake Bay in areas considered most likely to be subject to impact by nutrients released from the proposed aquaculture facility. These sites were selected with regard to drogue movements and proximity to the proposed farm, and to cover a range of habitats from small creeks to the side of the main channel. A further consideration was access by boat at mid to low spring tide. Two sites in similar locations were studied in the control estuary of Snake Bay. As these sites were near but not necessarily adjacent to the shallow water sample sites their positions were recorded with the designations FM1, FM2, FM3, CM1 and CM2.

Methodology used was the Angle Count Cruising (ACC) method as described in Moritz-Zimmermann *et al* (2002) Section 4.4.1 and Brocklehurst and Edmeades (2003). This method involved using an aluminium basal wedge (Bitterlich gauge) to count trees in a 360° sweep from selected sites, in this case along 50 m transects. A gap in the wedge corresponding to a Basal Area Factor (BAF) of 1.0, 0.75, 0.5 or 0.25 was selected that counted 30 to 40 trees per sweep. All trees greater than or equal to the gap were counted, including borderline trees. Trees were identified to species level and their diameter at breast height (DBH), height, status (dead or alive) and condition was recorded. DBH was measured at 1.3m above ground or 20 cm above prop roots as described in Moritz-Zimmermann *et al* (2002). ACC counts are sub-samples compared to full plots but take much less time. The accuracy of ACC method is ± 10% for trees less than 400 mm DBH (Brocklehurst and Edmeades, 1995), so is applicable to this study where all trees were less than 400 mm DBH.

Using the formulae given below this enabled calculation of:

- total basal area per ha;
- basal area per species per ha;
- basal area of dead trees per ha;
- dominance of species and dead trees;
- total stem density per ha;
- stem density per species per ha; and
- stem density of dead trees per ha.

For each sweep site:
Basal Area (m^2/ha) = count x BAF
Dominance = (BA of species/ Total BA) x 100
Stem Density (SD/ha) for each individual tree = BAF/(0.00007854*$(DBH)^2$)
SD/ha = the sum of SD of all trees counted

Stand structure and composition was surveyed at four sweep sites along a 50m transect perpendicular to the shore across the various vegetation zones at each site. The distance between sweep sites was such that few individual trees were counted in more than one sweep. Transects were located using GPS, a mangrove tree at the water's edge was marked with a labelled orange cattle tag and the direction of the transect from this tag was recorded. The first sweep site (the start of the transect) was selected so it was sufficiently distant from the water's edge that a full circle of mangroves could be measured to ensure the ACC results would be valid. This resulted

in very few of the mangroves at the water's edge being included in the count. At each sweep site each tree counted was identified to species level where possible and measured for diameter, height, status and condition. Only trees counted using the ACC method were identified and assessed. Five trees at each site were selected as typical of the site and tagged for future measurement. The distance of subsequent sweep sites was recorded using a 50m tape.

Results

Mangrove stand composition at Snake Bay farm sites was dominated by *Rhizophora* sp. at all but 2 sites (F2-3 and F2-4). Control sites were dominated by *Ceriops tagal* at C1-3, C1-4, C2-3 and C2-4, and *Bruguiera exaristata* at C1-2, C2-1 and C2-2. *Rhizophora* sp. was the dominant species at C1-1 only. *Avacennia marina* was relatively uncommon at both the control and farm sites, with only 4 individual trees recorded from F3-4.

The dominating species at the seaward end of the transects at all sites was *Rhizophora* sp., with the exception of C2-1 where *Bruguiera exaristata* was the most common with *Rhizophora* sp comprising 30% of stem density. The dominating species at the mid transect sites were *Rhizophora* sp. and *Bruguiera exaristata.* Inshore locations were dominated by several species. At the control sites, *Ceriops tagal* was the dominating inshore species, while *Rhizophora* sp. dominated inshore farm sites except F2-3 and F2-4 where *Bruguiera parviflora* and *B. exaristata* dominated respectively.

The calculated stem density of dead trees per hectare was greatly influenced by the occasional occurrence of a small dead mangrove very near the sweep site. There were no dead trees recorded at F3-4 or C2-3. A summary of results is given in Table 6-1 and field records are presented in Table 8-6 to
Table 8-24.

Interpretation

The dominance of *Rhizophora* sp. at the Snake Bay sites reflects the more gently sloping land surrounding that bay and the more varied stand composition at the control sites on the Shark Bay estuary reflect the steeper banks found there. Rhizophora species prefer lower habitats where their roots are inundated on all tides. Ceriops and Bruguiera species tolerate less frequent inundation. Despite the intention to study similar stands at the farm and control sites it was not easy to be sure what lay behind the tall belt of Rhizophora lining the banks of both estuaries. Once ashore and deep in the mangroves it was not feasible to abandon sites and search for more suitable ones because the window in the tide for access to the intertidal zone was very limited. However changes in stand structure and composition which are not replicated at control sites will be a significant monitoring tool.

Communities at both sites were typical for similar estuaries (see Brocklehurst and Edmeades, 2003). Although additional analysis can be done using this data its main use is to provide a baseline for monitoring future change.

Table 6-1 Mangrove stand structure and composition using ACC method at control and farm sites.

Transect	Distance m	Bearing deg mag	Date	TBA m3/ha	BA Sp1 m3/ha	BA Sp2 m3/ha	BA Dead m3/ha	Dom Sp1 %	Dom Sp2 %	Dom Dead %	TSD SD/ha	SD Sp1 SD/ha	SD Sp2 SD/ha	SD Dead SD/ha	Mean Ht m
F1-1	0	300	28/08/2005	30.8	20.3	4.5	1.5	65.9	14.6	4.9	6509	933	2397	59	9.0
F1-2	15	280	28/08/2005	27.0	23.3	2.3	0.8	86.1	8.3	2.8	6411	2229	1492	45	8.2
F1-3	41	260	28/08/2005	36.0	31.0	1.0	3.0	86.1	2.8	8.3	3614	1133	1883	127	11.7
F1-4	56	260	28/08/2005	25.5	17.3	3.8	3.8	67.6	14.7	14.7	3898	676	2087	189	10.3
F2-1	0	150	25/08/2005	17.5	13.5	3.0	0.5	77.1	17.1	2.9	5956	3352	2243	151	6.5
F2-2	16	140	28/08/2005	21.0	12.0	4.5	2.5	57.1	21.4	11.9	9474	1408	2891	749	6.0
F2-3	34	160	25/08/2005	21.5	9.5	8.5	1.5	44.2	39.5	7.0	3660	1834	330	115	7.2
F2-4	55	140	25/08/2005	20.0	16.0	2.5	0.5	80.0	12.5	2.5	7293	5210	217	1763	5.9
F3-1	0	90	25/08/2005	36.0	29.0	1.0	6.0	80.6	2.8	16.7	758	631	3	124	10.3
F3-2	27	90	25/08/2005	23.0	22.0	0.0	1.0	95.7	0.0	4.3	952	945	0	7	12.0
F3-3	50	90	25/08/2005	25.5	18.8	4.5	0.8	73.5	17.6	2.9	1555	1398	144	13	12.7
F3-4	65	60	25/08/2005	23.3	18.0	3.0	0.0	77.4	12.9	0.0	975	682	222	0	13.6
C1-1	0	110	26/08/2005	20.5	13.0	6.5	0.5	63.4	31.7	2.4	11404	415	10774	38	9.5
C1-2	15	140	26/08/2005	8.0	3.3	1.5	1.3	40.6	18.8	15.6	21827	6407	423	2419	6.7
C1-3	26	130	26/08/2005	26.3	21.8	0.0	4.5	82.9	0.0	17.1	15708	13567	0	2141	6.7
C1-4	46	120	26/08/2005	18.5	16.5	0.0	2.0	89.2	0.0	10.8	8879	7730	0	1149	7.4
C2-1	0	40	27/08/2005	22.5	14.5	6.5	1.5	64.4	28.9	6.7	7498	5222	2050	226	5.5
C2-2	13	70	27/08/2005	23.5	13.0	7.0	1.0	55.3	29.8	4.3	23203	8335	12048	2192	4.7
C2-3	28	70	27/08/2005	20.0	15.5	4.5	0.0	77.5	22.5	0.0	24642	23850	792	0	4.5
C2-4	39	10	27/08/2005	31.0	29.0	1.5	0.5	93.5	4.8	1.6	23066	16832	6135	99	5.8

Site	Dom sp. 1	Dom sp.2	Site	Dom sp. 1	Dom sp.2	Site	Dom sp. 1	Dom sp.2
F1-1	Rhizophora sp.	Bruguiera exaristata	F3-1	Rhizophora sp.	Sp. 1	C1-1	Rhizophora sp.	Bruguiera exaristata
F1-2	Rhizophora sp.	Bruguiera exaristata	F3-2	Rhizophora sp.	-	C1-2	Bruguiera exaristata	Rhizophora sp.
F1-3	Rhizophora sp.	Ceriops tagal	F3-3	Rhizophora sp.	Bruguiera gymnorrhiza	C1-3	Ceriops tagal	-
F1-4	Rhizophora sp.	Bruguiera exaristata	F3-4	Rhizophora sp.	Avacennia marina	C1-4	Ceriops tagal	-
F2-1	Rhizophora sp.	Bruguiera exaristata				C2-1	Bruguiera exaristata	Rhizophora sp.
F2-2	Rhizophora sp.	Bruguiera exaristata				C2-2	Bruguiera exaristata	Ceriops tagal
F2-3	Bruguiera parviflora	Rhizophora sp.				C2-3	Ceriops tagal	Bruguiera exaristata
F2-4	Bruguiera exaristata	Rhizophora sp.				C2-4	Ceriops tagal	Bruguiera parviflora

6.2 Epiphytic algal growth

Method

Epiphytic algal growth on mangrove roots were measured qualitatively using digital camera photographs taken from set positions at each of the intertidal sites. Two photos were taken at three locations 20 m apart at each intertidal site, one from about 5 m distant showing general extent of growth and one from about 1 m showing root assemblages in detail. Both were taken when the roots were sufficiently exposed and light conditions adequate to enable algal growth to be clearly seen. Comparison of a time series of photographs will show any significant change. Comparison with photos of control sites will show differences resulting from wider seasonal changes.

Results

Photos taken at the shallow water sample sites showed no visible epiphytic algal growth. Additionally, close inspection of mangrove roots and intertidal structures at those sites found no visible algal growth.

Two representative photos from each mangrove monitoring site are presented on the following pages (Not in this email version)

Interpretation

All intertidal mangrove root and rhizome assemblages appear in good health with regard to epiphytic algal growth, indicating waterborne nutrient levels are too low for the establishment of epiphytic algal growth.

6.3 Benthic faunal analysis

Sampling methods

Macroinvertebrates were collected using a Van Veen grab which sampled a 0.07 m^2 area of seabed. A total of three replicate samples were collected at each monitoring site (F1 to F6) and each control site (C1 to C6). The samples were sieved in the field using a 1 mm mesh sieve, and animal and sediment material retained on the sieve placed into vials diluted with 5% buffered formalin. In the laboratory, collected material was washed through a stacked series of sieves (1, 1.4, 2, 2.8 and 4 mm) using the methods described by Edgar (1990). Material retained on each sieve was sorted under a dissecting microscope with animals separated into species groups, counted and placed in labelled vials for long term storage.

Analytical methods

Benthic infauna data were analysed using univariate and multivariate statistical methods to assess patterns of spatial variation in the baseline data.

Benthic infauna data were analysed using multidimensional scaling (MDS), as run by SYSTAT (Wilkinson 1989) and PRIMER (Carr 1996) programs, in order to produce the best graphical depiction of faunal similarities among samples. For this analysis, the data matrix showing total abundance of species in each sample was double square root transformed and converted to a symmetric matrix of biotic similarity between pairs of samples using the Bray-Curtis similarity index. These procedures follow the recommendations of Faith *et al*. (1987) and Clarke (1993) for data matrices with numerous zero records. The usefulness of the two dimensional MDS display of relationships among samples is indicated by the stress statistic, which if <0.1 indicates that the depiction of relationships is good, and if >0.2 that the depiction is poor (Clarke 1993).

Several indices were calculated to provide information on macrobenthic diversity at sites sampled:

Species number, S
Where S equals the number of species or equivalent taxonomic unit collected in a sample.
Individuals, N
Where N equals then number of individuals of all species collected in a sample.
Diversity (Shannon-Wiener), $H' = -\sum_i \rho_i(\log \rho_i)$
Where ρ_i is the proportion of the total count arising from the $_i$th species.
Evenness (Pielou's), $J' = H'(observed)/H'_{max}$
Where H'_{max} is the maximum possible Shannon diversity which could be achieved if all species contained the same number of individuals (=log S).
Richness (Margalef's), d = (S-1)/log N
Where d is a measure of the number of species present for a given number of individuals.

In addition, K-dominance curves were calculated for each site sampled, based on pooled replicate data. K-dominance curves rank the families collected at each site from most abundant to least abundant and allow easy determination of levels of faunal dominance. K-dominance curves provide a useful indicator of benthic infauna community health, with

large y-intercept values and steep curves indicative of high levels of faunal dominance and hence low levels of community health.

Results and interpretation

Macrobenthic species collected during the survey are shown in Table 8-25 and Table 8-27 and consisted of 183 species represented by a total of 1802 individuals. Samples from the six farm sites in Snake Bay included 140 species and 1121 individuals, whilst the remaining 681 individuals, representing 107 species, were identified in samples from the Shark Bay Estuary control sites. The samples were dominated by polychaete worms (76 species, 820 individuals), crustaceans (50 species, 689 individuals) and molluscs (39 species, 123 individuals), while echinoderms, nemerteans and a range of less common taxa were also identified. The most common species were the tanaid crustacean *Apseudes* sp. (179 individuals), ophiuroid echinoderm *Ophiocentrus* sp. and polychaete worm *Eunice* sp. and were distributed across both farm and control sites, although the latter species was only detected in one control site sample.

The results of MDS analysis using all macrobenthic samples are displayed in Figure 6-1. The MDS plot reveals a gradation in faunal similarity in association with habitat/depth, with intertidal sites (F1-3, C1-3) grouped on the right side of the plot, shallow subtidal sites (F4, C4) positioned in the centre and deeper subtidal sites (F5-6, C5-6) grouped further to the left of the plot. The primary exception was sample C3-3, which showed greater similarity with some of the deeper subtidal samples than with the other intertidal samples. Within the intertidal and shallow subtidal groupings, there was also differentiation between farm and control sites, with the former located in the bottom of the plot. This pattern was less pronounced in the deeper subtidal sites, where considerable overlap occurred in levels of similarity among farm and control sites. Of note is C5-3 which is placed well outside the grouping and was the only anoxic sample.

