

**Centre for Environmental
Management
C Q U
Gladstone Campus**

**MARINE SURVEY
PITCH BAY, SOUTH TREES
PORT CURTIS**

Conducted for
Boyne Smelter Limited





**Central Queensland
UNIVERSITY
Centre for
Environmental Management
GLADSTONE CAMPUS**

**MARINE SURVEY
PITCH BAY SOUTH TREES
PORT CURTIS**

Author Dr Michael Walker BSc (Hons) (Tas), PhD (JCU)
Team Leader Senior Research Fellow
Faculty of Applied Science
Central Queensland University

Research Team Lee Hackney
Joanna Knight
Kirsty McNamara
Cathy Poolman
Viv Pengally
Michael Small
Andrew White

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EXECUTIVE SUMMARY

Boyne Smelters Ltd proposes to increase its hard stand area adjacent to the Comalco wharf. In order to do this a reclamation of some tidal lands adjacent to the existing hard stand area and bundwall is necessary. Prior to consideration of an application to undertake this reclamation the Centre for Environmental Management, Central Queensland University was commissioned to undertake a marine flora and fauna survey of the bay and its tidal lands.

The following quantitative and qualitative surveys were undertaken:-

- * marine intertidal mud flat survey low tide
- * marine subtidal mud flat high tide by diving
- * macrobenthic grab sampling high tide using a charter vessel "Ruys"
- * net fishing at night
- * mangrove surveys at low tide

The mud flat was found to support extensive areas of seagrass predominantly *Zostera capricorni* but also *Halophila ovalis* and some *Rhizophora stylosa* seedlings and *Aegialitis annulata* shrubs.

Seagrasses were most abundant 90 - 250 metres from the bundwall. The mudflat also contained an abundance of holes in areas not inhabited by seagrasses. These holes support extensive populations of small crabs and mudskippers. Molluscs, polychaetes and small hermit crabs were also present and abundant.

Survey of the mud flat at hightide with a 0.1m² van Veen grab yielded 159 marine macrobenthic species and a total of 1453 specimens. The macrobenthic fauna was dominated by gastropods followed by bivalves, polychaetes and crustaceans.

Mangrove communities consisted of six mangrove species:- *Rhizophora stylosa*; *Avicennia marina*; *Aegialitis annulata*; *Aegiceras corniculatum*; *Osbornia octodonta* and *Ceriops tagal*. *R. stylosa*, *A. marina* and *A. annulata* were the most important and abundant mangrove species. Mangrove communities supported a range of bird species, molluscs, decapod crustaceans and barnacles. Seagrasses and mud flat communities supported several green turtles and an extensive array of commercially and recreationally important marine fishes.

The observed and sampled communities appeared to be generally in good health. The area from 0 - 50 metres from the bundwall supported less seagrasses and benthic animals than elsewhere. It is suggested that run off from the existing road, hard stand area and bundwall have reduced the communities. This being the case the proposed reclamation is likely to have a minimal direct effect.

The proposed reclamation has potential to indirectly effect marine flora and fauna communities throughout the bay by future increased sedimentation, turbidity and run off from the road, hard stand area and bundwall. Future planning for the reclamation and care during the reclamation can reduce and minimise these impacts. It is recommended that these indirect effects be considered as part of the approval process for the reclamation and that the bay be monitored during the reclamation and at intervals thereafter. The form of this future monitoring is suggested.

1. INTRODUCTION

The aluminium industry is Gladstone's most important industry consisting of the largest alumina refinery in the world, operated by Queensland Alumina Ltd (QAL) and a world class smelter operated by Boyne Smelters Ltd (BSL). BSL is currently undergoing a \$1b expansion by adding another potline to its existing two.

BSL and QAL are physically located to the south east of the Gladstone town site adjacent to each other but separated by South Trees Inlet (Figure 1).

BSL, as part of its expansion program has recently installed two 12.5m high 12000t liquid pitch holding tanks on its hard stand storage area adjacent to the conveyor and road which runs from the Comalco wharf to the BSL plant. The installation of these two tanks has led to a net environmental and safety benefit in that ship transport eliminates 60-90 trucks a month, which previously transported liquid pencil pitch from a Newcastle supplier to the BSL plant. A total of 50 000t a year of pitch will be required after expansion. Pitch is used in the production of carbon anodes - an integral part of the smelting process (Observer 3.12.96) (Appendix 1, Plate 1). The installation of these tanks effectively removed 6000m² of storage area used for storage of aluminium ingots prior to shipping. It is necessary for BSL to replace this storage space as part of its expansion program. BSL has advanced to the Gladstone Port Authority, the Queensland Department of Primary Industries and the Queensland Department of Environment, a range of options which involve reclamation proposals. The preferred option is to increase the existing storage area by reclamation from the sea of tidal lands.

Prior to consideration of the preferred option it was considered necessary that a marine flora and fauna survey be undertaken of the area and the entire bay adjacent to it, its significance be assessed and the possible environmental effect of the reclamation investigated.

BSL commissioned in November, 1996 the Central Queensland University Centre for Environmental Management, based at the Gladstone Campus to undertake this assessment program. This occurred in November and December 1996 and is reported here. The Central Queensland University Centre for Environment Management team was lead by Dr. Michael Walker, a Senior Research Fellow/Senior Lecturer at the CQU Centre for Environmental Management.

2. MATERIALS AND METHODS

Survey methods employed for the marine survey were as follows:

2.1 Marine intertidal mud flat survey low tide.

Sampling and recording of marine flora and fauna along a transect line pegged either end at 1m intervals (Plates 2.4 and 2.5).

The first transect was 31 metres from and adjacent to the existing BSL hard stand storage area. A further 12 transects were undertaken across the bay at 20m intervals (Figure 2).

2.2 Marine subtidal mud flat survey high tide.

Sampling and recording using a marine transect line, inflatable boat, two divers, associated recorders and 0.5m² stainless steel grids partitioned into 25 squares (Plate 2.1, 2.2 and 2.3).

One transect was surveyed across the bay (Figure 3, Plates 2.1, 2.2 and 2.3).

2.3 Macrobenthic grab sampling was undertaken from a charter vessel "Ruys" using a 0.1m² van Veen grab, (Plates 3.2, 3.3 and 3.4). Twenty grab samples were taken covering the bay (Figure 4).

2.4 Net fishing was undertaken using an aluminium vessel. The following nets were used 75m of an 8 inch and 9 inch net joined together, 100m of 2.25 inch, 100m of 4.5 inch. They were set at high tide at night from the bund wall and near the mouth of the mangrove creek and from the shore tow thirds of the way across the bay towards QAL (Figure 5). Nets were hauled in prior to low tide and fishes identified and measured and weighed. Netting was undertaken under the terms of a General Fisheries Permit number PRM0013B issued by the Queensland Fisheries Management Authority.

2.5 Mangrove survey low tide.

Four transects were undertaken through the mangrove communities from the seaward margin to the beach at low tide. Transects were set at 240° and a 50 metre tape was utilised (Plates 4.1, 4.3, 4.4 and 4.5). Methodology utilised was the point-centred method (PCPM) as outlined by Cintron, G. and Morelli, Y.S. (1984).

In brief using this methodology, points were sampled along 240° transects at 10 metre intervals. At each sampling point four quarters or quadrats were determined by crossing the compass direction with a perpendicular line. The distance from the sampling point to the midpoint of the nearest tree in each quadrat was measured and the four distances averaged. Girth, diameter and height were also recorded.

Classifications used were: big trees >60mm diameter at breast height (DBH); trees >25 - 59mm DBH; shrubs >30cm in height. The exception is for *Rhizophora* which continue as seedlings >30cm in height.

In general the survey methods utilised follow English et al (1994).

3. RESULTS

3.1 Marine intertidal low tide

3.1.1 marine vegetation survey mudflat - transects 1 - 13

Transect 1 - 31metres from the bundwall adjacent to first pitch tank taken from the mangrove fringe seawards, 270metres in length (Table 1.1, Figure 6).

Initially *Zostera capricorni* seagrass 2% - 10% cover 1-6m intermittent to 24m. Nothing 25 - 56m in way of seagrass or mangrove material. Dead *Rhizophora* seedlings were present at 67 and 72m and 5 - 25% cover of seagrass 77 - 85m. Live, dead and stressed seedlings were present intermittently from 89 -153m and more regularly from 158 - 229m and intermittently to 243m. The maximum numbers of *Rhizophora stylosa* seedlings encountered were 8 live at 242m, 6 live at 212m. Mangrove seedlings in the upper part of the profile of the transect were often dead or stressed probably because of exposure to heat at low tide and were in better condition at the profiles lower limits.

In summary this transect showed a band of *Zostera capricorni* up to 10% cover from 1 - 6m, 7 - 24m and from 77 - 85m and *Rhizophora stylosa* intermittent seedlings from 67 - 157m and a band of seedlings from 158-229m in abundance up to 6 -8 per metre square but mostly 1 - 3 per square metre.

Transect 2 - 51metres from the bundwall adjacent to first pitch tank taken from the mangrove fringe seawards, 198metres in length (Table 1.2, Figure 6).

Transect showed patches of *Zostera capricorni* from: 17 - 26m at 1 - 10% cover; 32 - 35m at 1 - 2% cover; 47 - 49m at 1 - 20 % cover; 71m at 1% cover; 87m at 25% cover and a trace at 128m. Another species of seagrass *Halophila ovalis* was present at 87m along with *Zostera capricorni* at 25% cover and showed small traces at 126 - 312m. *Rhizophora stylosa* mangrove seedlings were present intermittently at 1 per square metre at: 87m; 124-126m; 136-137m, 153m and 188m.

In summary this transect showed a patch of seagrass *Zostera capricorni* from: 17 - 26m up to 10% cover; and a further patch from 47 - 49m up to 20% cover. Another seagrass species *Halophila ovalis* was located at 87m with small traces from 126 - 132m. Mangrove seedlings were present from 87m along the profile in abundance of up to 1m square.

Transect 3 - 71metres from the bundwall adjacent to first pitch tank taken from the mangrove fringe seawards, 198metres in length (Table 1.3, Figure 6).

Showed a good patch of seagrass *Zostera capricorni* from: 1 - 25m along the transect line at abundances of 5-20% cover; a further patch at 50-54m (5-20% cover); 60-61m (20% cover); 89-99m intermittently at 2% cover; 105-107m (2-25% cover) and 122-124m (25% cover). One dead *Rhizophora stylosa* seedling was present at 47m and 73m.

Transect 4 - 91metres from the bundwall adjacent to first pitch tank taken from the mangrove fringe seawards, 116metres in length (Table 1.4, Figure 6).

This transect showed patches of seagrass *Zostera capricorni* at: 1 - 15m (2-10%); 18m (2%); 23-26m (2-5%); 33-36m (2-7%); 40-49m (2-15%); intermittent patches from 54 - 80m (2 - 15%); 85 - 90m (2-15%); 96 - 97m (2%); 101 - 106m (10 - 15%) of *Zostera capricorni* and *Halophila ovalis*. A dead *Rhizophora stylosa* seedling was present at 113m only.

Transect 5 - 111metres from the bundwall adjacent to first pitch tank taken from the mangrove fringe seawards, 140metres in length (Table 1.5, Figure 6).

This transect line showed patches of seagrass from: 0 - 10m (5 -15% cover); 12-24m (1-5%); 32 -37m (2%); 42-56m (2-10%); 61-68m (2-8%); 73-80m (2-15%); 88-92m (10%); 94-98m (8-10%); 115-119m (2 -15%) and 133m (10%). The other seagrass species present in the bay - *Halophila ovalis* occurred at 115m along with *Zostera capricorni*. One live *Rhizophora stylosa* seedling was present at 134m.

Transect 6 - 131metres from the bundwall adjacent to first pitch tank taken from the mangrove fringe seawards, 120metres in length (Table 1.6, Figure 6).

This transect line showed seagrass *Zostera capricorni* from 0-25m (5-10% cover), 28-46m (5-10% cover), 48-49m (10%); 54-59m (10%); 62m (10%); 65-70m (2-10%); 75m (2%); 77m (15%); 81m (8% *Zostera capricorni* and 2% *Halophila ovalis*); 88-90m (15%); 99-100m (10%) and 105-120m 15% *Zostera capricorni* and 5% *Halophila ovalis*. No *Rhizophora stylosa* seedlings were encountered along the transect.

Transect 7 - 151metres from the bundwall adjacent to first pitch tank taken from the mangrove fringe seawards, 113metres in length (Table 1.7, Figure 6).

This transect showed seagrass *Zostera capricorni* from: 1-22m (10-20% cover); 38-44m (5-20%); 56-57m (15%); 66-72m (2%); 83-96m (5-10%); 101-104m (2-10%); and 112-113m (15%). *Halophila ovalis* was located at: 44m (5% cover); 95m (5%); 101m (2%) and 112m (2%). No *Rhizophora stylosa* seedlings were encountered along the transect.

Transect 8 - 171metres from the bundwall adjacent to first pitch tank taken from the mangrove fringe seawards, 156metres in length (Table 1.8, Figure 6).

This transect showed *Zostera capricorni* from: 1-53m (10-20% coverage); 64-92m (10-15%); 103-111m (5%); 116m (1%); 119-121m (10%); 126-127m (2-5%); 136-138m (2-5%); 146-148m (5-10%) and 151-156m (5-10%). *Halophila ovalis* was located at 138m (10% coverage); and 146-147m (2%). There were no *Rhizophora stylosa* encountered along the transect.

Transect 9 - 191metres from the bundwall adjacent to first pitch tank taken from the mangrove fringe seawards, 121metres in length (Table 1.9, Figure 6).

This transect showed *Zostera capricorni* from: 1-32m (5-20% coverage); 38-40m (5-10%); 42-52m (2-10%); 56-60m (5-8%); 62-63m (5%), 67-68m (2-5%); 71-76m (2-5%); 80-89m (2-5%); 92-93m (5%); and 115-121m (5%). *Halophila ovalis* was present along the transect at 3 - 11m (2-15%); a trace at 26m and 68m (10%).

No *Rhizophora stylosa* seedlings were encountered along the transect but one small *Aegialitis annulata*.

Transect 10 - 211metres from the bundwall adjacent to first pitch tank taken from the mangrove fringe seawards, 125metres in length (Table 1.10, Figure 6).

This transect showed *Zostera capricorni* from: 1-23m (5-20%); 25-27m (5%); 29-31m (2-10%); 36-37m (20%); 39-47m (1-10%) and traces from 64-73m. *Halophila ovalis* was encountered at 9m (1%); 23m (1%) and 25m (5%). A live *Rhizophora stylosa* was encountered at 97m and small *Aegialitis annulata* shrubs at: 75m; 4-5 at 93-94m; one at 96-97, 99 and 103; 6 shrubs at 104m, 2 at 105m, 10 at 106 and 107m; 3 at 108m; 2 at 110m and 111m; 9 at 112m; 13 at 113m and 1 at 114m, 115m and 124m.

Transect 11 - 231metres from the bundwall adjacent to first pitch tank taken from the mangrove fringe seawards, 104metres in length (Table 1.11, Figure 6).

This transect showed *Zostera capricorni* from 2 - 35m (1-20%). A trace of *Halophila ovalis* occurred at 15m. In terms of mangroves *Aegialitis annulata* occurred at: 36m (1 shrub); 73m (1 shrub) and 78m (1 shrub).

Transect 12 - 251metres from the bundwall adjacent to first pitch tank taken from the mangrove fringe seawards, 80metres in length (Table 1.12, Figure 6).

This transect showed a bed of *Zostera capricorni* from 5-40m (10-20% cover - mostly 20% cover and a trace of *Halophila ovalis* at 36m. The mangrove *Rhizophora stylosa* occurred at 52m, 1 seedling and 20 stressed seedlings at 5m.

Transect 13- 271metres from the bundwall adjacent to first pitch tank taken from the mangrove fringe seawards, 37metres in length (Table 1.13 Figure 6).

This transect showed no seagrass and only one *Rhizophora stylosa* seedling.

3.1.2 Marine fauna survey mudflat - transects 1 - 13

Transect 1 - 31m from the bundwall adjacent to first pitch tank taken from the mangrove fringe seawards, 270metres in length (Table 2.1, Figure 8).

Yielded gastropods *Nassarius* sp, *Epitonium* and one from the family Potamindidae; decapods, a very tiny unidentified crab, another unidentified crab species 1 and a *Uca* species (fiddlercrab). In addition two species of mudskippers were seen at four intervals along the transect line.

Transect 2 - 51m from the bundwall adjacent to first pitch tank taken from the mangrove fringe seawards, 198metres in length (Table 2.2, Figure 8).

Yielded gastropods *Nassarius* sp, and one from the family Littorinidae; decapods, an unidentified crab species 1, a *Uca* species. Crab holes were also present and one mudskipper was observed.

Transect 3 - 71m from the bundwall adjacent to first pitch tank taken from the mangrove fringe seawards, 140metres in length (Table 2.3, Figure 8).

Yielded two gastropods of the families Trochidae and Turbinidae and several *Plicarcularia burchardi*; decapods, an unidentified species 1 crab, a hermit crab. Crab holes were also present and in one particular area one mud skipper was observed.

Transect 4 - 91m from the bundwall adjacent to first pitch tank taken from the mangrove fringe seawards, 116metres in length (Table 2.4, Figure 8).

Yielded several *Plicarcularia burchardi* molluscs, one set of crab holes and a polychaete tube.

Transect 5- 111m from the bundwall adjacent to first pitch tank taken from the mangrove fringe seawards, 140metres in length (Table 2.5, Figure 8).

Yielded several *Plicarcularia burchardi* molluscs(4), a *Nassarius* sp, 2 *Uca* and almost a continuous belt of crab and mudskipper holes from 93 - 132 metres.

Transect 6- 131m from the bundwall adjacent to first pitch tank taken from the mangrove fringe seawards, 120metres in length (Table 2.6, Figure 8).

Yielded gastropods, 8 *Nassarius* sp, family Potamididae, several *Plicarcularia burchardi* and a *Telescopium* mud whelk, a tiny crab species and an abundance of crab and mudskipper holes from 62 -100metres.

Transect 7- 151m from the bundwall adjacent to first pitch tank taken from the mangrove fringe seawards, 113metres in length (Table 2.7, Figure 8).

Yielded gastropods, family Neritidae, *Nassarius* sp, *Plicarcularia burchardi* and mud whelks and decapods, many small specimens of a small crab species 1, *Uca* and a belt of crab and mudskipper holes.

Transect 8 - 171m from the bundwall adjacent to first pitch tank taken from the mangrove fringe seawards, 156metres in length (Table 2.8, Figure 8).

Yielded gastropods, *Nassarius* sp, an abundance of family Potamididae, *Plicarcularia burchardi*, and the mud whelk *Telescopium*; decapods *Uca* sp. Crab holes and mudskipper were also present but not as abundant throughout the transect as transect 7. Two polychaete tubes were also encountered.

Transect 9 - 191m from the bundwall adjacent to first pitch tank taken from the mangrove fringe seawards, 121metres in length (Table 2.9, Figure 8).

Yielded gastropods; family Potamididae being abundant over the latter half of the transect, *Plicarcularia burchardi* abundant, *Epitonium* sp, the mud whelk *Telescopium* and several Aceonidae; decapods, *Uca* and a mudskipper and polychaete tube. Crab and mudskipper holes were abundant throughout transect. (Figure 8)

Transect 10 - 211m from the bundwall adjacent to first pitch tank taken from the mangrove fringe seawards, 125metres in length (Table 2.10, Figure 8).

Yielded gastropods; family Neritidae, *Nassarius* sp, *Epitonium* sp, family Potamididae, *Plicarcularia burchardi*, family Aceonidae and decapods, crab species abundant, *Uca* sp, Penaeidae. Mudskippers and polychaete tubes were particularly abundant throughout most of the transect (Figure 8).

Transect 11 - 231m from the bundwall adjacent to first pitch tank taken from the mangrove fringe seawards, 108metres in length (Table 2.11, Figure 8).

Yielded gastropods, *Nassarius* sp, a tiny crab, 3 *Uca* and 2 polychaete tubes. The seaward part of the transect was dominated by an abundance of crab and mudskipper holes.

Transect 12 - 251m from the bundwall adjacent to first pitch tank taken from the mangrove fringe seawards, 80metres in length (Table 2.12, Figure 8).

Yielded the gastropod *Nassarius* sp and two polychaete tubes. Crabs and mudskipper holes dominated the latter seaward half of the transect.

Transect 13 - 271m from the bundwall adjacent to first pitch tank taken from the mangrove fringe seawards, 37metres in length.(Table 2.13, Figure 8)

Yielded 3 gastropods, family Neritidae and a unidentified crab species 1. Crab and mudskipper holes dominated the seaward end of the transect.

3.2 Marine intertidal mudflat survey, high tide - diving

The Seagrass *Zostera capricorni* was found 200m, 196m, 194m, 190m, from the commencement of the transect, QAL side of Pitch Bay, (Plate 2.1) and 162m, 152m, 124m, 85m, 82.5m, 80m and 65m in percentage coverage's of 2 - 100%.

The Seagrass *Halophila ovalis* was found at 10 - 30 percentage coverages at 166m, 170m, 178m, 192m, 194m, 196m along the transect line.

Crab and/or Mudskipper holes were found from 50 - 60m, 124m - 130m, and 154m along the transect line.

The survey overall showed that both seagrass species were present in the area adjacent to the bundwall.

3.3 Macrobenthic sampling Pitch Bay, South Trees.

159 marine macrobenthic species found in 20 grab samples taken throughout Pitch Bay, South Trees (Figure 4) with a total number of 1453 specimens. These species are shown and sampling station in Table 4 grouped accordingly to taxa/class. The most abundant taxa were: gastropods (79 species, 1135specimens)(Table 4.1); bivalvia (19 species, 129 specimens) (Table 4.2); crustacea (19 species, 47 specimens)(Table 4.3); polychaeta (25species, 49 specimens)(Table 4.4); miscellaneous (17 species, 93 specimens) (Table 4.5).

In terms of abundance the fauna was dominated by gastropods (80%) which combined with the bivalves account for 80% of the fauna. In terms of species suites polychaetes account for 16% of the total, crustacea 11% and the other miscellaneous taxa 7% with gastropoda being 50% and bivalvia 12% (Table 5).

In general terms examination of Table 4 reveals that relatively few animals were collected from station 20 at the mouth of the mangrove creek adjacent to the bund wall and the further one sampled from the bund wall the greater the abundance and diversity.

3.4 Net fishing Pitch Bay, South Trees

Nets of varying mesh sizes set in Pitch Bay, Port Curtis yielded the following species:

RHINOCHOBATIDA	<i>Rhinobatus armatus</i>	common shovel nose ray
CARCHARHINIDAE	<i>Carcharhinus spallanzani</i>	blacktip whaler shark
DOROSOMIDAE	<i>Harengula abbreviata</i> <i>Harengula koningsbergeri</i>	herring spotted herring
PLATYCEPHALIDAE	<i>Platycephalus fuscus</i> <i>Platycephalus indicus</i>	dusky flathead bartailed flathead
SALLAGINIDAE	<i>Sillago sihama</i>	northern whiting
POMADASYIDAE	<i>Pomadasys hasta</i>	spotted javelin fish
PLECTORHYNCHIDAE	<i>Plectorhynchus nigrus</i>	brown sweetlips
SPARIDAE	<i>Acanthopagrus australis</i> <i>Acanthopagrus berda</i>	yellow finned bream pikey bream
DREPANIDAE	<i>Drepane punctata</i>	sickle fish
SCATOPHAGIDAE	<i>Selenotoca multifasciata</i>	striped butter fish
MUGILIDAE	<i>Mugil cephalus</i> <i>Mugil georgii</i>	sea mullet fantail mullet
SPHYRAENIDAE	<i>Sphyraena obtusata</i>	striped sea pike
POLYNEMIDAE	<i>Eleutheronema tetradactylum</i> <i>Polydactylus multiradiatus</i>	blue salmon\thread fin flat salmon\thread fin
CYANOGLOSSIDAE	<i>Cyanoglossus maccullochi</i>	sole

Length and weight of species caught is given in Appendix 2.

3.4 continued.

One Sea Snake, two Green Turtles and one large Stringray were caught in nets and released.

Fish were cut open, for observation of spawning condition after measuring for length and weight. The following was found:

Sea Mullet were full of eggs and close to spawning. Two Female sea Mullet had ovary weights of 65gms, gonadosomatic indices of 10.6 and 10.3, and two Mullet weighing 45 gms, gonadosomatic indices of 8.8. The males had testes weights of 15 and 48gms and gonadosomatic indices of 4.8 and 11.8.

The **Brown Sweetlip** was full of eggs and almost spawning. It had orange ovaries which weighed 75gms, a gonadosomatic index of 1.65.

One **Sickle Fish** had large gonads which weighed 110gms , a gonadosomatic index of 8.8.

3.5 Mangrove Community Survey, Pitch Bay, South Trees

Data from the transects undertaken (Figure 9), is summarised in tables 6 - 11.

The following parameters were determined:

Density number of trees per quarter and number of stems per 0.1 hectare (Table 7).

Relative density % (Table 7)

Basal area (Table 8)

Absolute frequency (Table 9)

Relative frequency % (Table 9)

Relative dominance % (Table 10)

Importance value which considers relative density and relative dominance, considers relative frequency together (Table 11).

The following **densities**, expressed in items of stems per hectre, were observed for the four transects:

Rhizophora stylosa 82 - 291 stems per hectare

Avicennia marina 52 - 136 stems per hectare

Aegialitis annulata 48 - 101 stems per hectare

Aegiceras corniculatum 9 - 63 stems per hectare

Osbornia octodonta 3 - 19 stems per hectare

Ceriops tagal 5 stems per hectare

The total number of stems per 0.1 hectre were 263 - transect 3

266 - transect 4

338 - transect 2

469 - transect 1 (Table 7)

Relative densities for the four transects were:

Rhizophora 31 - 62%

Avicennia 11 - 51%

Aegialitis 18 - 30% (Table 7)

Basal Areas expressed in m^2 for the four transects were:

<i>Rhizophora</i>	6.9 - 69.3 m^2
<i>Avicennia</i>	9.4 - 15.0 m^2
<i>Aegialitis</i>	1.0 - 1.4 m^2
<i>Osbornia</i>	0.3 - 0.9 m^2
<i>Aegiceras</i>	0.2 m^2
<i>Ceriops</i>	0.9 m^2

Rhizophora was ranked 1 for 3 of the 4 transects and *Avicennia* 2 for 3 of the 4 transects. *Avicennia* replaced *Rhizophora* in transect 3 in terms of top ranking.

Aegialitis was ranked 3 in each quarter in terms of basal area (Table 8).

Absolute frequency per transect ranged from 50 - 100% for *Rhizophora* (Table 8)

55 - 77% for *Avicennia*;

50 - 100% for *Aegialitis* with lower

frequencies for *Osbornia*, *Aegiceras* and *Ceriops* (Table 9).

Relative frequency for the 4 transects ranged from 29 - 39% for *Rhizophora*

22 - 42% for *Avicennia* and

11 - 39% for *Aegialitis* (Table 9).

Relative dominance for the 4 transects ranged from 34 - 80% for *Rhizophora*

17 - 51% for *Avicennia*

2 - 8% (Table 10).

Importance value takes into consideration relative density, relative frequency and relative dominance as well as an absolute ranking value (Table 11).

For Transect 1 *Rhizophora* was clearly the most important species followed by *Avicennia*, *Aegialitis* (Table 11). *Osbornia* and *Aegiceras* were also present but of minor importance (Table 11).

For Transect 2 *Rhizophora* again was clearly the most important species followed by *Avicennia* and *Aegialitis* (Table 11).

For Transect 3 *Avicennia* was the most important followed by *Rhizophora*. These species were clearly more important than *Aegialitis*, which was clearly more important than *Aegiceras*. *Osbornia* and *Ceriops* were of minor importance only.

3.6 Other fauna.

Other fauna were noted during the marine survey of Pitch Bay, South Trees, during November 1996.

They were as follows:

CHELONIDAE

Chelonia myolas Green Turtle

Turtles were seen from a distance to 5 metres away, feeding on seagrass beds, on every occasion a survey was undertaken. 2 juvenile green turtles, carapace width 30cm, were caught accidentally in fishing nets. They were released unharmed and could be identified as being different by the barnacles present on their carapaces. One very large green turtle whose carapace was covered with long green filamentous algae, was observed close up on two occasions. The maximum number seen within the bay at one time was estimated to be six animals.

HYDROPHIIDAE

Seasnake

A large white and light grey banded sea snake with a white underbelly was caught in a fishing net adjacent to the bund wall. It was released unharmed.

PANDIONIDAE

Pandion haliaetus Osprey

One or two osprey were observed, during daylight hours, whenever, Pitch Bay was visited. A nest was located in a *Rhizophora stylosa* tree not far from the bund wall (Plate 4.2). This bird is recorded as common throughout Port Curtis (QDEH, 1994).

SCOLOPACIDAE

Numenius madagascariensis Eastern curlew

An eastern curlew was observed during a mangrove transect. It is regarded as a rare bird for Port Curtis (QDEH, 1994).

Numenius phaeopus Whimbrel

A whimbrel was observed during a mangrove transect. It is common to Port Curtis (QDEH, 1994).

HIRUNDINIDAE

***Hirundo neoxena* Welcome swallow**

Welcome swallow were observed over the tidal flats. They are commonly encountered in Port Curtis (QDEH, 1994).

MEROPIDAE

***Merops ornatus* Rainbow bee eater**

A rainbow bee eater was observed in open mangrove scrub during a mangrove transect. It is regarded as common throughout Port Curtis (QDEH, 1994).