The stress statistic for the MDS plot in Figure 6-1 exceeds 0.2 and therefore reflects a relatively poor depiction of patterns of similarity among samples. The data were therefore re-analysed on the basis of pooled replicate samples for each site, with the results provided in Figure 6-2. In this case, the stress statistic of 0.13 reflects an accurate depiction of relationships among sites. The separate groupings of intertidal and deeper subtidal sites are again distinct, as are the farm and control site groupings for intertidal and shallow subtidal sites. On the basis of replicate data, the shallow subtidal sites appeared to group more strongly with the intertidal sites than displayed in Figure 6-1, particularly in the case of C4.

Patterns of similarity amongst macrobenthic samples therefore reflect both habitat/depth variation and geographical separation of the two estuary systems surveyed. The taxa that account most for differences in assemblages on the basis of habitat and estuary are tanaid crustaceans belonging to the genus *Apseudes* and a polychaete worm belonging to the genus *Eunice*. One species of *Apseudes* was present at intertidal and shallow subtidal sites but was not found at deeper subtidal sites, a finding that contributed significantly to the separation of sites on the basis of habitat in the MDS plots. Site C6 displayed the lowest similarity with other sites due not only to the absence of the above *Apseudes* species, but the virtual absence (1 individual was identified) of a second *Apseudes* species that was relatively common at other deep subtidal sites. *Eunice* sp. was common at the farm intertidal sites in Snake Bay and was also identified at F4, but was absent from intertidal and shallow subtidal control samples in the adjacent Shark Bay Estuary. The latter finding

significantly contributed to the separation of intertidal and shallow subtidal samples on the basis of estuary, although other taxa also contributed to the MDS groupings observed.

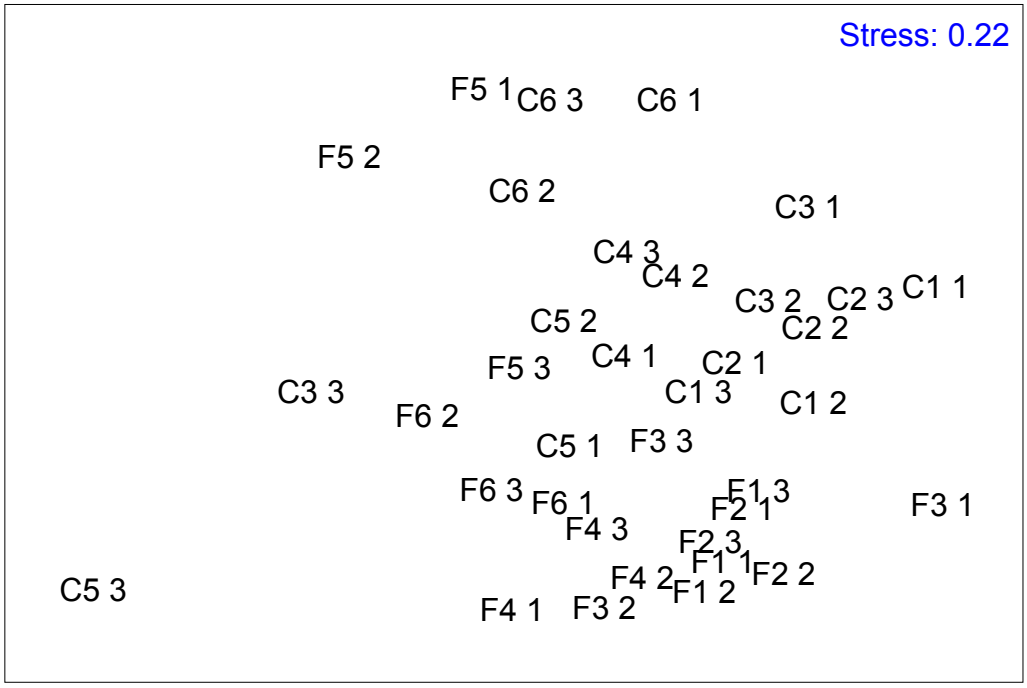


Figure 6-1 Results of MDS analysis using macrobenthic data from triplicate samples at each site.

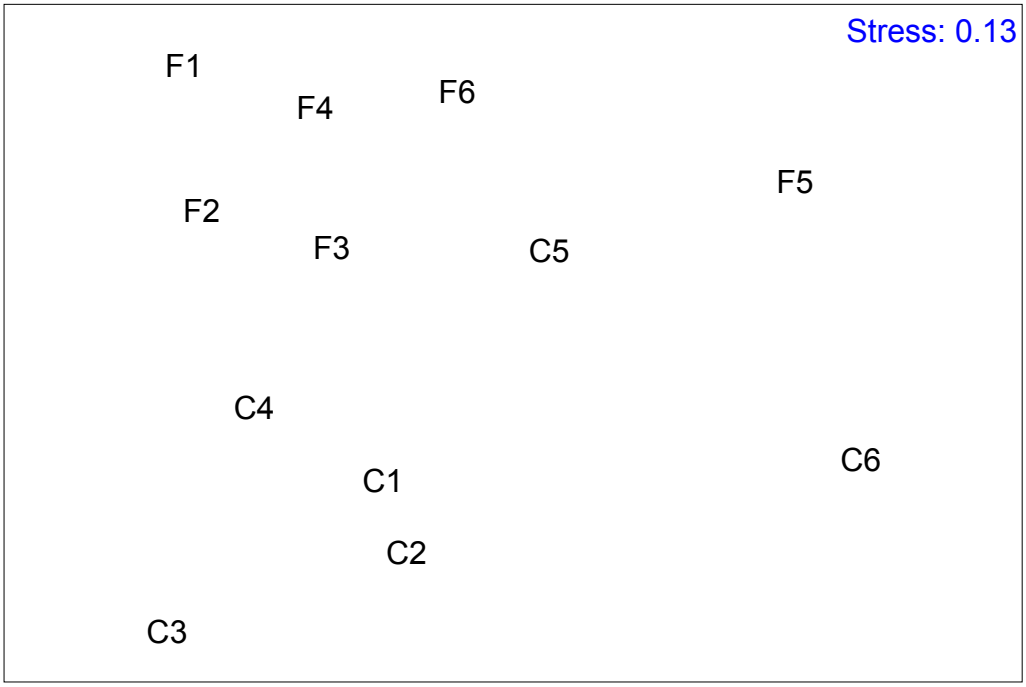
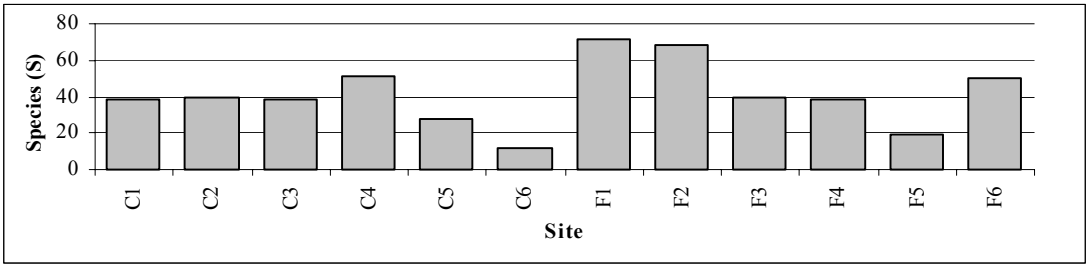
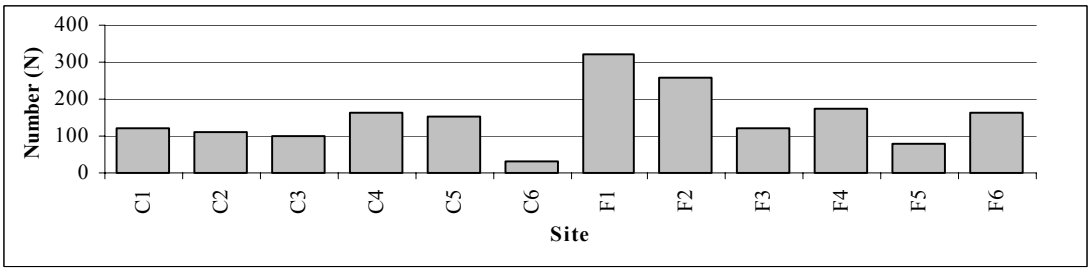
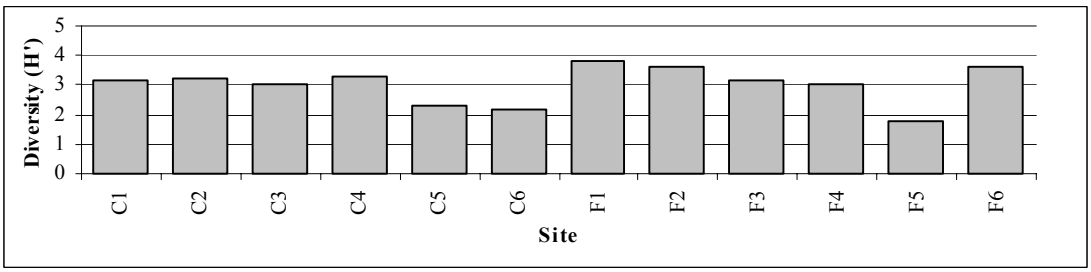


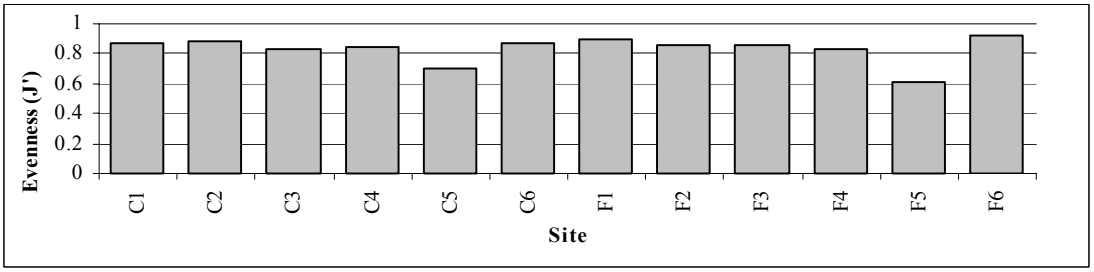
Figure 6-2 Results of MDS analysis using pooled replicate macrobenthic data from each site.

The results of diversity indices calculations are provided in Figure 6-3 and provide baseline data that can be readily compared with future data to assess temporal variation in biodiversity. Species and individual numbers peaked at sites F1 and F2, and were consistently low at C6 and F5. Species number and abundance exhibited no clear relationship to depth, although it is notable that highly consistent values of these parameters were recorded across the three intertidal control sites. Similar patterns were observed for the Shannon–Wiener diversity index (H') and Margalef's richness index (d), with highest values at F1 and F2, lowest values at C6 and F5 and comparable values for the intertidal control sites. Sites C4 and F6 also recorded elevated values for these indices due to the high numbers of species observed relative to the numbers of individuals collected. Pielou's evenness index (J'), which reflects how evenly the numbers of individuals are distributed amongst species, recorded similar values at all sites, with the exception of reduced evenness at sites C5 and F5. Overall, there was no consistent trend for elevated diversity in one estuary compared with another, or in one particular habitat compared with another. It is notable however that the lowest diversity and abundance values were recorded in several of the deeper subtidal sites, a finding that may reflect reduced light penetration and primary production in some of the deeper sections of the estuaries.









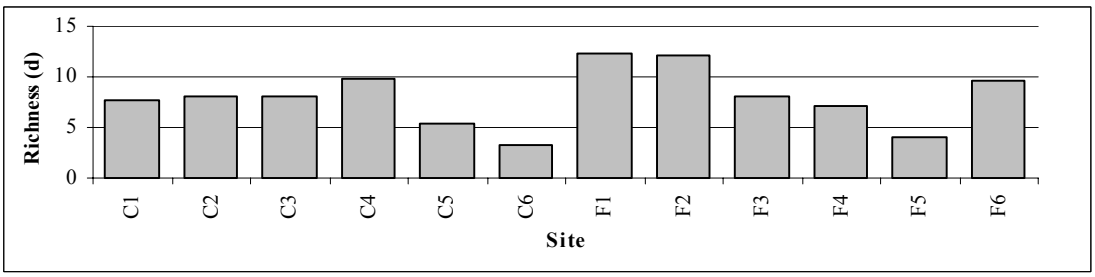


Figure 6-3 Macrobenthic diversity indices for farm and control sites; S = number of species, N = number of individuals, H' = Shannon-Wiener diversity index, J' = Pielou's evenness index, d = Margalef's richness index.

K-dominance curves for pooled replicate samples at each site are presented in Figure 6-4. At most sites the curves reflected low levels of faunal dominance with the most dominant species comprising 20% or less of animal numbers. Where this was the case, remaining components of the assemblages consisted of a large number of low abundance species, again reflecting low levels of dominance. Consistent with reduced diversity values depicted in Figure 6-3, sites C5, C6 and F5 were exceptions to the above, since the most common species at each of these sites comprised 30 to 50 % of the total animal numbers. These sites were also characterised by lower species numbers overall than other sites, again reflecting higher faunal dominance on the basis of cumulative calculations. The higher dominance at these deeper subtidal sites may reflect reduced habitat suitability for many species due to poor light conditions and associated primary production, as described above in diversity indices results. None of the K-dominance curves depicted in Figure 6-4 are indicative of high levels of pollution or other forms of environmental degradation.

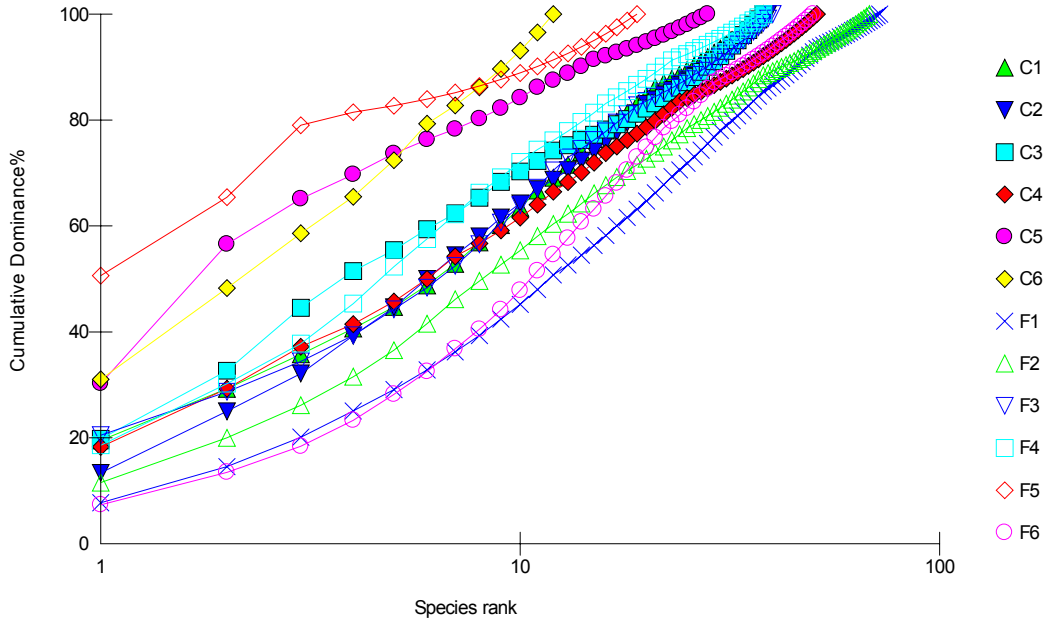


Figure 6-4 K-dominance curves for pooled replicate macrobenthic samples at each site.

Summary

Benthic infaunal analysis found no obvious signs of existing impacts on macrobenthic communities in Snake Bay and the adjacent Shark Bay Estuary. Analysis of faunal similarities amongst samples from these two estuaries detected habitat-related variation, with intertidal and shallow subtidal communities distinct from deeper subtidal communities. Within the intertidal and shallow subtidal sites, differentiation was observed between Snake Bay and the Shark Bay Estuary, while deeper subtidal samples exhibited more variation and could not be clearly distinguished on the basis of estuary. Diversity indices and K-dominance calculations revealed no consistent trends in biodiversity or dominance on the basis of estuary or habitat, although several deeper subtidal sites recorded reduced diversity and elevated dominance compared with other sites. This finding may reflect reduced light penetration and primary production in some deeper sections of the estuaries, since results were not indicative of high levels of pollution or other environmental disturbance. The benthic infaunal data gathered in this survey will provide a useful baseline against which future biological change can be assessed.

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8 Appendices – Data tables

8.1 Survey coordinates

Table 8-1 Sample site coordinates

Grid: Lat/Lon hdddºmm.mmm'
Datum: WGS 84

Site	Latitude	Longitude	Location
F1	11º 25.350' S	130º 42.318' E	Snake Bay
F2	11º 28.273' S	130º 46.077' E	Snake Bay
F3	11º 29.150' S	130º 43.020' E	Snake Bay
F4	11º 29.318' S	130º 42.958' E	Snake Bay
F5	11º 26.548' S	130º 43.303' E	Snake Bay
F6	11º 25.980' S	130º 41.668' E	Snake Bay
C1	11º 24.547' S	130º 35.790' E	Shark Bay
C2	11º 25.029' S	130º 36.549' E	Shark Bay
C3	11º 25.922' S	130º 36.025' E	Shark Bay
C4	11º 25.855' S	130º 35.968' E	Shark Bay
C5	11º 25.092' S	130º 36.212' E	Shark Bay
C6	11º 24.346' S	130º 35.105' E	Shark Bay
FM1	11º 25.198' S	130º 42.433' E	Snake Bay
FM2	11º 28.264' S	130º 46.142' E	Snake Bay
FM3	11º 29.317' S	130º 42.969' E	Snake Bay
CM1	11º 25.868' S	130º 36.059' E	Shark Bay
CM2	11º 25.050' S	130º 36.592' E	Shark Bay

8.2 Redox potential

Table 8-2 Uncorrected redox potential readings in millivolts at specified depths in sediment cores.

Core	Depth (cm)		
no.	0	1	4
F1-1	-78	-131	-145
F1-2	-109	-138	-159
F1-3	-97	-109	-143
F2-1	-86	-145	-146
F2-2	-133	-146	-158
F2-3	-63	-101	-128
F3-1	-101	-115	-156
F3-2	-69	-125	-137
F3-3	-66	-125	-166
F4-1	-63	-88	-103
F4-2	-114	-123	-142
F4-3	-117	-126	-148
F5-1	230	-15	-139
F5-2	252	245	-131
F5-3	205	199	-121
F6-1	200	75	-105
F6-2	203	168	-87
F6-3	182	-99	-138
C1-1	225	153	-97
C1-2	72	-43	-68
C1-3	149	-116	-157
C2-1	-25	-109	-126
C2-2	-40	-86	-122
C2-3	-114	-131	-160
C3-1	-77	-129	-144
C3-2	205	-106	-115
C3-3	-82	-138	-153
C4-1	-148	-163	-167
C4-2	-59	-103	-134
C4-3	-105	-139	-154
C5-1	-112	-159	-174
C5-2	-96	-138	-191
C5-3	-126	-173	-246
C6-1	133	-143	-166
C6-2	121	-134	-172
C6-3	190	175	-131

8.3 Particle size analysis

Table 8-3 Particle size analysis in percent of top 100 mm of sediment cores – farm sites

Sample No	Sieve mesh size 4 %	2 %	1 %	.5 %	.250 %	.125 %	.063 %	<.063 %
F1-1	2.6	1.3	6.5	5	8	14	5	58
F1-2	0.0	5.4	-1.5	6	7	14	14	55
F1-3	0.6	3.2	3.9	9	9	16	5	53
Mean	1.1	3.3	3.0	7	8	15	8	55
Std Dev	1.4	2.0	4.1	2.1	1.0	1.1	5.4	2.6
Cum %	1.1	4.4	7.4	14	22	37	45	100
F2-1	20.8	10.4	6.5	6	7	7	8	34
F2-2	15.6	7.1	5.2	5	7	6	9	44
F2-3	16.9	9.1	3.9	4	5	5	7	49
Mean	17.7	8.9	5.2	5	6	6	8	42
Std Dev	2.7	1.6	1.3	1.3	1.5	1.0	1.0	7.9
Cum %	17.7	26.6	31.8	37	43	50	58	100
F3-1	7.8	3.9	3.9	5	7	7	5	60
F3-2	6.5	5.2	5.2	5	6	5	7	61
F3-3	5.8	1.9	3.2	3	6	6	6	68
Mean	6.7	3.7	4.1	4	6	6	6	63
Std Dev	1.0	1.6	1.0	1.0	0.7	1.3	1.0	4.2
Cum %	6.7	10.4	14.5	19	25	31	37	100
F4-1	11.7	12.3	20.1	10	6	8	3	29
F4-2	16.9	14.3	14.3	10	6	6	3	30
F4-3	15.6	10.4	15.6	9	6	6	4	32
Mean	14.7	12.3	16.7	10	6	7	3	30
Std Dev	2.7	1.9	3.1	0.7	0.4	1.4	0.7	2.0
Cum %	14.7	27.1	43.7	54	60	67	70	100
F5-1	0.0	0.0	0.0	1	1	3	1	95
F5-2	0.0	0.0	0.0	1	1	2	3	94
F5-3	0.6	0.0	0.0	0	1	1	4	93
Mean	0.2	0.0	0.0	1	1	2	3	94
Std Dev	0.4	0.0	0.0	0.6	0.4	0.6	1.3	1.0
Cum %	0.2	0.2	0.2	1	2	4	6	100
F6-1	1.9	0.6	2.6	5	42	4	1	43
F6-2	5.2	2.6	2.6	5	36	7	1	40
F6-3	1.3	1.9	2.6	8	36	8	1	40
Mean	2.8	1.7	2.6	6	38	6	1	41
Std Dev	2.1	1.0	0.0	1.9	3.2	2.1	0.0	1.5
Cum %	2.8	4.5	7.1	13	51	58	59	100

Table 8-4 Particle size analysis in percent of top 100 mm of sediment cores – control sites

Sample No	Sieve mesh size 4 %	2 %	1 %	.5 %	.250 %	.125 %	.063 %	<.063 %
C1-1	0.0	1.3	1.3	5	10	8	4	70
C1-2	0.0	1.3	5.2	5	3	10	3	73
C1-3	0.0	0.6	0.6	3	4	3	3	87
Mean	0.0	1.1	2.4	4	6	7	3	77
Std Dev	0.0	0.4	2.5	1.5	4.2	4.0	0.7	9.1
Cum %	0.0	1.1	3.5	8	13	20	23	100
C2-1	0.0	1.3	1.3	1	3	1	3	90
C2-2	1.3	2.6	2.6	3	3	2	1	85
C2-3	2.6	1.3	2.6	3	1	3	3	84
Mean	1.3	1.7	2.2	2	2	2	2	86
Std Dev	1.3	0.7	0.7	0.7	0.7	0.6	1.0	3.1
Cum %	1.3	3.0	5.2	7	10	11	14	100
C3-1	0.0	3.2	1.9	3	7	4	4	77
C3-2	0.0	1.3	2.6	4	8	5	4	75
C3-3	0.0	0.6	3.2	4	-6	21	5	73
Mean	0.0	1.7	2.6	4	3	10	4	75
Std Dev	0.0	1.4	0.6	0.4	8.1	9.4	0.4	1.6
Cum %	0.0	1.7	4.3	8	11	21	25	100
C4-1	3.9	1.3	1.9	3	9	22	4	55
C4-2	2.6	1.3	1.3	1	9	21	4	60
C4-3	3.9	0.6	1.3	1	6	12	9	66
Mean	3.5	1.1	1.5	2	8	18	6	60
Std Dev	0.7	0.4	0.4	1.4	1.5	5.7	3.0	5.9
Cum %	3.5	4.5	6.1	8	16	34	40	100
C5-1	10.4	6.5	1.3	1	5	12	9	55
C5-2	15.6	9.1	5.2	4	9	4	5	48
C5-3	7.8	5.2	2.6	3	4	3	4	71
Mean	11.3	6.9	3.0	3	6	6	6	58
Std Dev	4.0	2.0	2.0	1.3	2.7	4.9	2.7	12.1
Cum %	11.3	18.2	21.2	24	30	36	42	100
C6-1	6.5	2.6	1.3	3	5	4	3	75
C6-2	2.6	1.9	1.9	4	7	5	4	74
C6-3	4.5	1.9	2.6	1	5	3	3	78
Mean	4.5	2.2	1.9	3	6	4	3	76
Std Dev	1.9	0.4	0.6	1.3	1.1	0.6	0.6	2.0
Cum %	4.5	6.7	8.7	11	17	21	24	100

8.4 Water quality measurement

Table 8-5 Physico-chemical parameters measured at ebb tide at control and farm sites

Site	Depth m	Temperature °C	Conductivity ms/cm	Salinity ppt	DO % sat	DO mg/l	pH
F1	0.8	27.5	50.2	32.9	70.4	4.6	7.48
F1	0.9	27.3	50.4	33.0	64.7	4.3	7.46
F1	0.7	27.4	50.5	33.1	64.8	4.3	7.44
F2	0.7	27.3	49.9	32.7	72.5	4.8	7.47
F2	0.8	27.2	50.0	32.7	71.9	4.7	7.48
F2	0.9	27.2	49.9	32.6	70.8	4.7	7.49
F3	0.8	27.6	49.5	32.4	67	4.4	7.45
F3	0.8	27.8	49.8	32.6	78.5	5.1	7.52
F3	0.8	27.9	49.7	32.5	77.2	5	7.52
F4	1.8	26.9	50.4	33.0	55.9	3.7	7.36
F4	1.8	26.9	50.3	33.0	59	3.9	7.37
F4	1.8	26.9	50.3	33.0	61.3	4.1	7.38
F5	11.4	26.7	47.1	30.6	17.2	1.2	7.65
F5	10.0	26.8	49.5	32.4	79.2	5.3	7.7
F5	7.5	26.8	49.5	32.4	80.4	5.4	7.71
F6	15.4	26.7	49.4	32.3	80.8	5.4	7.78
F6	15.1	26.7	49.4	32.3	80.5	5.4	7.8
F6	15.3	26.7	49.4	32.3	80.5	5.4	7.8
C1	0.6	26.9	49.7	32.5	63.7	4.2	7.38
C1	0.7	27.2	49.2	32.2	67.3	4.5	7.42
C1	0.7	27.2	49.2	32.1	68.2	4.5	7.42
C2	0.8	26.4	49.3	32.2	63.5	4.3	7.42
C2	0.8	26.3	49.3	32.2	56.9	3.8	7.4
C2	0.8	26.3	49.3	32.2	58.4	3.9	7.4
C3	0.6	26.4	49.1	32.1	56.6	3.8	7.38
C3	0.6	26.4	49.0	32.0	56.8	3.8	7.38
C3	0.6	26.6	49.0	32.0	61.7	4.1	7.42
C4	3.3	26.4	48.3	31.5	64.5	4.3	7.34
C4	3.3	26.4	48.3	31.5	64.6	4.4	7.33
C4	3.3	26.4	48.3	31.5	64.2	4.3	7.33
C5	12.9	26.5	48.9	31.9	63.6	4.3	7.36
C5	12.4	26.5	48.9	31.9	63.5	4.3	7.35
C5	11.0	26.5	48.9	31.9	63.5	4.3	7.36
C5	12.2	26.5	48.9	31.9	63.7	4.3	7.36
C6	9.7	26.8	49.3	32.2	71.7	4.8	7.55
C6	10.3	26.8	49.3	32.2	71.7	4.8	7.56
C6	9.3	26.9	49.3	32.2	71.5	4.8	7.55

8.5 Mangrove stand structure and composition

Table 8-6 Mangrove structure and composition at site F1-1.