CAMPEPHAGIDAE

***Coracina novaehollandiae* Black faced cuckoo shrike**

Black faced cuckoo shrike were observed in open mangrove woodland. They are common to Port Curtis (QDEH, 1994).

MELIPHAGIDAE

***Lichenostomus fasciularis* Double barred finch**

Double barred finch were observed on several occasions in the mangrove forest. They are regarded as infrequent visitors to Port Curtis (QDEH, 1994).

ORIOLEDAE

***Sphecotheres viridis* Figbird**

A figbird was observed in open mangrove forest. It is regarded as common to Port Curtis (QDEH, 1994).

DICAEIDAE

***Dicaeum hirundinaceum* Mistletoe bird**

Several mistletoebirds were observed during the mangrove transects. They are occasional visitors to Port Curtis (QDEH, 1994).

ARTAMIDAE

Artamus leucorhynohus

White breasted wood swallow

A white breasted wood swallow was observed during a mangrove transect. They are common throughout Port Curtis (QDEH, 1994).

GASTROPODS AND BARNACLES

Several species of gastropods and barnacles were observed during mangrove transects either intertidally or above high tide marks on mangrove trunks or on leaves. They were not considered because of time and financial limitations during this survey. This was also the case with spiders and insects. Specimens of this fauna were collected for later identification.

4. DISCUSSION

The survey of Pitch Bay, South Trees, Port Curtis involving: visual and quantitative survey of the mudflats of low and high tide of marine flora and fauna revealed that the mud flat was composed of the seagrasses *Zostera carpricorni* and *Halophila ovalis*, *Rhizophora stylosa* mangrove seedlings and *Aegialitis annulata* shrubs.

Seagrasses were most abundant from 90 - 250 metres from the bundwall. The area adjacent to the bundwall from 0 - 51 metres was relatively devoid of seagrasses but contained large numbers of *Rhizophora stylosa* seedlings.

The mudflat contained an abundance of holes inhabited by mudskippers and small crabs of several species. In general terms the holes were in areas where seagrasses were not present. Molluscs of several species were abundant throughout the mudflats as were hermit crabs, decapod crustaceans and polychaetes.

Survey of the mud flat at high tide using 20 0.1m² van Veen grab samples yielded 159 marine macrobenthic species and a total number of 1453 specimens. The area was dominated by gastropods which combined with bivalves accounted for 62% of the fauna. Polychaetes accounted for 16% of the total, and crustacea 11%. In general terms the further one samples from the bundwall the greater the abundance of species and specimens. It is suggested that run off from the road and the hard storage area down the bundwall reduces invertebrate abundance and diversity in the vicinity.

Survey of the mangrove communities yielded six mangrove species: *Rhizophora stylosa*; *Avicennia marina*; *Aegialitis annulata*; *Aegiceras corniculatum*; *Osbornia octodonta* and *Ceriops tagal*. The most abundant and important species were *R. stylosa*, *A. marina* and *A. annulata*. Densities, frequencies and dominance were determined for these mangrove species. Mangrove communities supported a range of birds, molluscs, decapod crustaceans and barnacles. Together with the seagrass and mudflat communities they further supported an extensive fish community. The seagrass and mudflats also supported several green turtles.

The communities observed are in general in good health except for some signs of stress in mangrove seedlings adjacent to the bundwall probably being temperature related with the onset of summer and some mangroves bearing signs of stress from bauxite dust coating their leaves and trunks. The communities are typical to what was observed adjacent to the South Trees Bridge (Walker et al, 1996) and at Wiggins Island (Houston et al, 1995) and as described in the Curtis Coast Study for Port Curtis (DEH, 1994).

The proposed reclamation of tidal land adjacent to the bundwall is likely to have a minimal direct effect as the area from the bundwall to 50m is relatively unproductive in terms of marine flora and fauna compared with elsewhere in the bay. There is, however, potential to have indirect effects as a result of the reclamation. These effects are suggested as being increased sedimentation and turbidity during the reclamation and future run off down the bundwall, from the road and hard storage area. Sedimentation and turbidity has the potential to smother seagrasses, bottom

living invertebrates and mangrove roots and to reduce light availability. Run off has the potential to introduce toxic or subtoxic chemicals to the marine environment.

Both these anthropogenic effects, however, can be minimised by good planning and practice during the reclamation planning process and during the reclamation. If this is done then the survival of the bay in its present form should continue. It is interesting to note that this bay is assessed as being in a good environmental state considering that it is between two major wharves and industries. It is suggested that these industries have attributed to the health of the bay by good environmental management practice and by restriction of access to the bay by members of the public. Some potential management protocols are give in the Recommendation Section - Section 5 of this report.

5. RECOMMENDATIONS

1. The planning process for the reclamation work should take into consideration the following:-

- * the need to minimise sedimentation and increased turbidity during the reclamation work

- * the need to reduce and or contain future run off from reclaimed lands.

2. Marine flora and fauna monitoring of the bay to be know as Pitch Bay should be undertaken during the reclamation and after the reclamation at intervals of 1 month, 6 months and yearly (in December).

Monitoring should include the following:-

- * survey of the mud flat at low tide both visually and quantitatively

- * grab sampling twice yearly

- * net fishing

- * mangrove survey.

The same transect lines to those established and sampled during the survey should be utilised. The suggested time to undertake the survey is about a week.

The reclamation undertaken should attempt also to preserve the integrity of the tidal creek adjacent to the bundwall.

6. REFERENCES

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TABLE 1.1
SURVEY MUD/SAND FLAT, SOUTH TREES, PORT CURTIS 19.11.96

Transect Line 1 - 31m from bund wall, adjacent to first pitch tank

Transect Dist. (m)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
% <i>Z capricorni</i>	10	10	10	10	5	5				2	2		5										2	2		
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

Transect Dist. (m)	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
% <i>Z capricorni</i>																										
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

Transect Dist. (m)	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78
% <i>Z capricorni</i>																									5	5
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead															2					1						

TABLE 1.1 CONT.
SURVEY MUD/SAND FLAT, SOUTH TREES, PORT CURTIS 19.11.96

Transect Dist. (m)	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104
% <i>Z capricorni</i>	2			4	5	25	10									10										
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live											2								3							
Stressed																				1						
Dead											2					1									2	

Transect Dist. (m)	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130
% <i>Z capricorni</i>						2	2																			
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																			1			1				
Stressed								1																		
Dead																										

Transect Dist. (m)	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156
% <i>Z capricorni</i>						1					10	2														
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live								2									1						2			
Stressed												1							1							
Dead	1														1											

TABLE 1.1 CONT.
SURVEY MUD/SAND FLAT, SOUTH TREES, PORT CURTIS 19.11.96

Transect Dist. (m)	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182
% <i>Z capricorni</i>																						2				
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live			3	3			1	1			1	3	1		1	2	2		2			3	1	2		5
Stressed		1	5	2						5	2															
Dead																										

Transect Dist. (m)	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208
% <i>Z capricorni</i>																										
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live			5							1	2							4					3	6	1	1
Stressed																							2			
Dead								1						1					1							

Transect Dist. (m)	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234
% <i>Z capricorni</i>																										
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live			2	6					1		2		2			1					1					
Stressed	2																									
Dead										2																

TABLE 1.1 CONT.
SURVEY MUD/SAND FLAT, SOUTH TREES, PORT CURTIS 19.11.96

Transect Dist. (m)	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260
% <i>Z capricorni</i>																										
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live	1							8	5																	
Stressed																										
Dead																										

Transect Dist. (m)	261	262	263	264	265	266	267	268	269	270
% <i>Z capricorni</i>										
% <i>H ovalis</i>										
<i>Rhizophora stylosa</i>										
No. seedlings Live										
Stressed										
Dead										

TABLE 1.2
SURVEY MUD/SAND FLAT, SOUTH TREES, PORT CURTIS 19.11.96
 Transect Line 2 - 51m from bund wall, adjacent to first pitch tank

Transect Dist. (m)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
% <i>Z capricorni</i>																	7	1	10	10		10	5		2	1
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

Transect Dist. (m)	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
% <i>Z capricorni</i>						1			2												1	20	20			
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

Transect Dist. (m)	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78
% <i>Z capricorni</i>																			1							
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

TABLE 1.2 CONT.
SURVEY MUD/SAND FLAT, SOUTH TREES, PORT CURTIS 19.11.96

Transect Dist. (m)	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104
% <i>Z capricorni</i>									25																	
% <i>H ovalis</i>									25																	
<i>Rhizophora stylosa</i>																										
No. seedlings Live									1																	
Stressed																										
Dead																										

Transect Dist. (m)	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130
% <i>Z capricorni</i>																								trace		
% <i>H ovalis</i>																						trace	trace	trace		trace
<i>Rhizophora stylosa</i>																										
No. seedlings Live																					1	1				
Stressed																										
Dead																				1						

Transect Dist. (m)	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156
% <i>Z capricorni</i>																										
% <i>H ovalis</i>	trace	trace																								
<i>Rhizophora stylosa</i>																										
No. seedlings Live																								1		
Stressed								1																		
Dead						1																				

TABLE 1.2 CONT.
SURVEY MUD/SAND FLAT, SOUTH TREES, PORT CURTIS 19.11.96

Transect Dist. (m)	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182
% <i>Z capricorni</i>																										
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

Transect Dist. (m)	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198
% <i>Z capricorni</i>																
% <i>H ovalis</i>																
<i>Rhizophora stylosa</i>																
No. seedlings Live						1										
Stressed																
Dead																

TABLE 1.3
SURVEY MUD/SAND FLAT, SOUTH TREES, PORT CURTIS 19.11.96

Transect Line 3 - 71m from bund wall, adjacent to first pitch tank

Transect Dist. (m)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
% <i>Z capricorni</i>	20	20	20	20	20	20	20	20	20	20	10				10	10	10	10		5	5	5	5	5		
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

Transect Dist. (m)	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
% <i>Z capricorni</i>					5																			5	5	15
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																					1					

Transect Dist. (m)	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78
% <i>Z capricorni</i>	10	20						20	20																	
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																					1					

TABLE 1.3 CONT.
SURVEY MUD/SAND FLAT, SOUTH TREES, PORT CURTIS 19.11.96

Transect Dist. (m)	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104
% <i>Z capricorni</i>											2					2				2	2					
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

Transect Dist. (m)	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130
% <i>Z capricorni</i>	25	2	5															25	25	25						
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

Transect Dist. (m)	131	132	133	134	135	136	137	138	139	140
% <i>Z capricorni</i>										
% <i>H ovalis</i>										
<i>Rhizophora stylosa</i>										
No. seedlings Live										
Stressed										
Dead										

TABLE 1.4
SURVEY MUD/SAND FLAT, SOUTH TREES, PORT CURTIS 19.11.96

Transect Line 4 - 91m from bund wall, adjacent to first pitch tank

Transect Dist. (m)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
% <i>Z capricorni</i>	10	10	10	10	10	10	10	5	5	2	2	2	2	2	2			2					2	5	5	5
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

Transect Dist. (m)	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
% <i>Z capricorni</i>							7	2	2	2				15	15	15	15	15	15	15	15	2	2			
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

Transect Dist. (m)	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78
% <i>Z capricorni</i>		2	2		5					10			2			15				2			5			15
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

TABLE 1.4 CONT.
SURVEY MUD/SAND FLAT, SOUTH TREES, PORT CURTIS 19.11.96

Transect Dist. (m)	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104
% <i>Z capricorni</i>	5	5					5	15	15	5	5	2						2	2				15	15	15	15
% <i>H ovalis</i>																							10	10	10	10
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

Transect Dist. (m)	105	106	107	108	109	110	111	112	113	114	115	116
% <i>Z capricorni</i>	15	5								15		
% <i>H ovalis</i>	10	5								10		
<i>Rhizophora stylosa</i>												
No. seedlings Live												
Stressed												
Dead								1				

TABLE 1.5
SURVEY MUD/SAND FLAT, SOUTH TREES, PORT CURTIS 19.11.96
Transect Line 5 - 111m from bund wall, adjacent to first pitch tank

Transect Dist. (m)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
% <i>Z capricorni</i>	10	10	10	10	15	15	15	15	15	5		1	2	5	5	5	5	5	5	5	5	5	5	5		
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

Transect Dist. (m)	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
% <i>Z capricorni</i>						2	2	2	2	2	2					5	5	4	4	4	4	2	10	10	10	10
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

Transect Dist. (m)	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78
% <i>Z capricorni</i>	10	10	10	10					8	8	8	8	8	8	2	5					10	15	2	10	10	10
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

TABLE 1.5 CONT.
SURVEY MUD/SAND FLAT, SOUTH TREES, PORT CURTIS 19.11.96

Transect Dist. (m)	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104
% <i>Z capricorni</i>	10	2								10	10	10	10	10		10	10	10	10	8		8	15	20	20	20
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

Transect Dist. (m)	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130
% <i>Z capricorni</i>	10	10	10			10					15	2	2	2	10											
% <i>H ovalis</i>											1															
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

Transect Dist. (m)	131	132	133	134	135	136	137	138	139	140
% <i>Z capricorni</i>			10							
% <i>H ovalis</i>										
<i>Rhizophora stylosa</i>										
No. seedlings Live				1						
Stressed										
Dead										

TABLE 1.6
SURVEY MUD/SAND FLAT, SOUTH TREES, PORT CURTIS 19.11.96

Transect Line 6 -131m from bund wall, adjacent to first pitch tank

Transect Dist. (m)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
% <i>Z capricorni</i>	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	5	5	5	5	5	
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

Transect Dist. (m)	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
% <i>Z capricorni</i>		5	5	5	5	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10		10	10			
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

Transect Dist. (m)	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78
% <i>Z capricorni</i>		10	10	10	10	10	10			10			10	2	2	2	10	10					2		15	
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

TABLE 1.6 CONT.
SURVEY MUD/SAND FLAT, SOUTH TREES, PORT CURTIS 19.11.96

Transect Dist. (m)	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104
% <i>Z capricorni</i>			8							15	15	15									10	10				
% <i>H ovalis</i>			2																							
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

Transect Dist. (m)	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
% <i>Z capricorni</i>	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
% <i>H ovalis</i>	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
<i>Rhizophora stylosa</i>																
No. seedlings Live																
Stressed																
Dead																

TABLE 1.7
SURVEY MUD/SAND FLAT, SOUTH TREES, PORT CURTIS 20.11.96

Transect Line 7 - 151 from bund wall, adjacent to first pitch tank

Transect Dist. (m)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
% <i>Z capricorni</i>	20	20	20	20	20	20	15	15	15	15	15	15	20	20	20	20	20	20	10	10	10	10				
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

Transect Dist. (m)	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
% <i>Z capricorni</i>												5	5	5	5	5	5	20								
% <i>H ovalis</i>																		5								
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

Transect Dist. (m)	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78
% <i>Z capricorni</i>				15	15									2	2	2	2	2	2	2						
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