No.	Tag No.	Species	Diam at Breast Height (cm)	Height (m)	Status	Condition	Stem Density
1	F1-1	Bruguiera exaristata	8.2	6	1	3.6	142
2	F1-2	Ceriops tagal	3.1	3.5	1	1	994
3	F1-3	Rhizophora sp.	13.5	10	1	1.6	52
4	F1-4	Rhizophora sp.	19.0	13	1	1.6	26
5	F1-5	Bruguiera gymnorrhiza	13.0	8	1	1	57
6		Rhizophora sp.	17.0	14	1	3.6	33
7		Rhizophora sp.	17.0	12	1	3.7	33
8		Rhizophora sp.	23.0	12	1	6.3	18
9		Rhizophora sp.	13.0	13	1	3.6	57
10		Bruguiera gymnorrhiza	11.0	10	1	1.6	79
11		Rhizophora sp.	14.0	12	1	1.7.3	49
12		Rhizophora sp.	18.0	5	0	3	29
13		Rhizophora sp.	24.0	14	1	7.6.3	17
14		Rhizophora sp.	23.0	12	1	1.3.6	18
15		Rhizophora sp.	23.0	10	1	7.6.3	18
16		Rhizophora sp.	17.0	12	1	1.3.6	33
17		Rhizophora sp.	16.0	8	1	1.7	37
18		Rhizophora sp.	17.0	9	1	1.6.7	33
19		Rhizophora sp.	17.0	10	1	1.3	33
20		Rhizophora sp.	11.2	7	1	6.7	76
21		Bruguiera exaristata	4.4	7	1	1.6	493
22		Rhizophora sp.	20.0	11	1	1.3	24
23		Ceriops tagal	3.1	2	1	1	994
24		Ceriops tagal	3.3	2	1	1	877
25		Bruguiera exaristata	4.5	5.5	1	1	472
26		Rhizophora sp.	13.0	9	1	1	57
27		Bruguiera gymnorrhiza	8.9	5	1	1.3	121
28		Rhizophora sp.	19.0	12	1	1.3.6	26
29		Rhizophora sp.	21.0	12	1	1.3.6	22
30		Rhizophora sp.	16.5	11	1	1.3	35
31		Rhizophora sp.	16.0	9	1	1.3.6	37
32		Bruguiera exaristata	5.7	4	1	1.6	294
33		Bruguiera exaristata	3.4	3.5	1	1.6	826
34		Rhizophora sp.	27.5	13	1	1.3.6	13
35		Bruguiera exaristata	7.5	4	1	1.7	170
36		Rhizophora sp.	18.0	5	0	3	29
37		Rhizophora sp.	17.0	12	1	1	33
38		Rhizophora sp.	14.0	11	1	1.6	49
39		Rhizophora sp.	17.5	12	1	1.6	31
40		Rhizophora sp.	16.3	10	1	3.6	36
41		Rhizophora sp.	16.0	10	1	3.6	37

Status: 0 = dead, 1 = alive

Condition: 1 = healthy, 2 = trunk rot, 3 = crown damage, 4 = overmature, 5 = senescent, 6 = dead branches, 7 = leaning

Table 8-7 Mangrove structure and composition at site F1-2.

No.	Tag No.	Species	Diam at Breast Height (cm)	Height (m)	Status	Condition	Stem Density
1	F1-6	Bruguiera exaristata	5.7	4.5	1	1	294
2	F1-7	Rhizophora sp.	28.0	10	1	1	12
3	F1-8	Rhizophora sp.	3.3	2.5	1	1	877
4	F1-9	Bruguiera exaristata	3.2	4	1	1	933
5	F1-10	Ceriops tagal	1.9	2.5	1	1	2645
6		Rhizophora sp.	16.0	10	1	1	37
7		Rhizophora sp.	17.0	10	1	1.6.7	33
8		Rhizophora sp.	16.0	7	1	3.6.7	37
9		Rhizophora sp.	21.0	12	1	1.6	22
10		Rhizophora sp.	20.0	10	1	6	24
11		Rhizophora sp.	19.0	12	1	1.6.3	26
13		Rhizophora sp.	17.0	10	1	1.6	33
13		Rhizophora sp.	15.5	12	1	1.7.3	40
14		Rhizophora sp.	10.0	8	1	3.6	95
15		Rhizophora sp.	19.5	12	1	3.6	25
16		Rhizophora sp.	14.5	6	0	3	45
17		Rhizophora sp.	18.0	10	1	1	29
18		Rhizophora sp.	15.0	7	1	6.7	42
19		Rhizophora sp.	17.0	12	1	6.7	33
20		Rhizophora sp.	12.5	8	1	1.7	61
21		Rhizophora sp.	11.5	8	1	7.6	72
22		Rhizophora sp.	11.5	7	1	7.6	72
23		Rhizophora sp.	16.5	8	1	7	35
24		Rhizophora sp.	23.0	10	1	1.6	18
25		Rhizophora sp.	11.5	8	1	1.6	72
26		Rhizophora sp.	17.5	8	1	1.6	31
27		Rhizophora sp.	16.5	10	1	1.7	35
28		Bruguiera exaristata	6.0	6	1	1	265
29		Rhizophora sp.	19.0	7	1	1	26
30		Rhizophora sp.	17.0	8	1	1	33
31		Rhizophora sp.	9.0	7	1	1.7	118
32		Rhizophora sp.	11.0	8	1	7	79
33		Rhizophora sp.	18.5	8	1	1.6	28
34		Rhizophora sp.	11.0	8	1	1.7	79
35		Rhizophora sp.	11.8	5	1	1	69
36		Rhizophora sp.	17.0	8	1	1	33

Status: 0 = dead, 1 = alive

Condition: 1 = healthy, 2 = trunk rot, 3 = crown damage, 4 = overmature, 5 = senescent, 6 = dead branches, 7 = leaning

Table 8-8 Mangrove structure and composition at site F1-3.

No.	Tag No.	Species	Diam at Breast Height (cm)	Height (m)	Status	Condition	Stem Density
1	F1-11	Rhizophora sp.	22.5	1.5	1	1.7	25
2	F1-12	Bruguiera exaristata	5.2	6	1	1	471
3	F1-13	Ceriops tagal	2.6	2.5	1	1	1883
4	F1-14	Rhizophora sp.	18.0	14	1	1.7	39
5	F1-15	Rhizophora sp.	14.0	13	1	1.7	65
6		Rhizophora sp.	14.0	12	1	6	65
7		Rhizophora sp.	16.0	14	1	1.6.7	50
8		Rhizophora sp.	20.0	13	1	1.6.7	32
9		Rhizophora sp.	16.5	14	1	1.6	47
10		Rhizophora sp.	15.2	10	0	0	55
11		Rhizophora sp.	18.7	12	1	1.3.6.7	36
12		Rhizophora sp.	28.0	12	1	2.3.4.6.7	16
13		Rhizophora sp.	17.0	14	1	1	44
14		Rhizophora sp.	19.0	14	1	6	35
15		Rhizophora sp.	21.5	13	1	1	28
16		Rhizophora sp.	18.2	13	1	3.6	38
17		Rhizophora sp.	18.0	12	1	1	39
18		Rhizophora sp.	23.0	8	0	0	24
19		Rhizophora sp.	15.7	13	1	1	52
20		Rhizophora sp.	24.0	12	1	4.6.3	22
21		Rhizophora sp.	22.0	14	1	1.3.7	26
22		Rhizophora sp.	17.0	13	1	1.3.7	44
23		Rhizophora sp.	32.8	15	1	1.3.4.6	12
24		Rhizophora sp.	17.0	12	1	1.3	44
25		Rhizophora sp.	28.2	14	1	1	16
26		Rhizophora sp.	22.0	14	1	1.7	26
27		Rhizophora sp.	16.3	6	0	7	48
28		Rhizophora sp.	13.0	10	1	1	75
29		Rhizophora sp.	20.7	12	1	1.7	30
30		Rhizophora sp.	27.0	14	1	1.3	17
31		Rhizophora sp.	19.2	13	1	1.6.7	35
32		Rhizophora sp.	30.0	14	1	1.3	14
33		Rhizophora sp.	12.3	8	1	1.6	84
34		Rhizophora sp.	17.8	13	1	1	40
35		Rhizophora sp.	29.5	13	1	1.3	15
36		Rhizophora sp.	25.0	14	1	1.7	20

Status: 0 = dead, 1 = alive
Condition: 1 = healthy, 2 = trunk rot, 3 = crown damage, 4 = overmature, 5 = senescent, 6 = dead branches, 7 = leaning

Table 8-9 Mangrove structure and composition at site F1-4.

F1-4	28/08/2005	Dist m	56	Brg deg M	260		
BAF	TBA	BA Sp 1	BA Sp 2	BA Dead	Dom Sp 1	Dom Sp 2	Dom Dead
0.75	25.5	17.3	3.8	3.8	67.6	14.7	14.7
	TSD	SD Sp 1	SD Sp 2	SD Dead	Mean Height		
	3898	46917	208679	20692	10.3		

No.	Tag No.	Species	Diam at Breast Height (cm)	Height (m)	Status	Condition	Stem Density
1	F1-16	Ceriops tagal	2.9	4	1	1	1135
2	F1-17	Bruguiera exaristata	4.3	4.5	1	1	516
3	F1-18	Bruguiera exaristata	6.7	8	1	1	213
4	F1-19	Rhizophora sp.	11.5	6	1	7	72
5	F1-20	Rhizophora sp.	15	11	1	1	42
6		Rhizophora sp.	25	12	1	7.6.3	15
7		Rhizophora sp.	24	10	0	0	17
8		Rhizophora sp.	25	11	0	7	15
9		Rhizophora sp.	23	12	1	6.3	18
10		Rhizophora sp.	25.5	12	1	3.6	15
11		Rhizophora sp.	22	12	1	7	20
12		Rhizophora sp.	21.5	14	1	6	21
13		Rhizophora sp.	28	12	1	1	12
14		Rhizophora sp.	25	13	1	3	15
15		Rhizophora sp.	21	14	1	1	22
16		Rhizophora sp.	33	14	1	3.4	9
17		Rhizophora sp.	22.5	14	1	3.6	19
18		Rhizophora sp.	21.5	12	1	3.6	21
19		Rhizophora sp.	18.5	10	0		28
20		Bruguiera exaristata	4.5	4.5	1	6.1	472
21		Bruguiera exaristata	4.8	5	1	1	414
22		Bruguiera exaristata	4.5	4.5	1	1	472
23		Rhizophora sp.	26	14	1	3.6	14
24		Rhizophora sp.	8.6	5	0		129
25		Rhizophora sp.	21.5	14	1	3	21
26		Rhizophora sp.	23	5	0	7	18
27		Rhizophora sp.	22.8	10	1	3.6	18
28		Rhizophora sp.	26.5	14	1	6.1	14
29		Rhizophora sp.	30	12	1	6.3	11
30		Rhizophora sp.	22	10	1	7.1	20
31		Rhizophora sp.	23.5	13	1	6.1	17
32		Rhizophora sp.	20.8	10	1	3.1	22
33		Rhizophora sp.	21	12	1	5.1	22
34		Rhizophora sp.	30	10	1	1	11

Status: 0 = dead, 1 = alive

Condition: 1 = healthy, 2 = trunk rot, 3 = crown damage, 4 = overmature, 5 = senescent, 6 = dead branches, 7 = leaning

Table 8-10 Mangrove structure and composition at site F2-1

No.	Tag No.	Species	Diam at Breast Height (cm)	Height (m)	Status	Condition	Stem Density
1	F2-1	Bruguiera exaristata	3.6	3.5	1	1.6	491
2	F2-2	Bruguiera gymnorrhiza	5.5	4.5	1	1	210
3	F2-3	Bruguiera exaristata	4.9	5.5	1	1	265
4	F2-4	Rhizophora sp.	8.5	8	1	1	88
5	F2-5	Rhizophora sp.	12.0	9	1	1	44
6		Rhizophora sp.	14.0	8	1	1.6.3	32
7		Rhizophora sp.	10.0	8	1	1	64
8		Rhizophora sp.	5.0	5	1	1	255
9		Bruguiera exaristata	4.5	5	1	1	314
10		Rhizophora sp.	3.5	6	1	1	520
11		Rhizophora sp.	5.5	6	1	1	210
12		Bruguiera exaristata	4.0	4.5	1	1	398
13		Bruguiera exaristata	3.5	4	1	1	520
14		Rhizophora sp.	5.5	6.5	1	1	210
15		Rhizophora sp.	6.0	8	1	1	177
16		Rhizophora sp.	7.5	6	1	1.3	113
17		Rhizophora sp.	6.0	6	1	1.7	177
18		Rhizophora sp.	11.0	8	1	1.7	53
19		Bruguiera exaristata	5.0	7	1	1	255
20		Rhizophora sp.	12.0	9	1	1.6	44
21		Rhizophora sp.	12.0	8	1	1	44
22		Rhizophora sp.	12.0	9	1	1	44
23		Rhizophora sp.	12.0	7	1	2.6	44
24		Rhizophora sp.	16.0	9	1	1	25
25		Rhizophora sp.	13.0	7	1	3.7	38
26		Rhizophora sp.	12.0	6	1	1.6	44
27		Rhizophora sp.	10.0	5	1	1	64
28		Rhizophora sp.	8.0	8	1	1	99
29		Rhizophora sp.	6.5	3	0		151
30		Rhizophora sp.	5.1	5	1	6.7	245
31		Rhizophora sp.	5.0	6	1	1	255
32		Rhizophora sp.	6.0	3.5	1	1	177
33		Rhizophora sp.	6.0	7	1	1	177
34		Rhizophora sp.	17.5	9	1	1.3	21
35		Rhizophora sp.	8.5	9	1	1	88

Status: 0 = dead, 1 = alive

Condition: 1 = healthy, 2 = trunk rot, 3 = crown damage, 4 = overmature, 5 = senescent, 6 = dead branches, 7 = leaning

Table 8-11 Mangrove structure and composition at site F2-2.

No.	Tag No.	Species	Diam at Breast Height (cm)	Height (m)	Status	Condition	Stem Density
1	F2-6	Bruguiera exaristata	3.7	4.5	1	1	465
2	F2-7	Ceriops tagal	2.7	4.4	1	1.3	873
3	F2-8	Rhizophora sp.	15.0	10	1	1	28
4	F2-9	Bruguiera exaristata	4.9	4	1	1	265
5	F2-10	Bruguiera gymnorrhiza	1.5	2	1	1	2829
6		Bruguiera parviflora	4.1	4.2	1	1	379
7		Bruguiera exaristata	4.4	4	1	1.3	329
8		Ceriops tagal	5.1	4	0		245
9		Bruguiera exaristata	15.0	7	1	1.3	28
10		Rhizophora sp.	15.0	6	1	6.7	28
11		Rhizophora sp.	4.4	4	1	6.3	329
12		Rhizophora sp.	11.7	10	1	1	47
13		Rhizophora sp.	8.2	8	1	1.6	95
14		Rhizophora sp.	7.0	6	1	1	130
15		Rhizophora sp.	16.0	10	1	1.7	25
16		Rhizophora sp.	10.2	7	1	1.7	61
17		Rhizophora sp.	11.8	7	1	1.3	46
18		Rhizophora sp.	18.0	8	1	1.3.6	20
19		Rhizophora sp.	11.5	6	1	1	48
20		Rhizophora sp.	10.0	7	1	1.7	64
21		Rhizophora sp.	18.5	10	1	1.6	19
22		Bruguiera exaristata	6.8	6	1	1	138
23		Rhizophora sp.	9.4	5	1	1	72
24		Rhizophora sp.	14.4	6	1	1.3	31
25		Rhizophora sp.	27.5	6	0		8
26		Rhizophora sp.	8.5	3	0		88
27		Rhizophora sp.	7.3	6	1	1	119
28		Rhizophora sp.	25.0	2	0		10
29		Rhizophora sp.	4.0	2	0		398
30		Rhizophora sp.	18.5	8	1	1.3	19
31		Bruguiera exaristata	3.5	2.5	1	1.6	520
32		Rhizophora sp.	11.7	6	1	3.7.6	47
33		Bruguiera exaristata	4.3	4	1	1.7	344
34		Rhizophora sp.	14.0	9	1	1	32
35		Bruguiera gymnorrhiza	4.3	3	1	1.3	344
36		Bruguiera exaristata	4.2	4	1	1.6	361
37		Rhizophora sp.	19.5	9	1	1.3	17
38		Rhizophora sp.	17.7	9	1	1.7	20
39		Rhizophora sp.	14.0	6	1	1.3.6	32
40		Bruguiera exaristata	3.8	4	1	1	441
41		Rhizophora sp.	11.5	8	1	1.3	48
42		Rhizophora sp.	14.0	9	1	1.6	32

Status: 0 = dead, 1 = alive

Condition: 1 = healthy, 2 = trunk rot, 3 = crown damage, 4 = overmature, 5 = senescent, 6 = dead branches, 7 = leaning

Table 8-12 Mangrove structure and composition at site F2-3.