TABLE 1.7 CONT.
SURVEY MUD/SAND FLAT, SOUTH TREES, PORT CURTIS 20.11.96

Transect Dist. (m)	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104
% <i>Z capricorni</i>					10	10	10	10	10	10	10	10	10	10	10	10	5	5					10	10	10	2
% <i>H ovalis</i>																	5						2			
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

Transect Dist. (m)	105	106	107	108	109	110	111	112	113
% <i>Z capricorni</i>								15	15
% <i>H ovalis</i>								2	
<i>Rhizophora stylosa</i>									
No. seedlings Live									
Stressed									
Dead									

TABLE 1.8
SURVEY MUD/SAND FLAT, SOUTH TREES, PORT CURTIS 20.11.96

Transect Line 8 - 171m from bund wall, adjacent to first pitch tank

Transect Dist. (m)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
% <i>Z capricorni</i>	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

Transect Dist. (m)	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
% <i>Z capricorni</i>	20	20	20	15	15	15	15	15	15	15	15	15	15	15	15	15	15	10	10	10	10	10	10	10	10	10
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

Transect Dist. (m)	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78
% <i>Z capricorni</i>	10											15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

TABLE 1.8 CONT.
SURVEY MUD/SAND FLAT, SOUTH TREES, PORT CURTIS 20.10.96

Transect Dist. (m)	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104
% <i>Z capricorni</i>	10	10	10	10	10	10	10	10	10	10	10	10	10	10											5	5
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

Transect Dist. (m)	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130
% <i>Z capricorni</i>	5	5	5	5	5	5	5					1			10	10	10					5	2			
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

Transect Dist. (m)	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156
% <i>Z capricorni</i>						2	2	5								10	10	5			5	10	10	10	10	10
% <i>H ovalis</i>								10								2	2									
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

TABLE 1.9
SURVEY MUD/SAND FLAT, SOUTH TREES, PORT CURTIS 20.11.96

Transect Line 9 - 191m from bund wall, adjacent to first pitch tank

Transect Dist. (m)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
% <i>Z capricorni</i>	20	20	20	20	10	10	10	10	10	10	10	15	10	10	15	15	15	15	15	15	15	8	8	15	10	10
% <i>H ovalis</i>			2	2	15	15	2	2	2	2	2															trace
<i>Aegialitis annulata</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

Transect Dist. (m)	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
% <i>Z capricorni</i>	10	10	10	10	8	5						5	10	10		10	5	5	5	5	1	1	5	2	2	2
% <i>H ovalis</i>																										
<i>Aegialitis annulata</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

Transect Dist. (m)	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78
% <i>Z capricorni</i>				5	5	8	8	8		5	5				2	5			2	5	2	5	2	2		
% <i>H ovalis</i>																10										
<i>Aegialitis annulata</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

TABLE 1.9 CONT.
SURVEY MUD/SAND FLAT, SOUTH TREES, PORT CURTIS 20.11.96

Transect Dist. (m)	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104
% <i>Z capricorni</i>		2	5	5	5	5	2	2	2	2	2			5	5											
% <i>H ovalis</i>																										
<i>Aegialitis annulata</i>								1																		
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

Transect Dist. (m)	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121
% <i>Z capricorni</i>											5	5	5	5	5	5	5
% <i>H ovalis</i>																	
<i>Aegialitis annulata</i>																	
<i>Rhizophora stylosa</i>																	
No. seedlings Live																	
Stressed																	
Dead																	

TABLE 1.10
SURVEY MUD/SAND FLAT, SOUTH TREES, PORT CURTIS 20.11.96

Transect Line 10 - 211m from bund wall, adjacent to first pitch tank

Transect Dist. (m)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
% <i>Z capricorni</i>	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	5		5	5
% <i>H ovalis</i>									1														1		5	
<i>Aegialitis annulata</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

Transect Dist. (m)	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
% <i>Z capricorni</i>	5		10	2	5					20	20		5	1	1	2	1	1	5	15	10					
% <i>H ovalis</i>																										
<i>Aegialitis annulata</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

Transect Dist. (m)	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78
% <i>Z capricorni</i>												trace		trace	trace	trace	trace	trace	trace		trace					
% <i>H ovalis</i>																										
<i>Aegialitis annulata</i>																							1			
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

TABLE 1.10 CONT.
SURVEY MUD/SAND FLAT, SOUTH TREES, PORT CURTIS 20.11.96

Transect Dist. (m)	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104
% <i>Z capricorni</i>																										
% <i>H ovalis</i>																										
<i>Aegialitis annulata</i>															4	5		1	1		1				1	6
<i>Rhizophora stylosa</i>																										
No. seedlings Live																			1							
Stressed																										
Dead																										

Transect Dist. (m)	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125
% <i>Z capricorni</i>																					
% <i>H ovalis</i>																					
<i>Aegialitis annulata</i>	2	10	10	3		2	2	9	13	1	1									1	
<i>Rhizophora stylosa</i>																					
No. seedlings Live																					
Stressed																					
Dead																					

TABLE 1.11
SURVEY MUD/SAND FLAT, SOUTH TREES, PORT CURTIS 20.11.96

Transect Line 11 - 231m from bund wall, adjacent to first pitch tank

Transect Dist. (m)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
% <i>Z capricorni</i>		20	20	20	20	20	5	5	5	5	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
% <i>H ovalis</i>															trace											
<i>Aegialitis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

Transect Dist. (m)	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
% <i>Z capricorni</i>	20	20	20	10	10	5	1	5	1																	
% <i>H ovalis</i>																										
<i>Aegialitis</i>										1																
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

Transect Dist. (m)	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78
% <i>Z capricorni</i>																										
% <i>H ovalis</i>																										
<i>Aegialitis</i>																					1					1
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

TABLE 1.11 CONT.
SURVEY MUD/SAND FLAT, SOUTH TREES, PORT CURTIS 20.11.96

Transect Dist. (m)	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104
% <i>Z capricorni</i>																										
% <i>H ovalis</i>																										
<i>Aegialitis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

Transect Dist. (m)	105	106	107	108
% <i>Z capricorni</i>				
% <i>H ovalis</i>				
<i>Aegialitis</i>				
<i>Rhizophora stylosa</i>				
No. seedlings Live				
Stressed				
Dead				

TABLE 1.12
SURVEY MUD/SAND FLAT, SOUTH TREES, PORT CURTIS 20.11.96

Transect Line 12 - 251m from bund wall, adjacent to first pitch tank

Transect Dist. (m)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
% <i>Z capricorni</i>					20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed					20																					
Dead																										

Transect Dist. (m)	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
% <i>Z capricorni</i>	20	20	10	10	20	20	20	20	20	20	20	20	10	trace	trace											
% <i>H ovalis</i>										trace																
<i>Rhizophora stylosa</i>																										1
No. seedlings Live																										
Stressed																										
Dead																										

Transect Dist. (m)	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78
% <i>Z capricorni</i>																										
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

TABLE 1.12 CONT.
SURVEY MUD/SAND FLAT, SOUTH TREES, PORT CURTIS 20.11.96

Transect Dist. (m)	79	80
% <i>Z capricorni</i>		
% <i>H ovalis</i>		
<i>Rhizophora stylosa</i>		
No. seedlings Live		
Stressed		
Dead		

TABLE 1.13
SURVEY MUD/SAND FLAT, SOUTH TREES, PORT CURTIS 20.11.96

Transect Line 13 - 271m from bund wall, adjacent to first pitch tank

Transect Dist. (m)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
% <i>Z capricorni</i>																										
% <i>H ovalis</i>																										
<i>Rhizophora stylosa</i>																										
No. seedlings Live																										
Stressed																										
Dead																										

Transect Dist. (m)	27	28	29	30	31	32	33	34	35	36	37
% <i>Z capricorni</i>											
% <i>H ovalis</i>											
<i>Rhizophora stylosa</i>											
No. seedlings Live									1		
Stressed											
Dead											

TABLE 2.1
FAUNA SURVEY, MUD SAND FLAT, SOUTH TREES, PORT CURTIS 19.11.96
 240m Transect Line 1 - 31m from bund wall, adjacent to first pitch tank

	OCCURRENCE			
GASTROPODA				
Fam. Neritidae				
<i>Nassarius</i> sp	190 ⁽²⁾			
<i>Epitonium</i> sp	74			
Fam. Potamindidae	74			
Fam. Littorindae				
Fam. Trochidae				
Fam. Turbinidae				
<i>P. burchardi</i>				
<i>Telescopium</i>				
<i>Aceonidae</i>				
DECAPODS				
Crab (tiny)	114	266		
Crab sp 1	70	266		
<i>Uca</i> sp	65	114 ⁽²⁾		
Hermit crab				
Fam. Penaeidae				
CHORDATA				
Mudskipper	114	175	200	266 ⁽³⁾
POLYCHAETA				
<i>D. Dentata</i> tube				

Indicy indicates abundance in number if >1 : A = abundant

TABLE 2.2
FAUNA SURVEY, MUD SAND FLAT, SOUTH TREES, PORT CURTIS 19.11.96
 190m Transect Line 2 - 51m from bund wall, adjacent to first pitch tank

	OCCURRENCE			
GASTROPODA				
Fam. Neritidae				
<i>Nassarius</i> sp	126 ^(A)	127 ^(A)		
<i>Epitonium</i> sp				
Fam. Potamindidae				
Fam. Littorindae	13			
Fam. Trochidae				
Fam. Turbinidae				
<i>P. burchardi</i>				
<i>Telescopium</i>				
<i>Aceonidae</i>				
DECAPODS				
Crab (tiny)				
Crab sp 1	126 ^(A)	127 ^(A)		
<i>Uca</i> sp	194 ^(A)	195 ^(A)	196 ^(A)	197 ^(A)
Hermit crab				
Fam. Penaeidae				
CHORDATA				
Mudskipper	167			
POLYCHAETA				
<i>D. Dentata</i> tube				

Indicy indicates abundance in number if >1 : A = abundant

TABLE 2.3

FAUNA SURVEY, MUD SAND FLAT, SOUTH TREES, PORT CURTIS 19.11.96

140m Transect Line 3 - 71m from bund wall, adjacent to first pitch tank

	OCCURRENCE				
GASTROPODA					
Fam. Neritidae					
<i>Nassarius</i> sp					
<i>Epitonium</i> sp					
Fam. Potamindidae					
Fam. Littorindae					
Fam. Trochidae	40				
Fam. Turbinidae	40				
<i>P. burchardi</i>	94	95	116	122	124
<i>Telescopium</i>					
<i>Aceonidae</i>					
DECAPODS					
Crab (tiny)					
Crab sp 1	59				
<i>Uca</i> sp	40				
Hermit crab					
Fam. Penaeidae					
CHORDATA					
Mudskipper	1				
POLYCHAETA					
<i>D. Dentata</i> tube					

Indicy indicates abundance in number if >1 : A = abundant

TABLE 2.4
FAUNA SURVEY, MUD SAND FLAT, SOUTH TREES, PORT CURTIS 19.11.96
 116m Transect Line 4 - 91m from bund wall, adjacent to first pitch tank

	OCCURRENCE			
GASTROPODA				
Fam. Neritidae				
<i>Nassarius</i> sp				
<i>Epitonium</i> sp				
Fam. Potamindidae				
Fam. Littorindae				
Fam. Trochidae				
Fam. Turbinidae				
<i>P. burchardi</i>	5	97	114 ⁽²⁾	
<i>Telescopium</i>				
<i>Aceonidae</i>				
DECAPODS				
Crab (tiny)				
Crab sp 1				
<i>Uca</i> sp				
Hermit crab				
Fam. Penaeidae				
CHORDATA				
Mudskipper				
POLYCHAETA				
<i>D. Dentata</i> tube	30			

Indicy indicates abundance in number if >1 : A = abundant

TABLE 2.5
FAUNA SURVEY, MUD SAND FLAT, SOUTH TREES, PORT CURTIS 19.11.96
 140m Transect Line 5 -111m from bund wall, adjacent to first pitch tank

	OCCURRENCE			
GASTROPODA				
Fam. Neritidae				
<i>Nassarius</i> sp	115			
<i>Epitonium</i> sp				
Fam. Potamindidae				
Fam. Littorindae				
Fam. Trochidae				
Fam. Turbinidae				
<i>P. burchardi</i>	48	70	71	115
<i>Telescopium</i>				
<i>Acaonidae</i>				
DECAPODS				
Crab (tiny)				
Crab sp 1				
<i>Uca</i> sp	110	119		
Hermit crab				
Fam. Penaeidae				
CHORDATA				
Mudskipper				
POLYCHAETA				
<i>D. Dentata</i> tube				

Indicy indicates abundance in number if >1 : A = abundant

TABLE 2.6				
FAUNA SURVEY, MUD SAND FLAT, SOUTH TREES, PORT CURTIS 19.11.96				
120m Transect Line 6 - 131m from bund wall, adjacent to first pitch tank				
	OCCURRENCE			
GASTROPODA				
Fam. Neritidae				
<i>Nassarius</i> sp	120 ⁽⁸⁾			
<i>Epitonium</i> sp				
Fam. Potamindidae	63	120 ⁽²⁾		
Fam. Littorindae				
Fam. Trochidae				
Fam. Turbinidae				
<i>P. burchardi</i>	42	47 ⁽⁴⁾	63	
<i>Telescopium</i>				
<i>Aceonidae</i>				
DECAPODS				
Crab (tiny)				
Crab sp 1	64			
<i>Uca</i> sp				
Hermit crab				
Fam. Penaeidae				
CHORDATA				
Mudskipper				
POLYCHAETA				
<i>D. Dentata</i> tube				
Indicy indicates abundance in number if >1 : A = abundant				

TABLE 2.7
FAUNA SURVEY, MUD SAND FLAT, SOUTH TREES, PORT CURTIS 20.11.96
 120m Transect Line 7 - 151m from bund wall, adjacent to first pitch tank

	OCCURRENCE						
GASTROPODA							
Fam. Neritidae	44						
<i>Nassarius</i> sp	93 ⁽²⁾	101 ⁽²⁾	112				
<i>Epitonium</i> sp							
Fam. Potamindidae							
Fam. Littorindae							
Fam. Trochidae							
Fam. Turbinidae							
<i>P. burchardi</i>	93 ⁽²⁾	101 ⁽²⁾					
<i>Telescopium</i>	105						
<i>Aceonidae</i>							
DECAPODS							
Crab (tiny)							
Crab sp 1	58	71	73 ⁽⁵⁾	74 ⁽⁵⁾	76 ⁽⁵⁾	77 ⁽⁵⁾	78 ⁽⁵⁾
<i>Uca</i> sp							
Hermit crab							
Fam. Penaeidae							
CHORDATA							
Mudskipper							
POLYCHAETA							
<i>D. Dentata</i> tube							

Indicy indicates abundance in number if >1 : A = abundant

TABLE 2.8
FAUNA SURVEY, MUD SAND FLAT, SOUTH TREES, PORT CURTIS 20.11.96
 156m Transect Line 8 - 171m from bund wall, adjacent to first pitch tank

	OCCURRENCE											
GASTROPODA												
Fam. Neritidae												
<i>Nassarius</i> sp												
<i>Epitonium</i> sp												
Fam. Potamindidae	91 ⁽¹⁰⁾	100 ⁽¹⁰⁾	131 ⁽¹⁰⁾	132 ⁽¹⁰⁾	133 ⁽²⁰⁾	134 ⁽²⁰⁾	135 ⁽²⁰⁾	143 ⁽¹²⁾	145 ⁽¹²⁾	148 ⁽¹⁵⁾	149 ⁽¹⁰⁾	150 ⁽¹⁰⁾
Fam. Potamindidae	151 ⁽³⁰⁾	152 ⁽³⁰⁾	153 ⁽³⁰⁾	154 ⁽³⁰⁾	155 ⁽³⁰⁾							
Fam. Littorindae												
Fam. Trochidae												
Fam. Turbinidae												
<i>P. burchardi</i>	138											
<i>Telescopium</i>	137	148										
<i>Aceonidae</i>												
DECAPODS												
Crab (tiny)												
Crab sp 1												
<i>Uca</i> sp	134	135										
Hermit crab												
Fam. Penaeidae												
CHORDATA												
Mudskipper												
POLYCHAETA												
<i>D. Dentata</i> tube	34	49										

Indicy indicates abundance in number if >1 : A = abundant

TABLE 2.9
FAUNA SURVEY, MUD SAND FLAT, SOUTH TREES, PORT CURTIS 20.11.96
121m Transect Line 9 - 191m from bund wall, adjacent to first pitch tank

	OCCURRENCE													
GASTROPODA														
Fam. Neritidae														
<i>Nassarius</i> sp														
<i>Epitonium</i> sp	17													
Fam. Potamindidae	56	57 ⁽⁷⁾	58 ⁽¹¹⁾	59 ⁽⁵⁾	60 ⁽²⁰⁾	61 ⁽¹⁰⁾	66 ⁽¹⁰⁾	67 ⁽¹⁵⁾	70 ⁽¹⁰⁾	71 ⁽¹⁰⁾	72 ^(A)	73 ^(A)	77 ⁽⁵⁾	
Fam. Potamindidae	78 ⁽⁵⁾	79 ⁽¹⁰⁾	81 ⁽¹⁰⁾	82 ⁽¹⁰⁾	83 ⁽¹⁰⁾	84 ⁽¹⁰⁾	85 ⁽¹⁰⁾	86 ⁽³⁾	87 ⁽³⁾	92 ^(A)	93 ^(A)	121 ⁽¹⁰⁾		
Fam. Littorindae														
Fam. Trochidae														
Fam. Turbinidae														
<i>P. burchardi</i>	8	9 ⁽³⁾	10	11 ⁽²⁾	24	25	26	27 ⁽²⁾	28 ⁽⁵⁾	29 ⁽³⁾	30 ⁽²⁾	41 ⁽⁴⁾	63	
<i>Telescopium</i>	61	90 ⁽²⁾	91 ⁽²⁾	112										
<i>Aceonidae</i>	54 ⁽⁶⁾	55 ⁽⁶⁾	57 ⁽⁶⁾	61 ⁽⁶⁾	71 ⁽⁵⁾	121 ⁽¹⁰⁾								
DECAPODS														
Crab (tiny)														
Crab sp 1														
<i>Uca</i> sp	57	77	85											
Hermit crab														
Fam. Penaeidae														
CHORDATA														
Mudskipper	85													
POLYCHAETA														
<i>D. Dentata</i> tube	27													

Indicy indicates abundance in number if >1 : A = abundant

TABLE 2.10
FAUNA SURVEY, MUD SAND FLAT, SOUTH TREES, PORT CURTIS 20.11.96
 125m Transect Line 10 - 211m from bund wall, adjacent to first pitch tank

	OCCURRENCE											
GASTROPODA												
Fam. Neritidae	66	74										
<i>Nassarius</i> sp	3 ⁽²¹⁾	35	73	76	109							
<i>Epitonium</i> sp	68	73										
Fam. Potamindidae	33	35	90 ⁽¹⁰⁾	91 ⁽¹⁰⁾	92 ⁽⁴⁾							
Fam. Littorindae												
Fam. Trochidae												
Fam. Turbinidae												
<i>P. burchardi</i>	9	11	26									
<i>Telescopium</i>	26											
<i>Aceonidae</i>	87 ⁽³⁾	89	90 ⁽⁵⁾	92 ⁽⁸⁾	93	99 ⁽³⁾	100 ⁽³⁾					
DECAPODS												
Crab (tiny)												
Crab sp 1	73	94 ⁽⁴⁾	95 ⁽⁵⁾	97	98	100	105 ⁽⁶⁾	106 ⁽²⁾	107 ⁽¹⁰⁾	108 ⁽³⁾	110 ⁽²⁾	111 ⁽²⁾
Crab sp 1	112 ⁽⁹⁾	113 ⁽³⁾	114									
<i>Uca</i> sp	103											
Hermit crab												
Fam. Penaeidae	116	117	118	119								
CHORDATA												
Mudskipper	90	119										
POLYCHAETA												
<i>D. Dentata</i> tube	22	40										

Indicy indicates abundance in number if >1 : A = abundant

TABLE 2.11
FAUNA SURVEY, MUD SAND FLAT, SOUTH TREES, PORT CURTIS 20.11.96
 108m Transect Line 11 - 2311m from bund wall, adjacent to first pitch tank

	OCCURRENCE			
GASTROPODA				
Fam. Neritidae				
<i>Nassarius</i> sp	41			
<i>Epitonium</i> sp				
Fam. Potamindidae				
Fam. Littorindae				
Fam. Trochidae				
Fam. Turbinidae				
<i>P. burchardi</i>				
<i>Telescopium</i>				
<i>Aceonidae</i>				
DECAPODS				
Crab (tiny)	88 ⁽³⁾			
Crab sp 1				
<i>Uca</i> sp	86			
Hermit crab				
Fam. Penaeidae				
CHORDATA				
Mudskipper				
POLYCHAETA				
<i>D. Dentata</i> tube	49 ^(A)	50 ^(A)		

Indicy indicates abundance in number if >1 : A = abundant

TABLE 2.12
FAUNA SURVEY, MUD SAND FLAT, SOUTH TREES, PORT CURTIS 20.11.96
80m Transect Line 12 - 251m from bund wall, adjacent to first pitch tank

	OCCURRENCE			
GASTROPODA				
Fam. Neritidae				
<i>Nassarius</i> sp	36(2)	37(2)	39	43
<i>Epitonium</i> sp				
Fam. Potamindidae				
Fam. Littorindae				
Fam. Trochidae				
Fam. Turbinidae				
<i>P. burchardi</i>				
<i>Telescopium</i>				
<i>Aceonidae</i>				
DECAPODS				
Crab (tiny)				
Crab sp 1				
<i>Uca</i> sp				
Hermit crab				
Fam. Penaeidae				
CHORDATA				
Mudskipper				
POLYCHAETA				
<i>D. Dentata</i> tube	48 ⁽²⁾	49 ⁽³⁾		

Indicy indicates abundance in number if >1 : A = abundant

TABLE 2.13
FAUNA SURVEY, MUD SAND FLAT, SOUTH TREES, PORT CURTIS 20.11.96
 37m Transect Line 13 - 271m from bund wall, adjacent to first pitch tank

	OCCURRENCE			
GASTROPODA				
Fam. Neritidae	25	35 ⁽²⁾		
<i>Nassarius</i> sp				
<i>Epitonium</i> sp				
Fam. Potamindidae				
Fam. Littorindae				
Fam. Trochidae				
Fam. Turbinidae				
<i>P. burchardi</i>				
<i>Telescopium</i>				
<i>Aceonidae</i>				
DECAPODS				
Crab (tiny)				
Crab sp 1	33			
<i>Uca</i> sp				
Hermit crab				
Fam. Penaeidae				
CHORDATA				
Mudskipper				
POLYCHAETA				
<i>D. Dentata</i> tube				

Indicy indicates abundance in number if >1 : A = abundant

TABLE 3
INTERTIDAL MUDFLAT VEGETATION SURVEY - HIGH TIDE
SOUTH TREES, PORT CURTIS 17.11.96

<i>Zostera capricorni</i>	
Distance	% cover
65m	2
80m	10
82.5m	15
85m	10
124m	100
152m	5
162m	10
190m	5
192m	20
194m	30
196m	30
200m	20

<i>Halophila ovalis</i>	
Distance	%cover
166m	10
170m	10
178m	10
192m	20
194m	30
196m	30

Crab Holes
Distance
50 - 60m
124 - 130m
154m

TABLE 4.1: Distribution of macrobenthic fauna - Gastropoda by survey station, Pitch Bay, South Trees 13.11.96

STATION NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTALS
C. GASTROPODA																					
F. Aceonidae 1			1																	1	2
F. Aceonidae 2			5		1							1	1	3		1	1	4	4		21
F. Aceonidae 3															1		5				6
<i>Pupa solidula/fumala</i>		2	6									1		1					3		13
<i>Alys cylindricus</i>					4		3		8	1	1		2	7	1				3		30
<i>Cyclichna</i> sp.	3	3																			6
<i>Vexillum</i> sp.																1					1
<i>Pyrene</i> sp.	17	4	1			1															23
<i>Pyrene propinqua</i>	1	1																			2
F. Cypraeidae	1																				1
<i>Epitonium</i> sp.1	5	7	13		2	2						1				2			1		33
<i>Epitonium</i> sp.2	1	4	3	5		1			1							1					16
<i>Epitonium</i> sp.3	1	1	5				3							3		2			3		18
<i>Fusinus</i> sp.		1																			1
F. Littorinidae	2	1	8	2		1			57	16	4	10	5	127	7	20	2	5	30		297
<i>Lochryma sulcifera</i>	3	6	3	1																	13
<i>Marginella</i> sp.			2																		2
<i>Ergalatax</i> sp.	1		1													1					3
<i>Nassarius</i> sp. 1	7	8	19		2	3									1	1	1			1	43
<i>Nassarius</i> sp. 2																1					1
<i>Natica euzona</i>							1				2	1	1	2	1	9	2	4	8	6	37
F. Neritidae 1			1		3		1		11	2	10	5	5	31	3	11		1	23		107
F. Neritidae 2																1					1
F. Pyramidellidae	6	5	1									1									13
<i>Syrnola</i> sp.	7	6	14			1	1					2				1			1		33
F. Potamididae															4	2	7	3	1		17
<i>Ringicula</i> sp.	4		10	2	1	2			2		4	2		1							28
F. Scaphandridae																1					1
F. Trochidae 1	1																				1
F. Trochidae 2			3								1					1			1		6
F. Trochidae 3			1															2			3
F. Trochidae 4			1																		1
F. Trochidae 5			1																		1
F. Trochidae 6																1					1
F. Trochidae 7																1					1
F. Trochidae 8																1					1
F. Trochidae 9																4					4
<i>Turritella</i> sp. 1	5	2	4			1	1									1					12
<i>Turritella</i> sp. 2		3	3											1		1					8
<i>Cyclostremiscus</i> sp. 1		2	6	1	2	3			2		3										19
<i>Cyclostremiscus</i> sp. 2														8	2	23	3	8		3	47
C. Gastropoda 1	6	2	4			1	1												1		15
C. Gastropoda 2	6	4										2									12
C. Gastropoda 3	4																				4
C. Gastropoda 4	1		1																		2
C. Gastropoda 5	2	2	2		2		1									1					10
C. Gastropoda 6	1		1																		2
C. Gastropoda 7	3	1	1			3															8
C. Gastropoda 8	2	1	2																		5

TABLE 4.1 Cont. Distribution of macrobenthic fauna - Gastropoda - by survey station, Pitch Bay, South Trees 13.11.96

[illegible]

TABLE 4.2: Distribution of macrobenthic fauna - Bivalvia, by survey station, Pitch Bay, South Trees 13.11.96

STATION NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTALS
C. BIVALVIA																					
<i>Aloidis hydropica</i>						2	1					1					3				7
F. Arcidae															1						1
<i>Cardita</i> sp.													1								1
<i>Corbula</i> sp.		2												1							3
<i>Corbula sulcata</i>	1																2				3
F. Pectinidae		1																			1
<i>Semele</i> sp.				2	2	4															8
<i>Azorinus</i> sp.							1	5	1						34	6	2		1		50
<i>Tellina</i> sp. 1									4				1	1	1	1					8
<i>Tellina</i> sp. 2												3	2					3			8
<i>Pitar</i> sp.															3						3
<i>Placamen tiara</i>		3																			3
C. Bivalvia 1	3																				3
C. Bivalvia 2	1	1	2		1			5								1					11
C. Bivalvia 3			1			1															2
C. Bivalvia 4						3															3
C. Bivalvia 5											1										1
C. Bivalvia 6									7							5	5				17
C. Bivalvia 7																2	2				4
TOTAL BIVALVIA																					129

TABLE 4.3 : Distribution of macrobenthic fauna - Crustacea by survey station, Pitch Bay
South Trees 13.11.96

STATION NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTALS
P. CRUSTACEA																					
O. Amphipoda 1		1																			1
O. Amphipoda 2		1																			1
O. Amphipoda 3			1																		1
I.O. Anomura											2										2
<i>Atylus falcatus</i>	3																				3
I.O. Brachyura 1							2														2
I.O. Brachyura 2							1														1
I.O. Brachyura 3										1											1
I.O. Brachyura 4																2	1			1	4
O. Conchostraca	1			1																	2
O. Decapoda						1			7									7			15
F. Dexaminidae	5																				5
F. Majidae 1		1																			1
F. Majidae 2																	2				2
F. Mictyidae																				1	1
F. Penaeidae	1																				1
F. Portunidae										1											1
O. Tanaidacea			1			1												1			3
F. Xanthidae	2																				2
TOTAL CRUSTACEA																					47

TABLE 4.4 : Distribution of macrobenthic fauna - Polychaeta by survey station, Pitch Bay, South Trees 13.11.96

STATION NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTALS
C. POLYCHAETA																					
<i>F. Capitellidae</i>	5																				5
<i>F. Cirratulidae</i>					1																1
<i>Eunice (vittata)?</i>		2																			2
<i>Marphysa</i> sp.										1											1
<i>Nematonereis unicornis</i>	1																				1
<i>Glycera</i> sp.	2	1				1	1			1		1	3	1	4	1	2	2		1	21
<i>F. Goniadidae</i>			1	2	2					2		1									8
<i>Lumbrineris</i> sp. 1	3	1	1	1																	6
<i>Lumbrineris</i> sp. 2	1																				1
<i>F. Maldanidae</i>	2																				2
<i>F. Nereididae</i>												1	1		1						3
<i>Diopatra (dentata)?</i>	1			9																	10
<i>F. Orbiniidae</i> 1	1																				1
<i>F. Orbiniidae</i> 2			1	1		3															5
<i>Ophelina</i> sp.		1	1	1																	3
<i>F. Phyllodocidae</i>				1																	1
<i>F. Polynoidae</i>	1	1																			2
<i>F. Sabellidae</i>			1																		1
<i>F. Spionidae</i> 1		3	1	2		1															7
<i>F. Spionidae</i> 2						1															1
<i>Sternaspis scutata</i>						2		1	7					1							11
<i>F. Terebellidae</i> 1	2	1																			3
<i>F. Terebellidae</i> 2			1																		1
<i>F. Trichobrachidae</i>					1																1
<i>C. Polychaeta</i>	1																				1
TOTAL POLYCHAETA																					49