No.	Tag No.	Species	Diam at Breast Height (cm)	Height (m)	Status	Condition	Stem Density
1	F2-11	Bruguiera parviflora	9.2	8	1	1	75
2	F2-12	Bruguiera parviflora	12.5	6	1	1	41
3	F2-13	Ceriops tagal	2.4	2.5	1	1	1105
4	F2-14	Ceriops tagal	6.4	5.5	1	1	155
5	F2-15	Bruguiera parviflora	6.9	5	1	1.3.6	134
6		Bruguiera gymnorrhiza	11.7	9	1	1	47
7		Bruguiera parviflora	12.6	9	1	1	40
8		Bruguiera parviflora	11.7	9	1	1.3	47
9		Bruguiera parviflora	10.8	9	1	1.3	55
10		Rhizophora sp.	15.5	10	1	1.3	26
11		Rhizophora sp.	20.0	8	1	1.6.3	16
12		Rhizophora sp.	16.5	8	1	1.6.3	23
13		Bruguiera parviflora	10.5	2	0	3	58
14		Bruguiera exaristata	9.3	7	1	1.3	74
15		Rhizophora sp.	17.0	8	1	1.3	22
16		Rhizophora sp.	18.0	8	1	1	20
17		Bruguiera parviflora	10.7	7	1	1	56
18		Rhizophora sp.	14.0	2	0	3	32
19		Bruguiera parviflora	8.5	7	1	1	88
20		Rhizophora sp.	16.0	5	0	3	25
21		Rhizophora sp.	15.0	9	1	1.6.3	28
22		Rhizophora sp.	20.0	7	1	1.6	16
23		Rhizophora sp.	17.0	7	1	1.7	22
24		Bruguiera parviflora	11.6	9	1	1	47
25		Rhizophora sp.	18.0	9	1	1.3	20
26		Rhizophora sp.	16.0	8	1	3.7.6	25
27		Rhizophora sp.	18.0	8	1	1.3	20
28		Rhizophora sp.	17.8	9	1	3.6.7	20
29		Rhizophora sp.	23.3	10	1	1.3	12
30		Bruguiera parviflora	4.2	2.5	1	1	361
31		Bruguiera parviflora	5.8	4	1	1	189
32		Rhizophora sp.	23.5	10	1	1.3	12
33		Bruguiera parviflora	10.3	7	1	1	60
34		Bruguiera parviflora	9.3	7	1	1	74
35		Rhizophora sp.	14.5	9	1	1	30
36		Rhizophora sp.	29.0	9	1	1.7.3	8
37		Rhizophora sp.	24.0	10	1	3.6	11
38		Bruguiera parviflora	13.0	3	1	1	38
39		Bruguiera parviflora	11.7	8	1	1.3.6	47
40		Bruguiera parviflora	9.0	7	1	1	79
41		Bruguiera parviflora	6.6	5.5	1	1.3.6	146
42		Bruguiera parviflora	14.0	8.5	1	1	32
43		Bruguiera parviflora	5.3	6	1	1.3	227

Status: 0 = dead, 1 = alive
Condition: 1 = healthy, 2 = trunk rot, 3 = crown damage, 4 = overmature, 5 = senescent, 6 = dead branches, 7 = leaning

Table 8-13 Mangrove structure and composition at site F2-4.

No.	Tag No.	Species	Diam at Breast Height (cm)	Height	Status	Condition	SD
1	F2-16	Bruguiera exaristata	10.2	7	1	1	61
2	F2-17	Bruguiera exaristata	6.8	6	1	1.3	138
3	F2-18	Ceriops tagal	7.9	6	1	1.3.6	102
4	F2-19	Bruguiera exaristata	3.7	3	1	1	465
5	F2-20	Bruguiera exaristata	10.8	8	1	1	55
6		Bruguiera exaristata	7.6	7	1	1.3	110
7		Bruguiera exaristata	7.3	7	1	1.3	119
9		Bruguiera exaristata	6.8	6	1	1.3.6	138
10		Bruguiera exaristata	7.0	6	1	1.3	130
11		Bruguiera exaristata	6.3	6	1	3.6	160
12		Bruguiera exaristata	7.9	7	1	1.3	102
13		Bruguiera exaristata	7.7	7	1	1.3	107
14		Bruguiera exaristata	4.9	4	1	1.3.6	265
15		Bruguiera exaristata	5.0	5	1	3.6	255
16		Bruguiera exaristata	8.6	7	1	1	86
17		Rhizophora sp.	10.8	8	1	3	55
18		Rhizophora sp.	12.3	8	1	3	42
19		Bruguiera exaristata	3.4	2	1	3.6	551
20		Bruguiera exaristata	1.9	2	0		1763
21		Bruguiera exaristata	3.0	2.5	1	3.6	707
22		Bruguiera exaristata	5.2	4.5	1	3.6	235
23		Bruguiera exaristata	13.3	7	1		36
24		Bruguiera exaristata	11.9	7	1		45
25		Bruguiera exaristata	7.8	5	1	3.6.7	105
26		Rhizophora sp.	12.5	8	1		41
27		Bruguiera exaristata	6.5	6	1		151
28		Bruguiera exaristata	7.8	8	1		105
29		Bruguiera exaristata	10.5	6	1	3.6	58
30		Bruguiera exaristata	10.5	7	1	1	58
31		Bruguiera exaristata	10.5	6	1	1.3	58
32		Bruguiera exaristata	5.7	4	1	3.6.7	196
33		Bruguiera exaristata	7.3	6	1	1	119
34		Bruguiera exaristata	6.4	4	1	3.6	155
35		Bruguiera exaristata	7.9	5	1	1	102
36		Bruguiera exaristata	7.9	5.5	1	3.6	102
37		Bruguiera exaristata	7.5	6	1	1	113
38		Bruguiera exaristata	7.2	6	1	1.6	123
39		Rhizophora sp.	11.7	7	1	1	47
40		Rhizophora sp.	13.8	7	1	3.6	33

Status: 0 = dead, 1 = alive
Condition: 1 = healthy, 2 = trunk rot, 3 = crown damage, 4 = overmature, 5 = senescent, 6 = dead branches, 7 = leaning

Table 8-14 Mangrove structure and composition at site F3-1.

No.	Tag No.	Species	Diam at Breast Height (cm)	Height (m)	Status	Condition	Stem Density
1	F3-1	Rhizophora sp.	31.0	14	1	1.3	13
2	F3-2	Rhizophora sp.	28.0	14	1	1.3	16
3	F3-3	Rhizophora sp.	21.0	13	1	7	29
4	F3-4	Rhizophora sp.	14.0	8	1	6.7.3	65
5	F3-5	Rhizophora sp.	17.0	8	1	6.3	44
6		Rhizophora sp.	32.0	12	1	3.7	12
7		Rhizophora sp.	24.1	12	1	7	22
8		Rhizophora sp.	27.0	10	1	6.7.3	17
9		Rhizophora sp.	21.5	9	1	6.3	28
10		Rhizophora sp.	25.0	10	1	1.6	20
11		Rhizophora sp.	18.0	8	0	3.7	39
12		Rhizophora sp.	29.0	13	1	7.3	15
13		Sp. 1	36.0	5	0	7.2	10
14		Sp. 1	40.0	6	0	7.2	8
15		Sp. 1	64.0	15	1	2.3.7	3
16		Rhizophora sp.	32.0	10	1	1	12
17		Rhizophora sp.	32.0	12	1	1.7	12
18		Rhizophora sp.	23.0	6	0	7	24
19		Rhizophora sp.	22.0	8	1	1.6	26
20		Rhizophora sp.	23.0	9	1	1	24
21		Rhizophora sp.	31.5	10	1	6.3.7	13
22		Rhizophora sp.	24.0	14	1	1	22
23		Rhizophora sp.	25.0	10	1	1.6.7	20
24		Rhizophora sp.	19.0	10	0	7.3	35
25		Rhizophora sp.	24.0	12	1	1	22
26		Rhizophora sp.	30.0	12	1	6.7	14
27		Rhizophora sp.	28.0	14	1	3.6.7	16
28		Rhizophora sp.	29.0	10	1	3.6.7	15
29		Rhizophora sp.	38.0	14	1	1.7	9
30		Rhizophora sp.	18.0	10	1	1	39
31		Rhizophora sp.	19.0	8	1	3.6	35
32		Rhizophora sp.	30.0	15	1	1.3	14
33		Rhizophora sp.	21.0	8	1	3.6.7	29
34		Rhizophora sp.	29.0	8	1	3.6.7	15
35		Rhizophora sp.	42.0	5	0		7
36		Rhizophora sp.	37.0	7	1	3.6.7	9

Status: 0 = dead, 1 = alive
Condition: 1 = healthy, 2 = trunk rot, 3 = crown damage, 4 = overmature, 5 = senescent, 6 = dead branches, 7 = leaning

Table 8-15 Mangrove structure and composition at site F3-2 .

No.	Tag No.	Species	Diam at Breast Height (cm)	Height (m)	Status	Condition	Stem Density
1	F3-6	Rhizophora sp.	21.0	16	1	1.6	29
2	F3-7	Rhizophora sp.	7.0	6	1	1	260
3	F3-8	Rhizophora sp.	24.0	16	1	6.3.7	22
4	F3-9	Rhizophora sp.	15.0	15	1	1.3	57
5	F3-10	Rhizophora sp.	23.0	15	1	6	24
6		Rhizophora sp.	27.0	17	1	1	17
7		Rhizophora sp.	25.0	12	1	1.4.6.7	20
8		Rhizophora sp.	21.0	12	1	1.4.6.7	29
9		Rhizophora sp.	30.0	12	1	3.2.6.7	14
10		Rhizophora sp.	24.0	14	1	1	22
11		Rhizophora sp.	41.0	14	1	1	8
12		Rhizophora sp.	25.0	12	1	1.7	20
13		Rhizophora sp.	21.0	12	1		29
14		Rhizophora sp.	16.0	10	1	1	50
15		Rhizophora sp.	21.0	14	1	1	29
16		Rhizophora sp.	20.0	14	1	1	32
17		Rhizophora sp.	9.0	8	1	1	157
18		Rhizophora sp.	26.0	10	1	1.3	19
19		Rhizophora sp.	22.0	15	1	3.6	26
20		Rhizophora sp.	29.0	8	1	3.6.7	15
21		Rhizophora sp.	42.0	5	0		7
22		Rhizophora sp.	37.0	7	1	3.6.7	9
23		Rhizophora sp.	15.0	12	1	1.7	57

Status: 0 = dead, 1 = alive
Condition: 1 = healthy, 2 = trunk rot, 3 = crown damage, 4 = overmature, 5 = senescent, 6 = dead branches, 7 = leaning

Table 8-16 Mangrove structure and composition at site F3-3.

No.	Tag No.	Species	Diam at Breast Height (cm)	Height (m)	Status	Condition	Stem Density
1	F3-11	Rhizophora sp.	8.7	10	1	1	126
2	F3-12	Rhizophora sp.	15.0	15	1	1	42
3	F3-13	Rhizophora sp.	27.0	16	1	1	13
4	F3-14	Rhizophora sp.	18.0	16	1	1	29
5	F3-15	Rhizophora sp.	12.0	10	1	1	66
6		Rhizophora sp.	15.0	14	1	1	42
7		Rhizophora sp.	18.0	12	1	1.3	29
8		Rhizophora sp.	26.0	15	1	1.3	14
9		Rhizophora sp.	22.0	14	1	1.3	20
10		Rhizophora sp.	21.0	15	1	1	22
11		Rhizophora sp.	32.0	14	1	6	9
12		Rhizophora sp.	27.0	15	1	1.3	13
13		Rhizophora sp.	25.0	14	1	1	15
14		Rhizophora sp.	26.0	14	1	1.3	14
15		Rhizophora sp.	26.0	12	1	1.3	14
16		Rhizophora sp.	12.0	8	1	1	66
17		Rhizophora sp.	12.0	8	1	1	66
18		Rhizophora sp.	27.0	16	1	1.7	13
19		Rhizophora sp.	22.0	14	1	1.6.3	20
20		Bruguiera gymnorrhiza	30.0	14	1	1	11
21		Rhizophora sp.	22.0	15	1	1	20
22		Rhizophora sp.	15.0	12	1	1.3.6	42
23		Rhizophora sp.	15.0	12	1	1.7.3	42
24		Sp.1	27.0	10	0		13
25		Sp.1	13.0	12	1	1	57
26		Sp.1	8.0	10	1	1	149
27		Sp.1	28.0	14	1	1.7	12
28		Sp.1	28.0	16	1	1	12
29		Sp.1	26.0	15	1	1	14
30		Sp.1	9.0	10	1	1	118
31		Bruguiera gymnorrhiza	9.0	10	1	1	118
32		Rhizophora sp.	18.0	12	1	3.6	29
33		Rhizophora sp.	6.0	8	1	1	265
34		Bruguiera gymnorrhiza	25.0	11	1	3	15

Status: 0 = dead, 1 = alive
Condition: 1 = healthy, 2 = trunk rot, 3 = crown damage, 4 = overmature, 5 = senescent, 6 = dead branches, 7 = leaning

Table 8-17 Mangrove structure and composition at site F3-4.