TABLE 4.5 : Distribution of macrobenthic fauna - Miscellaneous by survey station, Pitch Bay, South Trees 13.11.96

STATION NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTALS
MISCELLANEOUS																					
C. Ascidiacea 1		1																			1
C. Ascidiacea 2		1																			1
C. Asteroidea		1																			1
<i>Dentalium</i> sp.	1		4	2	14	14					1	1							1		38
<i>Dentalium javuanum</i>		2	1			1															4
C. Echinoidea		1	1																		2
<i>Cellanthus</i> sp.	6	6	4									2							2		20
O. Foraminifera						1															1
F. Gobiidae																			1		1
C. Ophiuroidea 1	1	3																			4
C. Ophiuroidea 2	1																				1
C. Ophiuroidea 3	3		1																		4
C. Ophiuroidea 4					1																1
C. Pycnogonida 1		2	1																		3
C. Pycnogonida 2			1																		1
P. Sipuncula								1							5		5				11
<i>Zostera</i> sp.										P						P	P				
TOTAL MISC.																					93
TOTAL NO. ORGANISMS																					1453

TABLE 5 : Summary of species number and abundance of marine macrobenthic fauna as surveyed Pitch Bay, South Trees 13.11.96

CLASS	1		2		3		4		5		6		7		8		9		10	
	Sp.	Abd.	Sp.	Abd.	Sp.	Abd.	Sp.	Abd.	Sp.	Abd.	Sp.	Abd.	Sp.	Abd.	Sp.	Abd.	Sp.	Abd.	Sp.	Abd.
Gastropoda	27	105	30	78	46	163	9	19	15	29	13	24	10	20	1	1	9	90	3	19
Bivalvia	3	5	4	7	2	3	1	2	2	3	4	10	1	1	3	11	3	12	0	0
Polychaeta	11	20	7	10	7	7	7	17	3	4	5	8	1	1	1	1	1	7	2	2
Crustacea	5	12	3	3	2	2	1	1	0	0	2	2	2	3	0	0	1	7	2	2
Miscellaneous	5	12	8	12	7	13	1	2	1	15	3	16	0	0	1	1	0	0	2	2
TOTALS	51	154	52	110	64	188	19	41	21	51	27	60	14	25	6	14	14	116	9	25

CLASS	11		12		13		14		15		16		17		18		19		20	
	Sp.	Abd.	Sp.	Abd.	Sp.	Abd.	Sp.	Abd.	Sp.	Abd.	Sp.	Abd.	Sp.	Abd.	Sp.	Abd.	Sp.	Abd.	Sp.	Abd.
Gastropoda	10	39	14	34	7	16	15	198	11	28	30	124	9	25	8	28	20	121	7	18
Bivalvia	1	1	3	5	3	4	2	2	4	39	4	14	5	14	1	3	1	1	0	0
Polychaeta	1	2	1	1	3	5	3	3	1	4	2	2	1	2	1	2	0	0	1	1
Crustacea	1	2	0	0	0	0	0	0	0	0	1	2	2	3	2	8	0	0	2	2
Miscellaneous	1	1	2	3	0	0	0	0	1	5	1	1	2	6	0	0	3	5	0	0
TOTALS	14	45	20	43	13	25	20	203	17	76	38	143	19	50	12	41	24	127	10	21

TABLE 6.1 : Mangrove community, Pitch Bay, South Trees, Port Curtis, November 1996.

Transect (m)		Species	Distance (cm)	Girth (cm)	Type	Height (cm)	Comments
5m	1	<i>Aegialitis</i>	35	0.7	b	40	Sand/Pebbles
	2	<i>Aegialitis</i>	100	1.7	b	70	New buds
	3	<i>Aegialitis</i>	20	0.7	b	40	New buds
	4	<i>Aegialitis</i>	35	0.6	b	75	New buds
10m	1	<i>Aegialitis</i> - shrub	50	4.5	b	100	New buds
		<i>Aegialitis</i> - seedling	30			5	
		<i>Avicennia</i> - big tree	310	480	c	400	Mistletoe is present
	2	<i>Aegialitis</i> - shrub	110	1.1	b	65	
		<i>Aegialitis</i> - seedling	70			10	
	3	<i>Aegialitis</i> - shrub	40	3.6	b	90	
		<i>Aegialitis</i> - seedling	40			5	
	4	<i>Aegialitis</i> - shrub	65	0.6	b	25	
15m		<i>Aegialitis</i> - seedling	5			5	
	1	<i>Aegialitis</i> - shrub	120	0.9	b	50	
		<i>Aegialitis</i> - seedling	95			5	
		<i>Rhizophora</i> - tree	220	2.8	d	200	Propagule present
	2	<i>Aegialitis</i> - shrub	50	2	b	80	
		<i>Aegialitis</i> - seedling	70			15	
		<i>Rhizophora</i> - big tree	400	595	c	400	
		<i>Avicennia</i> - sapling	380	0.9	d	150	
		<i>Rhizophora</i> - tree	385	3.1	d	250	
	3	<i>Rhizophora</i> - sapling	60	0.1	d	50	
		<i>Aegialitis</i> - shrub	130	0.4	b	30	
		<i>Aegialitis</i> - seedling	80			10	
	4	<i>Aegialitis</i> - shrub	110	0.7	b	60	
		<i>Avicennia</i> - seedling	130			10	
		<i>Rhizophora</i> - sapling	249	1.8	b	110	
20m	1	<i>Avicennia</i> - shrub	40	0.9	b	70	
		<i>Rhizophora</i> - seedling	160			30	
		<i>Rhizophora</i> - sapling	120	1.1	d	150	
		<i>Rhizophora</i> - tree	310	3.8	d	300	
	2	<i>Rhizophora</i> - sapling	25	1.2	d	170	Rocky / sandy
		<i>Rhizophora</i> - tree	180	3.4	d	300	
		<i>Aegialitis</i> - shrub	140	0.1	b	50	
		<i>Rhizophora</i> - seedling	190	0.5	b	50	
	3	<i>Avicennia</i> - big tree	180	4.7	d	350	
		<i>Rhizophora</i> - sapling	40	1.4	d	170	
		<i>Aegialitis</i> - shrub	150	0.2	b	30	
		<i>Rhizophora</i> - seedling	50			40	
	4	<i>Rhizophora</i> - tree	100	9.5	d	400	Plant- stressed
		<i>Aegialitis</i> - shrub	45	1.5	b	70	
		<i>Aegialitis</i> - seedling	160			10	
		<i>Rhizophora</i> - sapling	260	1	d	160	
25m	1	<i>Aegialitis</i> - shrub	50	1.5	b	90	In bloom
		<i>Rhizophora</i> - sapling	70	1.1	d	180	
		<i>Rhizophora</i> - tree	170	2.6	d	350	Sparse canopy
		<i>Rhizophora</i> - big tree	250	5.5	d	400	Branch death, s.c.
	2	<i>Rhizophora</i> - sapling	60	1	d	150	Some seedling(Ag)
		<i>Aegialitis</i> - shrub	150	1.1	b	60	
		<i>Rhizophora</i> - big tree	130	5	d	400	Ring barking on tree
		<i>Rhizophora</i> - tree	60	3.9	d	350	

TABLE 6.1 cont. : Mangrove community, Pitch Bay, South Trees, Port Curtis, November 1996.

Transect (m)		Species	Distance (cm)	Girth (cm)	Type	Height (cm)	Comments
25 cont.	3	<i>Rhizophora</i> - tree	50	3	d	300	
		<i>Rhizophora</i> - shrub	40	1.7	b	110	
		<i>Rhizophora</i> - sapling	120	1.1	d	180	
		<i>Rhizophora</i> - big tree	210	5	d	300	
	4	<i>Rhizophora</i> - sapling	20	0.8	d	50	Black faced Cuckoo
		<i>Aegialitis</i> - shrub	100	1.8	b	80	In flower
		<i>Rhizophora</i> - tree	180	4	d	300	
		<i>Rhizophora</i> - tree	270	3.9	d	300	
35m	1	<i>Rhizophora</i> - shrub	50	1.2	b	70	Aeg/ Av/ R. seedlings
		<i>Avicennia</i> - sapling	150	0.3	d	130	
		<i>Rhizophora</i> - big tree	280	0.7	d	600	Branch death
	2	<i>Avicennia</i> - shrub	25	0.9	b	70	Mainly sand
		<i>Rhizophora</i> - big tree	170	530	c	600	2 trunks
		<i>Avicennia</i> - sapling	460	1.1	d	160	Leaf gall on 30% leaf
	3	<i>Aegialitis</i> - shrub	180	0.8	b	50	In bloom
		<i>Rhizophora</i> - big tree	200	390	c	550	Crown damage
	4	<i>Rhizophora</i> - shrub	80	2.8	b	120	Aeg/ R. seedlings
		<i>Rhizophora</i> - tree	270	4.1	d	400	Sparse canopy
		<i>Rhizophora</i> - big tree	330	520	c	600	
		<i>Avicennia</i> - sapling	130	0.5	d	140	
45m	1	<i>Rhizophora</i> - shrub	60	2.1	b	130	Silt / mud
		<i>Avicennia</i> - sapling	90	0.4	d	150	
		<i>Rhizophora</i> - tree	40	4.2	d	400	Sparse canopy
		<i>Rhizophora</i> - big tree	360	8.6	d	500	
	2	<i>Avicennia</i> - shrub	50	0.7	b	60	R. seedling
		<i>Rhizophora</i> - tree	330	3.5	d	350	
		<i>Rhizophora</i> - sapling	380	1	d	140	
		<i>Rhizophora</i> - big tree	230	300	c	600	
	3	<i>Avicennia</i> - shrub	50	0.8	b	100	
		<i>Rhizophora</i> - sapling	210	1	d	160	
		<i>Rhizophora</i> - big tree	250	310	c	650	
	4	<i>Rhizophora</i> - sapling	130	1.5	d	170	
		<i>Rhizophora</i> - big tree	120	4.5	c	700	Sparse canopy
		<i>Rhizophora</i> - shrub	280	0.8	b	70	
55m	1	<i>Rhizophora</i> - sapling	160	1.4	d	200	R. seedling
		<i>Rhizophora</i> - shrub	190	1.4	b	110	
		<i>Rhizophora</i> - tree	320	3.2	d	350	
		<i>Rhizophora</i> - big tree	340	530	c	350	Slight crown damage
	2	<i>Rhizophora</i> - tree	90	4.7	d	450	
		<i>Rhizophora</i> - sapling	110	1.8	d	300	
		<i>Rhizophora</i> - shrub	290	1.6	b	120	
		<i>Rhizophora</i> - big tree	470	6.2	d	600	
	3	<i>Rhizophora</i> - sapling	40	1.1	d	250	
		<i>Avicennia</i> - big tree	80	8.5	d	650	
		<i>Rhizophora</i> - tree	150	4	d	450	
		<i>Rhizophora</i> - shrub	130	1.2	b	90	
	4	<i>Rhizophora</i> - tree	120	2.8	d	350	R. seedlings
		<i>Rhizophora</i> - sapling	140	1.4	d	250	
		<i>Rhizophora</i> - shrub	130	0.8	b	90	
		<i>Avicennia</i> - big tree	360	330	c	600	Some crown damage
65m	1	<i>Rhizophora</i> - tree	30	3	d	500	
		<i>Rhizophora</i> - sapling	90	1.2	d	300	

TABLE 6.1cont. : Mangrove community, Pitch Bay, South Trees, Port Curtis, November 1996.

Transect (m)		Species	Distance (cm)	Girth (cm)	Type	Height (cm)	Comments
65 cont.	1	<i>Rhizophora</i> - shrub	100	0.7	b	60	
		<i>Avicennia</i> - big tree	250	8.5	d	550	
	2	<i>Rhizophora</i> - sapling	60	1.1	d	200	
		<i>Rhizophora</i> - tree	85	3.4	d	450	
		<i>Rhizophora</i> - shrub	180	0.6	b	100	
		<i>Avicennia</i> - big tree	150	9	d	600	
	3	<i>Rhizophora</i> - sapling	60	2.4	d	400	
		<i>Rhizophora</i> - tree	65	2.6	d	400	
		<i>Rhizophora</i> - shrub	90	1.1	b	110	
		<i>Avicennia</i> - big tree	390	7.8	d	550	
	4	<i>Rhizophora</i> - sapling	60	2.1	d	450	
		<i>Rhizophora</i> - shrub	100	1.2	b	100	
		<i>Rhizophora</i> - tree	70	4.5	d	600	
75m	1	<i>Rhizophora</i> - shrub	45	0.8	b	90	Aegialitis is present Buds, Propagules. R/ Aeg seedlings
		<i>Rhizophora</i> - sapling	50	1.5	d	220	
		<i>Avicennia</i> - tree	100	2.7	d	250	
	2	<i>Avicennia</i> - sapling	10	1.2	d	220	
		<i>Rhizophora</i> - shrub	40	0.9	b	100	
		<i>Rhizophora</i> - tree	210	3.4	d	300	
	3	<i>Aegialitis</i> - shrub	80	1	b	50	
		<i>Rhizophora</i> - sapling	60	1.2	d	220	
		<i>Rhizophora</i> - tree	100	3.2	d	300	
	4	<i>Rhizophora</i> - shrub	20	1.2	b	110	
		<i>Rhizophora</i> - sapling	30	1.3	d	200	
		<i>Rhizophora</i> - tree	200	4.5	d	400	
85m	1	<i>Osbornia</i> - sapling	180	1	d	180	In bloom, sparse can. R. seedlings pres. Av. present.
		<i>Aegiceras</i> - shrub	280	2	b	70	
	2	<i>Osbornia</i> - shrub	200	0.6	b	60	
		<i>Osbornia</i> - sapling	290	1.3	d	150	
	3	<i>Osbornia</i> - sapling	170	1.4	d	180	
		<i>Aegiceras</i> - shrub	250	1.6	b	70	
	4	<i>Osbornia</i> - sapling	150	1.4	d	200	
		<i>Rhizophora</i> - shrub	150	1.8	b	110	

KEY:

R	-	<i>Rhizophora</i>
Aeg	-	<i>Aegialitis</i>
Av	-	<i>Avicennia</i>
Ag	-	<i>Aegiceras</i>
d	-	Diameter
b	-	Basal diameter
c	-	Circumference

TABLE 6.2 : Mangrove community, Pitch Bay, South Trees, Port Curtis, November 1996.

Transect (m)		Species	Distance (cm)	Girth (cm)	Type	Height (cm)	Comments
0m	1	<i>Aegialitis</i> - shrub	50	0.6	b	20	R. seedling pres.
		<i>Rhizophora</i> - tree	350	4.5	d	350	Aeg. seedling pres.
		<i>Rhizophora</i> - sapling	500	1.1	d	150	
	2	<i>Aegialitis</i> - shrub	40	0.6	b	30	
		<i>Rhizophora</i> - sapling	370	1.4	d	200	
		<i>Rhizophora</i> - tree	400	3.8	d	300	
	3	<i>Rhizophora</i> - shrub	110	0.7	b	60	
		<i>Rhizophora</i> - tree	390	5	d	350	
		<i>Rhizophora</i> - sapling	500	1.2	d	180	
	4	<i>Aegialitis</i> - shrub	80	2	b	40	
10m	1	<i>Rhizophora</i> - shrub	120	0.5	b	40	
		<i>Rhizophora</i> - sapling	180	1.3	d	180	
		<i>Rhizophora</i> - tree	210	4	d	300	
	2	<i>Aegialitis</i> - shrub	40	2.1	b	70	
		<i>Rhizophora</i> - sapling	280	1.6	d	300	
		<i>Rhizophora</i> - tree	250	2.5	d	300	
	3	<i>Aegialitis</i> - shrub	30	3.5	b	80	
		<i>Rhizophora</i> - big tree	370	6.9	d	450	2 trunks
	4	<i>Rhizophora</i> - big tree	140	8.2	d	450	In flower
		<i>Aegialitis</i> - shrub	50	3.5	b	70	
		<i>Rhizophora</i> - sapling	280	1.1	d	170	
		<i>Rhizophora</i> - tree	400	2.9	d	300	
20m	1	<i>Rhizophora</i> - shrub	30	0.9	b	100	
		<i>Rhizophora</i> - tree	90	5	d	450	
		<i>Rhizophora</i> - sapling	120	1.4	d	250	Aeg/R. seedlings
	2	<i>Rhizophora</i> - sapling	30	0.6	d	150	
		<i>Aegialitis</i> - shrub	70	2	b	70	
		<i>Rhizophora</i> - tree	180	3.7	d	400	New flowers
	3	<i>Aegialitis</i> - shrub	30	1.8	b	90	
		<i>Rhizophora</i> - tree	90	3	d	300	
		<i>Rhizophora</i> - sapling	130	1.2	d	220	
	4	<i>Aegialitis</i> - shrub	50	1.7	b	70	
		<i>Rhizophora</i> - sapling	110	1	d	200	
		<i>Rhizophora</i> - tree	160	5.1	d	400	
30m	1	<i>Rhizophora</i> - shrub	20	0.9	b	100	
		<i>Rhizophora</i> - sapling	110	0.7	d	150	
		<i>Rhizophora</i> - tree	150	2.8	d	300	
	2	<i>Aegialitis</i> - shrub	50	0.6	b	40	
		<i>Rhizophora</i> - sapling	180	0.7	d	150	
		<i>Rhizophora</i> - tree	250	3.1	d	350	
	3	<i>Aegialitis</i> - shrub	50	1	b	50	
		<i>Rhizophora</i> - sapling	50	2.1	d	250	
		<i>Rhizophora</i> - tree	360	4	d	400	In bud
	4	<i>Aegialitis</i> - shrub	20	1.1	b	60	
		<i>Rhizophora</i> - sapling	120	0.8	d	150	
		<i>Rhizophora</i> - tree	390	2.6	d	150	
40m	1	<i>Rhizophora</i> - shrub	10	1.2	b	120	
		<i>Avicennia</i> - sapling	80	1.2	d	200	
		<i>Rhizophora</i> - tree	190	2.6	d	300	
	2	<i>Aegialitis</i> - shrub	20	0.6	b	40	
		<i>Rhizophora</i> - sapling	50	1.4	d	200	
		<i>Avicennia</i> - tree	270	4.3	d	400	Mistletoe present

TABLE 6.2 cont. : Mangrove community, Pitch Bay, South Trees, Port Curtis, November 1996.

Transect (m)		Species	Distance (cm)	Girth (cm)	Type	Height (cm)	Comments
40 cont.	3	<i>Aegialitis</i> - shrub	20	1	b	90	
		<i>Rhizophora</i> - sapling	70	1.3	d	200	
		<i>Avicennia</i> - tree	310	2.7	d	350	
	4	<i>Aegialitis</i> - shrub	10	1.8	b	90	
		<i>Rhizophora</i> - sapling	70	1	d	200	
		<i>Rhizophora</i> - tree	420	2.9	d	400	
50m	1	<i>Aegialitis</i> - shrub	20	0.5	b	40	
	2	<i>Aegialitis</i> - shrub	30	0.4	b	30	
		<i>Rhizophora</i> - sapling	170	0.6	d	130	
	3	<i>Aegialitis</i> - shrub	40	0.5	b	60	
		<i>Rhizophora</i> - sapling	110	0.7	d	140	
	4	<i>Aegialitis</i> - shrub	40	0.5	b	40	Aeg. seedling
60m		<i>Rhizophora</i> - sapling	120	1	d	170	
	1	<i>Rhizophora</i> - shrub	50	1.1	b	80	Aeg. seedlings
		<i>Rhizophora</i> - sapling	170	1.4	d	190	
		<i>Avicennia</i> - big tree	430	7	d	400	Mistletoe
	2	<i>Aegialitis</i> - shrub	40	0.3	b	30	
		<i>Avicennia</i> - big tree	410	6.9	d	400	Mistletoe
	3	<i>Aegialitis</i> - shrub	50	0.3	b	30	
		<i>Avicennia</i> - tree	410	2.7	d	250	
		<i>Avicennia</i> - bit tree	480	6.9	d	400	Mistletoe
	4	<i>Aegialitis</i> - shrub	40	0.6	b	40	
70m		<i>Avicennia</i> - tree	440	4.8	d	300	Mistletoe
	1	<i>Rhizophora</i> - shrubs	50	0.8	b	50	
		<i>Avicennia</i> - tree	300	3.3	d	280	
		<i>Rhizophora</i> - shrub	480	0.9	b	180	
	2	<i>Aegialitis</i> - shrub	50	0.3	b	30	
		<i>Avicennia</i> - sapling	420	1.7	d	190	R. seedling present
	3	<i>Aegialitis</i> - shrub	150	0.3	b	30	
		<i>Aegialitis</i> - shrub	20	0.3	b	30	Buds
	4	<i>Avicennia</i> - sapling	240	1	d	180	
80m	1	<i>Rhizophora</i> - shrub	40	0.6	b	50	
		<i>Avicennia</i> - sapling	120	2.3	d	250	
	2	<i>Rhizophora</i> - shrub	40	0.8	b	50	
		<i>Avicennia</i> - sapling	270	0.4	d	150	
		<i>Avicennia</i> - tree	470	2.7	d	300	
	3	<i>Aegialitis</i> - shrub	120	0.4	b	40	
		<i>Avicennia</i> - sapling	330	0.7	d	170	
	4	<i>Aegialitis</i> - shrub	130	0.3	b	30	Buds
		<i>Avicennia</i> - tree	240	2.7	d	250	
		<i>Avicennia</i> - sapling	240	1.5	d	200	
90m	1	<i>Aegialitis</i> - shrub	5	1	b	70	
		<i>Avicennia</i> - sapling	120	1.5	d	220	Mistletoe
		<i>Avicennia</i> - tree	300	3.8	d	350	Mistletoe
	2	<i>Aegialitis</i> - shrub	70	0.7	b	50	
		<i>Avicennia</i> - sapling	280	0.7	d	180	
		<i>Avicennia</i> - tree	370	2.6	d	300	Mistletoe
	3	<i>Rhizophora</i> - shrub	20	1.3	b	70	Cerriops present
	4	<i>Aegialitis</i> - shrub	50	0.4	b	40	
		<i>Avicennia</i> - tree	70	2.7	d	250	Mistletoe
		<i>Rhizophora</i> - sapling	150	0.7	d	170	

TABLE 6.2 cont. : Mangrove community, Pitch Bay, South Trees, Port Curtis, November 1996.

Transect (m)		Species	Distance (cm)	Girth (cm)	Type	Height (cm)	Comments
100m	1	<i>Aegialitis</i> - shrub	110	0.3	b	30	
		<i>Avicennia</i> - sapling	260	1.3	d	180	
	2	<i>Aegialitis</i> - shrub	100	0.3	b	30	Flowering
	3	<i>Rhizophora</i> - shrub	70	0.9	b	50	Ground cover - Seuda
		<i>Avicennia</i> - sapling	190	0.8	d	180	"
		<i>Avicennia</i> - tree	340	3.6	d	300	"
	4	<i>Aegialitis</i> - shrub	60	0.3	b	30	"
		<i>Avicennia</i> - tree	330	2.9	d	300	Mistletoe
		<i>Avicennia</i> - sapling	260	1.1	d	180	

TABLE 6.3 : Mangrove community, Pitch Bay, South Trees, Port Curtis, November 1996.

Transect (m)		Species	Distance (cm)	Girth (cm)	Type	Height (cm)	Comments
0m	1	<i>Rhizophora</i> - tree	78	4.1	c	300	R. seedling present
	3	<i>Aegiceras</i> - shrub	327	1.3		10	
10m	1	<i>Rhizophora</i> - sapling	170	1.1		200	R. seedling present
		<i>Rhizophora</i> - tree	280	56	c	400	Double trunk
	4	<i>Aegiceras</i> - shrub	290	1.8	c	10	
		<i>Rhizophora</i> - sapling	356	1.1		200	
20m	1	<i>Rhizophora</i> - sapling	158	0.7	b	160	R. seedling present
		<i>Rhizophora</i> - tree	375	2.8	d	200	
		<i>Aegiceras</i> - shrub	404	2.8	d	20	
	2	<i>Rhizophora</i> - big tree	180	73	c	500	
	3	<i>Rhizophora</i> - big tree	300	115	c	500	2 R. seedling present
	4	<i>Rhizophora</i> - sapling	240	1.9		300	In bloom
		<i>Aegiceras</i> - shrub	470	2.3	b	90	In bud
30m	1	<i>Rhizophora</i> - tree	87	7.2	d	300	Seedling present
		<i>Aegiceras</i> - shrub	140	1.1	b	30	
	2	<i>Avicennia</i> - big tree	140	7.5	d	500	Av. seedling present
	3	<i>Rhizophora</i> - sapling	164	2.9	d	300	
		<i>Aegialitis</i> - shrub	105	1.4	b	48	
	4	<i>Aegialitis</i> - shrub	170	1.5	b	65	R. seedling present
		<i>Avicennia</i> - tree	410	7.4	d	400	R. seedling present
40m	1	<i>Rhizophora</i> - sapling	350	3.2	d	300	R. seedlings present
		<i>Aegialitis</i> - shrub	28	2.5	b	50	
	2	<i>Aegialitis</i> - shrub	12	1.9	b	55	Ag. Seedlings
		<i>Avicennia</i> - tree	430	38	c	500	
		<i>Rhizophora</i> - sapling	380	3.3	d	300	Propagules present
	3	<i>Aegialitis</i> - shrub	40	1.5	b	40	Ae/ R seedlings
		<i>Rhizophora</i> - sapling	246	3.6	d	300	
		<i>Rhizophora</i> - tree	345	6.2	d	400	
	4	<i>Rhizophora</i> - sapling	210	3.8	b	300	Propagule
		<i>Aegialitis</i> - shrub	54	0.9	b	20	
50m	1	<i>Rhizophora</i> - sapling	46	3.5	d	300	
		<i>Rhizophora</i> - tree	138	5.9	d	300	
		<i>Aegialitis</i> - shrub	140	1.1	b	35	Aeg/R seedling.
	2	<i>Rhizophora</i> - sapling	28	2.9	d	300	
		<i>Avicennia</i> - tree	498	5.8	d	500	Highly stressed
	3	<i>Aegialitis</i> - shrub	74	1.2	b	25	
		<i>Rhizophora</i> - sapling	80	3	d	300	
		<i>Rhizophora</i> - tree	220	5.5	d	350	Propagules present
	4	<i>Rhizophora</i> - tree	45	5.2	d	350	R./Ae. seedling
		<i>Rhizophora</i> - sapling	170	2.5	d	300	
		<i>Aegialitis</i> - shrub	230	1	b	30	
60m	1	<i>Aegialitis</i> - shrub	44	2.1	b	45	In bloom
		<i>Rhizophora</i> - sapling	336	1.2	d	200	Propagules
	2	<i>Aegialitis</i> - shrub	106	1	b	30	R./Ae seedlings
		<i>Rhizophora</i> - sapling	340	3.6	d	300	
		<i>Avicennia</i> - tree	397	4.8	d	500	Stressed
	3	<i>Aegialitis</i> - shrub	58	1.7	b	40	Seedlings present
		<i>Avicennia</i> - sapling	450	2.6	d	300	
	4	<i>Osbornia</i> - shrub	230	6.5	b	100	
70m		<i>Rhizophora</i> - sapling	350	1.4	d	150	
	1	<i>Avicennia</i> - big tree	280	6.3	d	300	Stressed
		<i>Rhizophora</i> - sapling	187	2.1	d	200	Seedlings

TABLE 6.3 cont. : Mangrove community, Pitch Bay, South Trees, Port Curtis, November 1996.