No.	Tag No.	Species	Diam at Breast Height (cm)	Height (m)	Status	Condition	Stem Density
1	F3-20	Rhizophora sp.	22.0	16	1	1	20
2	F3-19	Bruguiera gymnorrhiza	16.0	9	1	1.3.7	37
3	F3-18	Avacennia marina	13.0	12	1	1.3	57
4	F3-17	Avacennia marina	12.0	16	1	1	66
5	F3-16	Rhizophora sp.	10.0	11	1	1	95
6		Rhizophora sp.	16.0	10	1	1.3.6	37
7		Rhizophora sp.	25.0	14	1	1	15
8		Bruguiera gymnorrhiza	25.0	14	1	1	15
9		Avacennia marina	13.0	15	1	1	57
10		Rhizophora sp.	22.0	15	1	1	20
11		Avacennia marina	15.0	16	1	1	42
12		Rhizophora sp.	24.0	14	1	1	17
13		Rhizophora sp.	17.0	14	1	6	33
14		Rhizophora sp.	13.0	14	1	1	57
15		Rhizophora sp.	24.0	14	1	1	17
16		Rhizophora sp.	21.0	14	1	1.7	22
17		Bruguiera gymnorrhiza	23.0	10	1	1	18
18		Rhizophora sp.	24.0	14	1	1.3	17
19		Rhizophora sp.	20.0	14	1	1.6	24
20		Rhizophora sp.	24.0	15	1	1	17
21		Rhizophora sp.	15.0	12	1	1	42
22		Rhizophora sp.	20.0	12	1	1.6	24
23		Rhizophora sp.	17.0	12	1	1.3.6	33
24		Rhizophora sp.	12.0	12	1	1	66
25	F3-13	Rhizophora sp.	27.0	16	1	1	13
26		Rhizophora sp.	30.0	16	1	1	11
27		Rhizophora sp.	20.0	12	1	1.3	24
28		Rhizophora sp.	29.0	12	1	1.7	11
29		Rhizophora sp.	21.0	16	1	1.7.4	22
30		Rhizophora sp.	31.0	16	1	1.7.4	10
31		Rhizophora sp.	16.0	14	1	1	37

Status: 0 = dead, 1 = alive
Condition: 1 = healthy, 2 = trunk rot, 3 = crown damage, 4 = overmature, 5 = senescent, 6 = dead branches, 7 = leaning

Table 8-18 Mangrove structure and composition at site C1-1.

No.	Tag No.	Species	Diam at Breast Height (cm)	Height (m)	Status	Condition	Stem Density
1	C1-1	Bruguiera exaristata	5.8	8	1	1	189
2	C1-2	Rhizophora sp.	19.0	10	1	1	18
3	C1-3	Bruguiera exaristata	8.8	9	1	3.6	82
4	C1-4	Bruguiera exaristata	4.0	6	1	1	398
5	C1-5	Sp.4	6.0	7	1	1	177
6		Rhizophora sp.	22.0	14	1	1	13
7		Rhizophora sp.	17.0	12	1	1.7	22
8		Bruguiera exaristata	13.0	8	0	3	38
9		Bruguiera exaristata	11.0	7	1	1	53
10		Rhizophora sp.	13.0	8	1	6.3	38
11		Bruguiera exaristata	8.0	8	1	1	99
12		Bruguiera exaristata	5.0	6	1	1.6	255
13		Bruguiera exaristata	4.4	7	1	1	329
14		Bruguiera exaristata	7.0	8	1	6	130
15		Rhizophora sp.	24.0	12	1	1	11
16		Bruguiera exaristata	18.0	10	1	6.3	20
17		Rhizophora sp.	26.0	14	1	1	9
18		Rhizophora sp.	17.0	12	1	1.6	22
19		Rhizophora sp.	27.0	7	1	7	9
20		Rhizophora sp.	19.0	14	1	1.6	18
21		Rhizophora sp.	24.0	10	1	1.7	11
22		Rhizophora sp.	10.0	12	1	1.7	64
23		Rhizophora sp.	31.0	9	1	1.7	7
24		Rhizophora sp.	23.0	14	1	1.7	12
25		Rhizophora sp.	22.0	10	1	5.7	13
26		Rhizophora sp.	20.0	6	1	5.7	16
27		Rhizophora sp.	25.0	16	1	1	10
28		Rhizophora sp.	16.0	10	1	1.7	25
29		Rhizophora sp.	20.0	12	1	1.3	16
30		Rhizophora sp.	29.0	8	1	4.7	8
31		Rhizophora sp.	20.0	14	1	1	16
32		Rhizophora sp.	27.0	12	1	1.6	9
33		Rhizophora sp.	22.0	14	1	1	13
34		Rhizophora sp.	27.0	12	1	1.7	9
35		Rhizophora sp.	25.0	11	1	1.3	10
36		Rhizophora sp.	26.0	10	1	1.7.3	9
37		Rhizophora sp.	27.0	8	1	1.7	9
38		Bruguiera exaristata	3.5	6	1	1	520
39		Bruguiera exaristata	2.5	4	1	1	1019
40		Bruguiera exaristata	2.2	3	1	1	1315
41		Bruguiera exaristata	1.0	2.5	1	1	6366

Status: 0 = dead, 1 = alive

Condition: 1 = healthy, 2 = trunk rot, 3 = crown damage, 4 = overmature, 5 = senescent, 6 = dead branches, 7 = leaning

Table 8-19 Mangrove structure and composition at site C1-2.

No.	Tag No.	Species	Diam at Breast Height (cm)	Height (m)	Status	Condition	Stem Density
1	C1-6	Ceriops tagal	ND	6	1	1	ND
2	C1-7	Bruguiera gymnorrhiza	2.0	7	1	1	796
3	C1-8	Bruguiera gymnorrhiza	3.5	4	1	1	260
4	C1-9	Ceriops tagal	0.7	2	1	1	6496
5	C1-10	Rhizophora sp.	4.0	6	1	1	199
6		Bruguiera exaristata	2.0	4	1	1	796
7		Bruguiera exaristata	1.7	4	1	1	1101
8		Bruguiera exaristata	1.8	4	1	1	982
9		Bruguiera exaristata	1.9	4	1	1	882
10		Ceriops tagal	0.8	2	1	1	4974
11		Bruguiera exaristata	3.5	4	1	6	260
12		Bruguiera exaristata	28.0	8	0		4
13		Bruguiera exaristata	11.0	12	1	1	26
14		Bruguiera gymnorrhiza	17.0	12	1	1	11
15		Bruguiera exaristata	15.0	12	1	1	14
16		Bruguiera gymnorrhiza	13.0	12	1	1	19
17		Bruguiera exaristata	14.0	12	1	1	16
18		Bruguiera exaristata	2.9	3	1	1	378
19		Bruguiera exaristata	2.4	3.5	1	1	553
20		Bruguiera exaristata	1.2	2	0		2210
21		Bruguiera exaristata	2.0	3.5	1	1	796
22		Bruguiera gymnorrhiza	12.0	8	1	1	22
23		Rhizophora sp.	6.0	7	1	1	88
24		Rhizophora sp.	5.5	7	1	1	105
25		Rhizophora sp.	18.0	14	1	1	10
26		Bruguiera exaristata	8.0	8	1	1.7	50
27		Rhizophora sp.	22.0	14	1	1	7
28		Bruguiera exaristata	2.4	4	1	1	553
29		Bruguiera exaristata	5.5	2.5	0	3	105
30		Rhizophora sp.	15.0	14	1	1	14
31		Bruguiera exaristata	8.0	2	0		50
32		Bruguiera exaristata	8.0	6	0		50

Status: 0 = dead, 1 = alive

Condition: 1 = healthy, 2 = trunk rot, 3 = crown damage, 4 = overmature, 5 = senescent, 6 = dead branches, 7 = leaning

Table 8-20 Mangrove structure and composition at site C1-3.

No.	Tag No.	Species	Diam at Breast Height (cm)	Height (m)	Status	Condition	Stem Density
1	C1-11	Ceriops tagal	5.5	8	1	1	316
2	C1-12	Ceriops tagal	5.8	9	1	1	284
3	C1-13	Ceriops tagal	5.0	7	1	1	382
4	C1-14	Ceriops tagal	2.5	3	1	1	1528
5	C1-15	Ceriops tagal	2.8	3	1	1	1218
6		Ceriops tagal	7.3	8	1	1	179
7		Ceriops tagal	4.9	7	1	1	398
8		Ceriops tagal	4.8	7	1	1	414
9		Ceriops tagal	5.5	8	1	1	316
10		Ceriops tagal	3.0	6	1	1	1061
11		Ceriops tagal	4.7	7	1	1	432
12		Ceriops tagal	7.0	8	1	1	195
13		Ceriops tagal	7.5	4	0	7	170
14		Ceriops tagal	7.7	8	1	1	161
15		Ceriops tagal	6.5	8	1	1	226
16		Ceriops tagal	2.5	3	1	1	1528
17		Ceriops tagal	6.2	8	1	1	248
18		Ceriops tagal	5.6	7	1	1	305
19		Ceriops tagal	6.5	8	1	1	226
20		Ceriops tagal	4.0	8	1	1	597
21		Ceriops tagal	6.7	8	1	1	213
22		Ceriops tagal	7.5	8	1	1	170
23		Ceriops tagal	4.6	8	1	2.7	451
24		Ceriops tagal	6.0	8	1	1	265
25		Ceriops tagal	5.0	8	1	1	382
26		Ceriops tagal	5.9	9	1	1	274
27		Ceriops tagal	4.8	6	1	6.3	414
28		Ceriops tagal	7.6	3	0	3	165
29		Ceriops tagal	4.5	8	1	1	472
30		Ceriops tagal	3.5	4	0		780
31		Ceriops tagal	3.6	3	0		737
32		Ceriops tagal	6.0	7	0		265
33		Ceriops tagal	5.5	6	1	1	316
34		Ceriops tagal	4.0	7	1	1.6	597
35		Ceriops tagal	20.0	5	0		24

Status: 0 = dead, 1 = alive

Condition: 1 = healthy, 2 = trunk rot, 3 = crown damage, 4 = overmature, 5 = senescent, 6 = dead branches, 7 = leaning

Table 8-21 Mangrove structure and composition at site C1-4.

No.	Tag No.	Species	Diam at Breast Height (cm)	Height (m)	Status	Condition	Stem Density
1	C1-16	Ceriops tagal	6.7	8	1	1	142
2	C1-17	Ceriops tagal	6.2	8	1	1	166
3	C1-18	Ceriops tagal	6.2	8	1	1	166
4	C1-19	Ceriops tagal	4.7	8	1	1	288
5	C1-20	Ceriops tagal	5.9	8	1	1	183
6		Ceriops tagal	5.1	8	1	1.7	245
7		Ceriops tagal	4.3	6	0	7	344
8		Ceriops tagal	3.6	6	1	1	491
9		Ceriops tagal	4.5	6	0		314
10		Ceriops tagal	5.1	8	1	1	245
11		Ceriops tagal	5.2	8	1	1	235
12		Ceriops tagal	6.6	9	1	1	146
13		Ceriops tagal	5.0	7	1	1	255
14		Ceriops tagal	6.3	8	1	1	160
15		Ceriops tagal	4.3	6	1	1.3	344
16		Ceriops tagal	4.6	8	1	1	301
17		Ceriops tagal	4.5	7	1	1	314
18		Ceriops tagal	5.4	8	1	1	218
19		Ceriops tagal	5.7	8	1	1	196
20		Ceriops tagal	4.5	6	1	1	314
21		Ceriops tagal	5.4	7	1	1	218
22		Ceriops tagal	5.1	8	1	1.6	245
23		Ceriops tagal	4.9	6	1	1.3	265
24		Ceriops tagal	4.2	6	1	1	361
25		Ceriops tagal	5.9	8	1	1	183
26		Ceriops tagal	5.6	8	1	1	203
27		Ceriops tagal	5.2	8	0	7	235
28		Ceriops tagal	7.3	9	1	1.6	119
29		Ceriops tagal	5.4	8	1	1	218
30		Ceriops tagal	5.0	3	0		255
31		Ceriops tagal	5.5	8	1	1	210
32		Ceriops tagal	4.8	8	1	1	276
33		Ceriops tagal	6.2	8	1	1	166
34		Ceriops tagal	5.4	7	1	1	218
35		Ceriops tagal	5.1	7	1	1	245
36		Ceriops tagal	5.6	8	1	1	203
37		Ceriops tagal	5.8	8	1	1	189

Status: 0 = dead, 1 = alive

Condition: 1 = healthy, 2 = trunk rot, 3 = crown damage, 4 = overmature, 5 = senescent, 6 = dead branches, 7 = leaning

Table 8-22 Mangrove structure and composition at site C2-1.

No.	Tag No.	Species	Diam at Breast Height	Height (m)	Status	Condition	Stem Density
1	C2-1	Bruguiera exaristata	8.0	6.5	1	1	99
2	C2-2	Bruguiera exaristata	8.5	5	1	1	88
3	C2-3	Bruguiera exaristata	4.0	4	1	1	398
4	C2-4	Rhizophora sp.	4.0	4.5	1	1	398
5	C2-5	Rhizophora sp.	16.0	7	1	1.7	25
6		Bruguiera exaristata	8.0	6.5	1	1	99
7		Bruguiera exaristata	6.0	5	1	1.7	177
8		Bruguiera exaristata	10.5	5.5	1	1	58
9		Bruguiera exaristata	5.6	7	1	1	203
10		Rhizophora sp.	4.5	5	1	1	314
11		Bruguiera exaristata	6.7	7	1	1	142
12		Bruguiera exaristata	8.5	7	1	1	88
13		Rhizophora sp.	7.8	6	1	1	105
14		Bruguiera exaristata	8.1	7.5	1	1.6	97
15		Bruguiera exaristata	7.1	6	1	1.7	126
16		Rhizophora sp.	3.7	2.5	1	1.3	465
17		Rhizophora sp.	3.5	4.5	1	1	520
18		Bruguiera exaristata	10.5	6	1	1	58
19		Rhizophora sp.	9.8	8	1	1	66
20		Rhizophora sp.	13.4	7	1	1.7.6	35
21		Bruguiera exaristata	6.8	5	1	1	138
22		Bruguiera exaristata	4.9	4	1	1	265
23		Bruguiera exaristata	6.4	5	1	1	155
24		Rhizophora sp.	19.0	7	1	1.7.6	18
25		Bruguiera exaristata	4.3	4	1	1	344
26		Bruguiera exaristata	5.8	4	1	1	189
27		Rhizophora sp.	11.0	6.5	1	1.7.6	53
28		Bruguiera exaristata	8.8	6	1	1	82
29		Rhizophora sp.	18.0	8	1	1.3.6	20
30		Bruguiera exaristata	7.0	5	1	1	130
31		Bruguiera exaristata	7.0	5	0	7	130
32		Bruguiera exaristata	3.9	4	1	1	419
33		Bruguiera exaristata	5.8	5	1	1	189
34		Rhizophora sp.	19.0	3	0	3	18
35		Rhizophora sp.	20.0	5	1	6.7	16
36		Bruguiera exaristata	10.5	6	1	1	58
37		Rhizophora sp.	20.0	8	1	3.6.7	16
38		Bruguiera exaristata	3.2	2.5	1	1.6	622
39		Bruguiera exaristata	6.0	5	1	1	177
40		Bruguiera exaristata	7.2	6	1	1	123
41		Bruguiera exaristata	5.5	6	1	1.6	210
42		Bruguiera exaristata	14.0	6	1	1.6	32
43		Bruguiera exaristata	7.6	6	1	1	110
44		Bruguiera exaristata	4.3	4.5	1	1.7.3	344
45		Bruguiera exaristata	9.0	5	0		79

Status: 0 = dead, 1 = alive

Condition: 1 = healthy, 2 = trunk rot, 3 = crown damage, 4 = overmature, 5 = senescent, 6 = dead branches, 7 = leaning

Table 8-23 Mangrove structure and composition at site C2-2.

No.	Tag No.	Species	Diam at Breast Height (cm)	Height (m)	Status	Condition	Stem Density
1	C2-6	Bruguiera exaristata	7.0	6	1	1	130
2	C2-7	Bruguiera exaristata	4.8	5	1	6	276
3	C2-8	Ceriops tagal	2.7	4	1	6	873
4	C2-9	Ceriops tagal	2.3	3	1	3	1203
5	C2-10	Ceriops tagal	1.7	2	1	1	2203
6		Bruguiera exaristata	4.3	4.5	1	1	344
7		Ceriops tagal	3.4	4	1	1	551
8		Ceriops tagal	2.8	4	1	3.6	812
9		Ceriops tagal	2.8	4	1	1	812
10		Bruguiera exaristata	4.8	4	1	1	276
11		Ceriops tagal	4.0	4	1	6	398
12		Ceriops tagal	5.6	4	1	6	203
13		Ceriops tagal	3.5	4	1	6	520
14		Ceriops tagal	1.9	2.5	1	1	1763
15		Ceriops tagal	3.2	4	1	1	622
16		Ceriops tagal	5.3	4	0		227
17		Ceriops tagal	3.3	4	1	1	585
18		Bruguiera exaristata	6.0	5	1	6	177
19		Ceriops tagal	2.4	3	1	1	1105
20		Bruguiera exaristata	4.7	4	1	1	288
21		Bruguiera exaristata	3.8	4	1	1	441
22		Bruguiera exaristata	2.8	4	1	6	812
23		Bruguiera exaristata	3.5	5	1	6	520
24		Bruguiera exaristata	3.2	5	1	1	622
25		Ceriops tagal	1.8	3.5	0		1965
26		Ceriops tagal	4.0	4	1	6	398
27		Rhizophora sp.	6.8	7	1	1	138
28		Rhizophora sp.	7.6	8	1	1	110
29		Bruguiera exaristata	3.2	5	1	1	622
30		Bruguiera exaristata	4.3	5	1	1	344
31		Bruguiera exaristata	8.8	6	1	1	82
32		Bruguiera exaristata	3.4	4	1	3	551
33		Bruguiera exaristata	10.5	8	1	6.3	58
34		Rhizophora sp.	6.6	7	1	1	146
35		Bruguiera exaristata	9.6	6	1	1	69
36		Rhizophora sp.	6.1	7	1	7	171
37		Bruguiera exaristata	10.5	5	1	3	58
38		Bruguiera exaristata	5.9	4.5	1	1.3	183
39		Rhizophora sp.	10.0	7	1	1	64
40		Bruguiera exaristata	6.6	5	1	1	146
41		Bruguiera exaristata	8.0	6	1	6	99
42		Bruguiera exaristata	4.1	5	1	1	379
43		Bruguiera exaristata	4.2	5	1	1	361
44		Bruguiera exaristata	3.7	4.5	1	1	465
45		Bruguiera exaristata	3.6	4	1	6	491
46		Bruguiera exaristata	4.8	5	1	1	276
47		Bruguiera exaristata	4.9	4.5	1	1	265

Status: 0 = dead, 1 = alive

Condition: 1 = healthy, 2 = trunk rot, 3 = crown damage, 4 = overmature, 5 = senescent, 6 = dead branches, 7 = leaning

Table 8-24 Mangrove structure and composition at site C2-3.

No.	Tag No.	Species	Diam at Breast Height (cm)	Height (m)	Status	Condition	Stem Density
1	C2-11	Bruguiera exaristata	9.2	7	1	1	75
2	C2-12	Ceriops tagal	2.4	3	1	1	1105
3	C2-13	Ceriops tagal	3.0	4	1	3.6	707
4	C2-14	Ceriops tagal	3.2	4	1	6	622
5	C2-15	Ceriops tagal	6.8	6	1	1	138
6		Bruguiera exaristata	7.1	6	1	1	126
7		Bruguiera exaristata	8.6	6	1	1	86
8		Bruguiera exaristata	7.6	6	1	1	110
9		Bruguiera exaristata	10.5	7	1	1.6	58
10		Bruguiera exaristata	8.6	6	1	1	86
11		Bruguiera exaristata	9.9	6.5	1	1	65
12		Bruguiera exaristata	8.6	6	1	1	86
13		Bruguiera exaristata	8.0	6	1	1	99
14		Ceriops tagal	4.2	4	1	1	361
15		Ceriops tagal	2.2	3	1	6	1315
16		Ceriops tagal	2.3	3	1	6	1203
17		Ceriops tagal	3.1	4	1	1	662
18		Ceriops tagal	2.6	4	1	1.6	942
19		Ceriops tagal	2.7	3	1	3.7	873
20		Ceriops tagal	3.4	6	1	1	551
21		Ceriops tagal	2.1	3	1	6	1444
22		Ceriops tagal	3.2	4	1	6	622
23		Ceriops tagal	2.6	3.5	1	3	942
24		Ceriops tagal	3.1	4	1	1	662
25		Ceriops tagal	2.8	4	1	6	812
26		Ceriops tagal	4.4	5	1	1	329
27		Ceriops tagal	2.9	5	1	6	757
28		Ceriops tagal	3.1	4	1	6	662
29		Ceriops tagal	2.2	2.5	1	3	1315
30		Ceriops tagal	2.0	3	1	3	1592
31		Ceriops tagal	4.5	5	1	1	314
32		Ceriops tagal	3.5	4.5	1	1	520
33		Ceriops tagal	3.1	4	1	1.6	662
34		Ceriops tagal	2.1	2.5	1	3.6	1444
35		Ceriops tagal	3.4	5	1	1	551
36		Ceriops tagal	3.8	6	1	1	441
37		Ceriops tagal	3.1	4	1	1.6	662
38		Ceriops tagal	3.6	4	1	1	491
39		Ceriops tagal	3.8	4	1	1	441
40		Ceriops tagal	3.0	3.5	1	1.6	707

Status: 0 = dead, 1 = alive

Condition: 1 = healthy, 2 = trunk rot, 3 = crown damage, 4 = overmature, 5 = senescent, 6 = dead branches, 7 = leaning

Table 8-25 Mangrove structure and composition at site C2-4.

No.	Tag No.	Species	Diam at Breast Height (cm)	Height (m)	Status	Condition	Stem Density
1	C2-16	Bruguiera parviflora	1.4	3.5	1	1	3248
2	C2-17	Bruguiera parviflora	2.1	4	1	1	1444
3	C2-18	Ceriops tagal	4.7	6	1	1.6	288
4	C2-19	Ceriops tagal	4.4	5	1	1.6	329
5	C2-20	Bruguiera parviflora	2.1	4.5	1	1.6	1444
6		Ceriops tagal	5.6	7	1	1	203
7		Ceriops tagal	4.4	6	1	1	329
8		Ceriops tagal	4.9	7	1	1	265
9		Ceriops tagal	5.1	7	1	1.6	245
10		Ceriops tagal	5.3	6	1	1	227
11		Ceriops tagal	5.4	6	1	1	218
12		Ceriops tagal	5.2	7	1	1	235
13		Ceriops tagal	8.2	8	1	1	95
14		Ceriops tagal	6.0	8	1	1	177
15		Ceriops tagal	4.1	6	1	1	379
16		Ceriops tagal	8.0	7	0	7	99
17		Ceriops tagal	3.4	5	1	1	551
18		Ceriops tagal	5.2	7	1	1	235
19		Ceriops tagal	3.4	5	1	7	551
20		Ceriops tagal	5.1	5	1	1	245
21		Ceriops tagal	3.5	6	1	1	520
22		Ceriops tagal	6.5	7	1	1	151
23		Ceriops tagal	3.3	5	1	1	585
24		Ceriops tagal	6.0	5	1	1	177
25		Ceriops tagal	4.3	6	1	1	344
26		Ceriops tagal	5.0	6	1	1	255
27		Ceriops tagal	3.4	6	1	6	551
28		Ceriops tagal	5.1	5	1	1	245
29		Ceriops tagal	3.5	5	1	1	520
30		Ceriops tagal	4.9	4.5	1	1	265
31		Ceriops tagal	4.6	6	1	1	301
32		Ceriops tagal	5.2	6	1	1	235
33		Ceriops tagal	3.2	4	1	1	622
34		Ceriops tagal	4.9	6	1	1	265
35		Ceriops tagal	4.5	5	1	1	314
36		Ceriops tagal	6.1	6	1	1	171
37		Ceriops tagal	5.9	6	1	1	183
38		Ceriops tagal	4.4	4	1	1.3	329
39		Ceriops tagal	3.5	4	1	1	520
40		Ceriops tagal	3.2	5	1	1.6	622

Table 8-25 Mangrove structure and composition at site C2-4 continued

No.	Tag No.	Species	Diam at Breast Height (cm)	Height (m)	Status	Condition	Stem Density
41		Ceriops tagal	6.8	6	1	1	138
42		Ceriops tagal	4.1	5	1	1	379
43		Ceriops tagal	6.8	7	1	1	138
44		Ceriops tagal	4.6	7	1	1	301
45		Ceriops tagal	5.9	6	1	1.3	183
46		Ceriops tagal	8.5	7	1	1	88
47		Ceriops tagal	4.7	5	1	1	288
48		Ceriops tagal	4.2	5	1	1	361
49		Ceriops tagal	5.7	6	1	1	196
50		Ceriops tagal	5.3	6	1	1	227
51		Ceriops tagal	5.4	5	1	1	218
52		Ceriops tagal	5.0	5	1	1	255
53		Ceriops tagal	6.4	7	1	1	155
54		Ceriops tagal	5.6	7	1	1	203
55		Ceriops tagal	5.3	6	1	1	227
56		Ceriops tagal	5.2	6	1	1	235
57		Ceriops tagal	5.9	7	1	1	183
58		Ceriops tagal	5.4	5	1	1	218
59		Ceriops tagal	5.4	6	1	1	218
60		Ceriops tagal	4.7	6	1	1	288
61		Ceriops tagal	5.5	5	1	1	210
62		Ceriops tagal	4.1	5	1	1	379

Status: 0 = dead, 1 = alive

Condition: 1 = healthy, 2 = trunk rot, 3 = crown damage, 4 = overmature, 5 = senescent, 6 = dead branches, 7 = leaning

8.6 Benthic faunal analysis

Table 8-25 Number of macrofaunal taxa collected in replicate samples at farm sites

Species	F1 1	F1 2	F1 3	F2 1	F2 2	F2 3	F3 1	F3 2	F3 3	F4 1	F4 2	F4 3	F5 1	F5 2	F5 3	F6 1	F6 2	F6 3	Total
Pycnogonid sp	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Ascidia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Byblis sp.	1	2	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	6
Ampelisca sp.	2	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
Corophium sp.	0	0	0	2	2	0	0	0	0	0	3	0	0	0	0	0	0	0	7
Isaeid sp.1	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	4
Isaeid sp.2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Lysianassid sp.	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Melitid sp.1	0	2	1	1	6	2	0	0	0	0	3	5	0	0	1	1	0	0	22
Melitid sp.2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2
Melitid sp.3	0	0	0	2	3	0	0	10	0	18	1	1	0	0	0	0	0	0	35
Melitid sp.4	2	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	6
Phoxocephalid sp.	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	2
Aorid sp.	0	0	0	0	0	2	0	0	0	0	5	7	0	0	0	6	0	0	20
Leucothoe sp.	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Grapsid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hymenosomatid sp.1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Hymenosomatid sp.2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Leucosiid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Macrophthalmus sp.1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Macrophthalmus sp.2	4	6	2	1	2	4	0	0	0	1	0	0	0	0	0	0	0	0	20
Ocypodid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pilumnus sp.	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	7	0	1	9
Pilumnid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Caprella sp.	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Alpheid sp.	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Clordina sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pandalid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Axius sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ogyrides sp.	0	0	0	0	0	0	0	0	0	0	0	0	4	8	0	0	0	0	12
Caridea sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Processa sp.	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Lucifer sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anthurid sp.1	5	2	2	3	3	2	0	2	1	2	0	1	0	0	1	6	0	2	32
Anthurid sp.2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Serolis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Mysid sp.	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Ostracod sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Ostracod sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ostracod sp.3	1	4	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	6
Ostracod sp.4	3	0	2	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	10
Ostracod sp.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apseudes sp.1	0	0	1	0	3	3	0	0	0	1	0	0	0	0	0	0	0	0	8
Apseudes sp.2	7	10	1	1	3	12	3	0	3	1	3	3	0	0	41	2	0	5	95
Apseudes sp.3	0	3	2	0	0	1	0	0	1	0	0	0	0	1	0	11	1	0	20
Apseudes sp.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kalliapseudes sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kalliapseudid sp.	0	0	0	1	3	9	0	0	0	7	18	7	0	0	0	2	2	0	49
Leptochelia sp.	1	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	4
Leuconiid sp.	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Nannastacid sp.	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Cyclaspis sp.	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

Species	F1 1	F1 2	F1 3	F2 1	F2 2	F2 3	F3 1	F3 2	F3 3	F4 1	F4 2	F4 3	F5 1	F5 2	F5 3	F6 1	F6 2	F6 3	Total
Holothurian sp.1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Holothurian sp.2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Ophiactis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ophiocentrus sp.1	12	5	5	3	3	16	0	1	5	0	0	1	1	3	7	10	0	0	72
Ophiocentrus sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	2	6
Ophiuroid sp.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0	0	3
Chitonid sp.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Marginellid sp.	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Haloginella sp.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Amathinid sp.	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	3
Nassarius sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Retusid sp.	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Turrid sp.	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Philine sp.	0	0	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	3
Gymnodoridid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Natica sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mytilid sp.	0	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	3
Nuculana sp.1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	2
Nuculana sp.2	0	2	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	5
Leionucula sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Gari sp.1	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Gari sp.2	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Tellina sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tellina sp.2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Tellina sp.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Tellinid sp.	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	3
Paphia undulata	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	3
Linga sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2
Spisula trigonella	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Mactra sp.	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2
Lucinid sp.	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
Galeommatid sp.	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Cultellus attenuatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Limid sp.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Spisula sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dosinia sp.	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Myadora tessera	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Venerid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	5
Theora sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Ungulinid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corbula sp.1	1	4	1	0	1	1	0	0	0	0	0	0	0	0	0	5	0	0	13
Corbula sp.2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3	0	0	4
Thracia sp.	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Ungulinid sp.	1	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	4
Dentaliid sp.	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Phoronid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Platyhelminth sp.	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Sipunculan sp.	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	2
Actiniaria sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gobid sp.	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	2
Echuiran sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1

Species	F1 1	F1 2	F1 3	F2 1	F2 2	F2 3	F3 1	F3 2	F3 3	F4 1	F4 2	F4 3	F5 1	F5 2	F5 3	F6 1	F6 2	F6 3	Total
Nemertean sp.1	1	1	1	0	1	1	0	1	1	0	1	2	1	0	0	0	0	0	11
Nemertean sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nemertean sp.3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Nematode sp.	0	0	1	0	2	1	0	0	0	0	2	0	0	0	0	0	0	0	6
Armandia sp.	0	0	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	3
Phyllodoce sp.1	1	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	4
Phyllodoce sp.2	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	1	0	4
Capitellid sp.1	8	0	2	3	0	1	1	0	0	0	1	0	0	0	0	0	0	2	18
Capitellid sp.2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Scyphoproctus sp.1	0	0	6	2	5	6	0	0	0	0	0	0	0	0	0	0	0	0	19
Scyphoproctus sp.2	0	11	0	0	0	0	0	3	2	5	6	2	0	0	1	5	2	1	38
Schistomeringos sp.	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Nephtys sp.	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	1	2	0	6
Aglaophamus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Bradiella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Flabelligerid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Goniadid sp.	0	0	0	0	1	0	0	4	0	0	0	0	0	0	0	0	0	0	5
Glycera cinnamomea	1	1	1	2	1	4	1	2	2	0	1	1	0	0	0	0	0	1	18
Leocrates sp.	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Hesionid sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hesionid sp.2	1	2	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	5
Sabellid sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sabellid sp.2	0	0	4	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	5
Eunice sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Eunice sp.2	0	0	5	3	25	2	0	25	0	0	6	3	0	0	0	1	0	0	70
Diopatra sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	4
Lumbrinereis sp.1	0	0	2	2	3	0	4	0	0	0	0	0	0	0	0	2	0	0	13
Lumbrinereis sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lumbrinereis sp.3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Notocirrus sp.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Maldanid sp.1	1	1	1	1	0	0	0	0	1	0	0	2	0	0	0	2	1	1	11
Maldanid sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maldanid sp.3	10	5	10	2	2	8	0	0	0	0	1	0	0	0	0	0	0	0	38
Maldane sp.	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Paraleonnates sp.	0	1	0	1	1	0	0	4	1	0	0	0	0	0	0	1	0	0	9
Orbiniid sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Orbiniid sp.2	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	2	0	4	9
Prionospio fallax	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Prionospio sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2
Prionospio sp.2	2	2	2	1	0	0	1	3	3	0	2	0	0	0	1	1	1	0	19
Scolelepis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spionid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aonides sp.	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	5
Paraprionospio sp.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Paraonella sp.	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Allia sp.	1	6	3	5	5	4	1	0	0	0	2	3	0	0	0	0	0	0	30
Cirratulid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Timarete sp.	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	1	0	0	4
Cirratulus sp.	2	0	4	0	0	1	0	0	0	0	0	3	0	0	0	1	4	2	17
Syllid sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Syllid sp.2	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	2
Typosyllis sp.	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	4
Lysilla sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1

Species	F1 1	F1 2	F1 3	F2 1	F2 2	F2 3	F3 1	F3 2	F3 3	F4 1	F4 2	F4 3	F5 1	F5 2	F5 3	F6 1	F6 2	F6 3	Total
Nicolea sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	4
Streblosoma sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Artacamella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Terebellides sp.	8	2	3	1	0	2	0	0	2	0	1	0	0	0	0	0	0	0	19
Isolda sp.	4	0	0	0	0	0	0	1	0	1	3	1	0	0	0	1	0	0	11
Sosanides sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	2	5
Ampharetid sp.	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	3
Disconatis sp.	0	0	1	2	1	0	0	0	0	0	0	0	0	0	1	0	1	0	6
Polynoid sp.1	0	5	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	6
Polynoid sp.2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Polynoid sp.3	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Loandalia sp.	3	13	0	1	0	2	0	0	0	0	0	0	0	0	0	0	1	1	21
Chloeia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Magelona sp.1	1	1	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	5
Magelona sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paleaequor sp.	3	6	0	0	1	1	0	0	0	0	3	0	0	0	0	0	0	1	15
Phyllochaetopterus sp.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Pilargid sp.1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Pilargid sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Poecilochaetus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2	1	5
Pectinaria sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sigalionid sp.	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Horstileanira sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1	1	5
Sternaspis sp.	3	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
Ancistrosyllis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Linopherus sp.	2	1	0	0	0	0	0	0	4	0	11	2	0	1	0	0	1	5	27
Oweniid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total species	40	46	38	33	36	38	7	18	25	13	24	20	5	6	11	34	22	20	436
Total individuals	106	137	80	54	98	108	12	68	42	42	81	49	8	16	57	92	34	37	1121

Table 8-26 Number of macrofaunal taxa collected in replicate samples at control sites

Species	C1 1	C1 2	C1 3	C2 1	C2 2	C2 3	C3 1	C3 2	C3 3	C4 1	C4 2	C4 3	C5 1	C5 2	C5 3	C6 1	C6 2	C6 3	Total
Pycnogonid sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ascidia sp.	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Byblis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ampelisca sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corophium sp.	0	3	1	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	8
Isaeid sp.1	0	1	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	4
Isaeid sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lysianassid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Melitid sp.1	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	4
Melitid sp.2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2
Melitid sp.3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Melitid sp.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phoxocephalid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aorid sp.	0	1	0	0	0	0	0	0	0	0	0	0	13	0	0	0	0	0	14
Leucothoe sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grapsid sp.	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Hymenosomatid sp.1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Hymenosomatid sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leucosiid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Macrophthalmus sp.1	2	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	7
Macrophthalmus sp.2	0	3	2	2	1	3	0	0	0	0	0	0	0	0	0	0	0	0	11
Ocypodid sp.	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Pilumnus sp.	0	0	1	0	0	0	0	0	0	0	1	1	0	3	0	0	1	0	7
Pilumnid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caprella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alpheid sp.	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2
Clordina sp.	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Pandalid sp.	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	3
Axius sp.	3	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	5
Ogyrides sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caridea sp.	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	3
Processa sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Lucifer sp.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Anthurid sp.1	0	2	3	1	4	3	0	0	0	2	0	0	0	0	0	0	0	0	15
Anthurid sp.2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Serolis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mysid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ostracod sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ostracod sp.2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Ostracod sp.3	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	3
Ostracod sp.4	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Ostracod sp.5	0	0	0	0	0	0	1	0	0	1	4	2	0	0	0	0	0	0	8
Apseudes sp.1	2	2	2	1	2	2	9	11	0	5	3	5	0	0	0	0	0	0	44
Apseudes sp.2	0	0	24	11	0	2	0	0	0	0	0	0	35	11	0	0	0	1	84
Apseudes sp.3	0	0	0	0	0	0	0	0	0	0	0	0	39	1	0	0	0	0	40
Apseudes sp.4	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	3
Kalliapseudes sp.	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Kalliapseudid sp.	0	0	0	0	0	0	0	0	1	2	4	1	1	0	0	0	0	0	9
Leptochelia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leuconiid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nannastacid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cyclaspis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Species	C1 1	C1 2	C1 3	C2 1	C2 2	C2 3	C3 1	C3 2	C3 3	C4 1	C4 2	C4 3	C5 1	C5 2	C5 3	C6 1	C6 2	C6 3	Total
Holothurian sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Holothurian sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ophiactis sp.	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Ophiocentrus sp.1	0	0	0	1	2	0	0	0	0	8	7	3	2	5	0	1	2	2	33
Ophiocentrus sp.2	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	3
Ophiuroid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chitonid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Marginellid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Haloginella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amathinid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nassarius sp.	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Retusid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Turrid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Philine sp.	0	0	0	4	6	5	0	0	0	0	0	0	0	0	0	0	0	0	15
Gymnodoridid sp.	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Natica sp.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Mytilid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nuculana sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nuculana sp.2	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2
Leionucula sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gari sp.1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Gari sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tellina sp.1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Tellina sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tellina sp.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tellinid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paphia undulata	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Linga sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spisula trigonella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mactra sp.	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	2
Lucinid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Galeommatid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cultellus attenuatus	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	2
Limid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spisula sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Dosinia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Myadora tessera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Venerid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Theora sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ungulinid sp.	0	0	0	0	0	0	0	0	0	0	0	4	1	0	0	0	0	0	5
Corbula sp.1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Corbula sp.2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Thracia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ungulinid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dentaliid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phoronid sp.	0	0	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	3
Platyhelminth sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sipunculan sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Actiniaria sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Gobid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echuiran sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Species	C1 1	C1 2	C1 3	C2 1	C2 2	C2 3	C3 1	C3 2	C3 3	C4 1	C4 2	C4 3	C5 1	C5 2	C5 3	C6 1	C6 2	C6 3	Total
Nemertean sp.1	1	0	1	0	2	0	0	0	1	1	2	0	0	2	0	0	0	0	10
Nemertean sp.2	0	0	0	2	0	0	0	0	1	1	0	0	0	0	0	0	0	0	4
Nemertean sp.3	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	3
Nematode sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Armandia sp.	1	1	0	1	0	0	0	2	0	0	1	0	1	0	0	0	0	0	7
Phyllodoce sp.1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Phyllodoce sp.2	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	2
Capitellid sp.1	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	3
Capitellid sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scyphoproctus sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scyphoproctus sp.2	0	1	2	1	0	0	1	1	1	2	1	0	5	1	0	2	1	0	19
Schistomeringos sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nephtys sp.	1	0	2	0	0	1	8	4	1	1	0	0	0	0	0	0	0	0	18
Aglaophamus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bradiella sp.	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2
Flabelligerid sp.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Goniadid sp.	0	0	0	0	0	1	4	3	0	0	0	0	0	0	0	0	0	0	8
Glycera cinnamomea	2	1	5	1	3	0	0	1	0	1	0	0	2	1	0	0	0	0	17
Leocrates sp.	0	0	0	0	1	1	0	0	0	0	1	1	0	0	0	0	0	0	4
Hesionid sp.1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Hesionid sp.2	0	2	1	1	6	1	1	3	0	1	4	2	1	2	0	6	1	2	34
Sabellid sp.1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	2
Sabellid sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eunice sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eunice sp.2	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	4
Diopatra sp.	0	0	1	0	0	0	0	1	0	3	4	0	1	0	1	0	0	0	11
Lumbrinereis sp.1	2	3	0	3	2	1	1	0	0	0	2	0	0	0	0	1	0	0	15
Lumbrinereis sp.2	0	0	0	1	0	1	2	0	0	0	0	1	0	0	0	1	1	0	7
Lumbrinereis sp.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Notocirrus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maldanid sp.1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Maldanid sp.2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Maldanid sp.3	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Maldane sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paraleonnates sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Orbiniid sp.1	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	2
Orbiniid sp.2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Prionospio fallax	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Prionospio sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Prionospio sp.2	0	4	1	2	0	2	1	1	0	0	0	2	0	0	0	0	0	0	13
Scolelepis sp.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Spionid sp.	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Aonides sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paraprionospio sp.	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	2
Paraonella sp.	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Allia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cirratulid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Timarete sp.	0	0	0	1	1	1	0	1	0	1	0	0	0	0	0	0	0	0	5
Cirratulus sp.	0	0	0	0	0	0	4	8	0	0	0	1	2	0	0	0	0	0	15
Syllid sp.1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2
Syllid sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Typosyllis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lysilla sp.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1

Species	C1 1	C1 2	C1 3	C2 1	C2 2	C2 3	C3 1	C3 2	C3 3	C4 1	C4 2	C4 3	C5 1	C5 2	C5 3	C6 1	C6 2	C6 3	Total
Nicolea sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Streblosoma sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Artacamella sp.	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Terebellides sp.	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	3
Isolda sp.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Sosanides sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ampharetid sp.	0	0	0	0	0	0	0	0	0	7	18	5	0	0	0	0	0	0	30
Disconatis sp.	0	0	0	0	0	1	0	0	0	1	2	1	0	1	0	0	1	0	7
Polynoid sp.1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Polynoid sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polynoid sp.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Loandalia sp.	0	6	6	0	0	0	1	0	0	1	0	3	0	0	0	0	0	0	17
Chloeia sp.	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Magelona sp.1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Magelona sp.2	1	1	1	0	0	0	0	0	0	0	3	1	0	0	0	0	0	0	7
Paleaequor sp.	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Phyllochaetopterus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pilargid sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pilargid sp.2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Poecilochaetus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pectinaria sp.	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Sigalionid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Horstileanira sp.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Sternaspis sp.	0	0	0	0	0	0	1	3	0	0	0	0	0	0	0	0	0	0	4
Ancistrosyllis sp.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Linopherus sp.	0	0	0	0	0	0	0	0	0	0	0	3	3	0	0	0	2	0	8
Oweniid sp.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Total species	11	24	24	18	18	25	18	22	9	20	27	26	19	13	3	8	7	3	295
Total individuals	17	43	63	37	38	37	40	51	10	43	74	47	116	33	3	15	9	5	681