Transect (m)		Species	Distance (cm)	Girth (cm)	Type	Height (cm)	Comments
70 cont.	1	<i>Aegialitis</i> - shrub	30	0.7	b	30	Mistletoe
		<i>Avicennia</i> - tree	340	3.8	d	300	
	2	<i>Rhizophora</i> - sapling	345	2.7	b	300	In flower
		<i>Aegialitis</i> - shrub	12	1.7	b	30	
	3	<i>Avicennia</i> - tree	110	4.4	d	300	Stressed
		<i>Avicennia</i> - big tree	250	85	c	300	Stressed
		<i>Avicennia</i> - sapling	200	1.3	d	100	Covered in gall
		<i>Aegialitis</i> - shrub	30	1.7	b	30	Stressed.
	4	<i>Rhizophora</i> - sapling	100	1.6	d	200	
		<i>Aegialitis</i> - shrub	35	1.5	b	40	
		<i>Avicennia</i> - tree	300	3.4	d	300	
80m	1	<i>Avicennia</i> - tree	240	3.6	d	200	Stressed
		<i>Aegialitis</i> - shrub	35	1.5	b	25	Propagules present
		<i>Rhizophora</i> - sapling	434	3.3	d	400	
		<i>Avicennia</i> - big tree	400	65	c	400	Dead branches
	2	<i>Avicennia</i> - big tree	30	6.2		400	Stressed
		<i>Aegialitis</i> - shrub	78	1.6	b	28	Propagules present
		<i>Avicennia</i> - sapling	270	2.7	d	200	
		<i>Rhizophora</i> - tree	400	3.9	d	300	Seedlings present
	3	<i>Avicennia</i> - sapling	40	1.7	d	200	
		<i>Aegialitis</i> - shrub	107	1.8	b	20	Stressed
		<i>Avicennia</i> - tree	250	3.4	d	300	
	4	<i>Aegialitis</i> - shrub	45	0.9	b	30	Stressed
		<i>Avicennia</i> - sapling	217	1.6	d	200	
		<i>Avicennia</i> - big tree	470	6.4	d	300	
90m	1	<i>Avicennia</i> - tree	150	3.9	d	300	Stressed
		<i>Rhizophora</i> - sapling	185	2.1	d	300	Seedlings present
		<i>Aegialitis</i> - shrub	150	1.2	b	40	In bud
	2	<i>Aegialitis</i> - shrub	10	1.2	b	20	In bud
		<i>Avicennia</i> - sapling	190	2.4	d	200	Propagules
		<i>Avicennia</i> - tree	238	4.4	d	300	
	3	<i>Aegialitis</i> - shrub	70	0.8	b	30	Propagules
		<i>Avicennia</i> - tree	140	3.7	d	300	
		<i>Rhizophora</i> - sapling	130	2.4	d	300	Propagules
	4	<i>Rhizophora</i> - tree	42	3	d	300	
100m		<i>Aegialitis</i> - shrub	15	1.1	b	50	Propagules
		<i>Rhizophora</i> - sapling	240	1.4	d	200	
	1	<i>Avicennia</i> - sapling	60	1.5	d	150	Propagules
		<i>Aegialitis</i> - shrub	40	9	b	20	
	2	<i>Aegialitis</i> - shrub	45	1.1	b	40	Propagules
		<i>Rhizophora</i> - sapling	280	1.2	d	200	
		<i>Avicennia</i> - tree	400	3.7	d	300	Propagules
		<i>Cerops</i> - shrub	46	1.7	b	60	
	4	<i>Avicennia</i> - sapling	225	1.9	d	100	Propagules
		<i>Cerops</i> - shrub	120	1.4	b	60	
110m		<i>Avicennia</i> - tree	370	2.9	d	300	Propagules
	1	<i>Avicennia</i> - shrub	10	1.6	b	80	R. Seedling
	2	<i>Avicennia</i> - shrub	10	1.2	b	50	
		<i>Avicennia</i> - sapling	220	2.1	d	100	
	3	<i>Avicennia</i> - shrub	211	1.2	b	70	
		<i>Rhizophora</i> - sapling	450	1.5	d	200	R. Seedling
	4	<i>Avicennia</i> - sapling	250	1.8	d	100	

TABLE 6.3 cont. : Mangrove community, Pitch Bay, South Trees, Port Curtis, November 1996.

Transect (m)		Species	Distance (cm)	Girth (cm)	Type	Height (cm)	Comments
110 cont	4	<i>Avicennia</i> - shrub	50	1.7	b	90	
120m	1	<i>Avicennia</i> - shrub	70	8	b	30	
		<i>Avicennia</i> - tree	313	4.2	d	250	Mistletoe present
		<i>Avicennia</i> - sapling	260	1.6	d	100	
	2	<i>Avicennia</i> - shrub	120	0.9	b	25	
		<i>Avicennia</i> - sapling	450	1.1	d	100	
		<i>Avicennia</i> - tree	190	0.9	d	250	Mistletoe present
	3	<i>Avicennia</i> - sapling	100	1.8	d	200	
		<i>Avicennia</i> - tree	210	2.9	d	150	
		<i>Aegialitis</i> - shrub	180	1.6	b	60	In bloom
	4	<i>Avicennia</i> - sapling	90	1.5	d	100	
		<i>Aegialitis</i> - shrub	100	1	b	30	

TABLE 6.4 : Mangrove community, Pitch Bay, South Trees, Port Curtis, November 1996.

Transect (m)		Species	Distance (cm)	Girth (cm)	Type	Height (cm)	Comments
0m	1						R. seedlings
	2						"
	3						"
	4						"
10m	1						R. seedling
	2						R. seedling
	3						R. seedlings - 7
	4						
20m	1						R. seedling
	2						
	3						R. seedling - 1
	4						R. seedlings - 2
30m	1	<i>Rhizophora</i> - tree	450	4.6	d	300	R/ Av seedlings
	2						R. seedlings - 2
	3						R. seedling - 1
	4	<i>Rhizophora</i> - big tree	440	6.6	d	300	R/ Av seedlings
40m	1	<i>Rhizophora</i> - big tree	170	6.2	d	500	R. seedlings
	2	<i>Rhizophora</i> - big tree	305	6.8	d	500	R. seedlings
	3	<i>Rhizophora</i> - sapling	300	1.7	d	200	R. seedlings
		<i>Rhizophora</i> - tree	120	5.9	d	450	R. seedlings
	4	<i>Rhizophora</i> - tree	300	3.8	d	450	R. seedlings
		<i>Rhizophora</i> - big tree	190	8.2	d	500	
50m	1	<i>Rhizophora</i> - tree	230	5	d	500	R. seedlings
		<i>Rhizophora</i> - sapling	490	2.4	d	400	
	2	<i>Avicennia</i> - big tree	310	78	c	1000	R. seedlings
	3	<i>Rhizophora</i> - tree	80	2.9	d	400	
		<i>Rhizophora</i> - sapling	90	1.5	d	250	
		<i>Rhizophora</i> - big tree	350	9.3	d	500	
	4	<i>Rhizophora</i> - tree	330	2.9	d	500	
		<i>Rhizophora</i> - big tree	310	6.6	d	500	
		<i>Rhizophora</i> - sapling	288	2.1	d	300	
60m	1	<i>Aegiceras</i> - shrub	50	1.6	b	20	
		<i>Rhizophora</i> - tree	70	3.7	d	400	
		<i>Avicennia</i> - sapling	320	2.4	d	200	
	2	<i>Rhizophora</i> - sapling	370	1.4	d	200	
		<i>Rhizophora</i> - tree	228	2.4	d	300	Propagules
	3	<i>Rhizophora</i> - tree	160	4	d	400	R. seedlings
	4	<i>Rhizophora</i> - tree	120	4	d	300	R. seedlings
70m	1	<i>Avicennia</i> - big tree	380	71	c	900	R. seedling
	2	<i>Avicennia</i> - big tree	90	6.2	d	950	Mistletoe
		<i>Rhizophora</i> - sapling	220	1.4	d	250	
		<i>Rhizophora</i> - tree	160	2.5	d	200	
	3	<i>Rhizophora</i> - sapling	250	2.2	d	200	R. seedling
	4						R. seedling
80m	1	<i>Rhizophora</i> - sapling	122	1.2	d	180	
	2	<i>Rhizophora</i> - sapling	128	1.6	d	200	
		<i>Rhizophora</i> - big tree	430	8.7	d	500	Lichen growing.
		<i>Aegiceras</i> - shrub	200	1.2	b	20	
	3	<i>Aegiceras</i> - shrub	185	2.8	b	60	In bloom
		<i>Rhizophora</i> - sapling	40	1.4	d	200	
	4	<i>Rhizophora</i> - sapling	90	1.2	d	200	Propagules
		<i>Aegiceras</i> - shrub	152	0.9	b	30	

TABLE 6.4 cont. : Mangrove community, Pitch Bay, South Trees, Port Curtis, November 1996.

Transect (m)		Species	Distance (cm)	Girth (cm)	Type	Height (cm)	Comments
80 cont.	4	<i>Avicennia</i> - big tree	300	82	c	800	
90m	1	<i>Aegiceras</i> - shrub	70	0.8	b	20	R. seedlings
		<i>Rhizophora</i> - tree	200	3.6	d	400	R. seedlings
		<i>Avicennia</i> - sapling	310	1.7	d	300	
	2	<i>Avicennia</i> - shrub	150	1.5	b	90	R. seedling
		<i>Rhizophora</i> - big tree	180	58	c	800	
	3	<i>Avicennia</i> - sapling	120	1.2	d	200	
		<i>Avicennia</i> - shrub	100	6	b	20	
	4	<i>Avicennia</i> - tree	220	5.1	d	400	
		<i>Avicennia</i> - sapling	140	1.1	d	150	
		<i>Aegialitis</i> - shrub	140	1.2	b	35	In bloom
100m	1	<i>Avicennia</i> - tree	200	3	d	400	R. seedling
	2	<i>Avicennia</i> - tree	330	4.8	d	400	
		<i>Avicennia</i> - shrub	140	2.2	b	80	
		<i>Avicennia</i> - sapling	240	1.4	d	300	
		<i>Avicennia</i> - big tree	480	9	d	500	
	3	<i>Avicennia</i> - big tree	230	7	d	400	Seedlings
		<i>Aegiceras</i> - shrub	60	1.1	b	30	
		<i>Avicennia</i> - sapling	290	1.1	d	200	
		<i>Avicennia</i> - tree	340	3.7	d	400	
	4	<i>Avicennia</i> - tree	100	5.3	d	400	
		<i>Avicennia</i> - sapling	330	2	d	350	
		<i>Aegiceras</i> - shrub	100	0.7	b	15	
110m	1	<i>Avicennia</i> - big tree	80	6.1	d	350	Stressed
		<i>Rhizophora</i> - tree	60	2.3	d	300	R. seedlings
		<i>Aegiceras</i> - shrub	40	1.3	b	40	
		<i>Rhizophora</i> - sapling	80	1.8	d	200	
	2	<i>Avicennia</i> - tree	110	4.3	d	300	
		<i>Aegiceras</i> - shrub	60	1.4	b	40	
		<i>Rhizophora</i> - sapling	130	2	d	300	Propagules present
	3	<i>Avicennia</i> - tree	190	4.9	d	400	R. seedlings present
		<i>Rhizophora</i> - sapling	120	2.2	d	200	
		<i>Aegiceras</i> - shrub	60	1.6	b	50	
	4	<i>Rhizophora</i> - tree	100	2.7	d	300	R. seedlings
		<i>Aegiceras</i> - shrub	60	1.5	b	40	
120m	1	<i>Avicennia</i> - sapling	100	0.6	d	100	
		<i>Avicennia</i> - tree	175	2	d	100	
	2	<i>Avicennia</i> - sapling	80	1.5	d	100	
		<i>Avicennia</i> - tree	200	2.5	d	200	
		<i>Aegiceras</i> - shrub	300	1.4	b	30	In bloom
	3	<i>Aegiceras</i> - shrub	180	1.3	b	40	In bloom
		<i>Avicennia</i> - big tree	120	6	d	300	
		<i>Avicennia</i> - sapling	220	0.8	d	100	
		<i>Avicennia</i> - tree	320	2.8	d	200	
	4	<i>Rhizophora</i> - shrub	100	3.6	b	150	
		<i>Avicennia</i> - sapling	170	2.2	d	300	
		<i>Avicennia</i> - tree	320	2.7	d	200	
130m	1	<i>Avicennia</i> - sapling	370	1.6	d	150	
		<i>Aegiceras</i> - shrub	300	3	b	70	Av. seedling
	2						Av. seedling
	3	<i>Avicennia</i> - shrub	140	2	b	40	Small, stunted
		<i>Avicennia</i> - shrub	130	3.7	b	60	Small, stunted

TABLE 6.4 cont. : Mangrove community, Pitch Bay, South Trees, Port Curtis, November 1996.

Transect (m)		Species	Distance (cm)	Girth (cm)	Type	Height (cm)	Comments
140m	1	<i>Avicennia</i> - tree	40	2.6	d	150	Av. seedlings present
		<i>Avicennia</i> - shrub	150	3	b	40	
	2	<i>Avicennia</i> - shrub	210	2.1	b	50	Stunted
	3	<i>Avicennia</i> - shrub	70	5.3	b	60	
	4	<i>Avicennia</i> - sapling	310	2.2	d	150	Av. seedlings
		<i>Avicennia</i> - shrub	40	2.7	b	24	
150m	1	<i>Avicennia</i> - big tree	500	57	c	500	In bloom R/ Av. seedlings
		<i>Avicennia</i> - shrub	330	1.4	b	20	
		<i>Avicennia</i> - sapling	290	1.3	d	100	
	2	<i>Avicennia</i> - shrub	130	0.8	b	20	Stressed
		<i>Avicennia</i> - sapling	450	2.1	d	200	
	3	<i>Avicennia</i> - shrub	110	1.7	b	70	
		<i>Avicennia</i> - sapling	270	1.1	d	100	
	4	<i>Avicennia</i> - shrub	90	1.4	b	50	
		<i>Avicennia</i> - sapling	150	1.7	d	100	
160m	1	<i>Avicennia</i> - sapling	70	1.3	d	100	R/ Av. seedling
		<i>Aegiceras</i> - shrub	58	1.3	b	40	
	2	<i>Avicennia</i> - tree	140	2.7	d	200	
		<i>Avicennia</i> - shrub	90	0.7	b	30	In bloom
		<i>Avicennia</i> - sapling	230	1.2	d	100	
	3	<i>Aegiceras</i> - shrub	80	1.7	b	44	
		<i>Avicennia</i> - sapling	170	1.1	d	150	In bloom
	4	<i>Aegiceras</i> - shrub	120	1.7	b	40	
		<i>Avicennia</i> - sapling	126	2	d	200	
170m	1	<i>Aegiceras</i> - shrub	130	1.7	b	50	Flowering
		<i>Avicennia</i> - tree	50	2.6	d	150	
	2	<i>Avicennia</i> - sapling	50	1.3	d	150	
		<i>Aegiceras</i> - shrub	130	1.8	b	40	Stressed
		<i>Avicennia</i> - tree	240	2.8	d	300	
	3	<i>Aegiceras</i> - shrub	120	2.3	b	40	
		<i>Avicennia</i> - sapling	200	1.4	d	140	Stressed
	4	<i>Aegiceras</i> - shrub	170	5.1	b	60	
		<i>Avicennia</i> - sapling	330	1.4	d	100	

TABLE 7 . Mangrove density (number per quarter and number per 0.1 hectare) and relative density mangrove community, Pitch Bay, South Trees, Port Curtis, November 1996.

Transect	ONE		TWO		THREE		FOUR	
	No. per quarter	No. of stems	No. per quarter	No. of stems	No. per quarter	No. of stems	No. per quarter	No. of stems
<i>Aegialitis</i>	0.21	98	0.3	101	0.04	11	0.18	48
<i>Avicennia</i>	0.11	52	0.24	81	0.37	97	0.51	136
<i>Rhizophora</i>	0.62	291	0.46	156	0.32	84	0.31	82
<i>Osbornia</i>	0.04	19			0.01	3		
<i>Aegiceras</i>	0.02	9			0.24	63		
<i>Ceriops</i>					0.02	5		
TOTAL		469		338		263		266

RELATIVE DENSITY

Transect	ONE	TWO	THREE	FOUR
<i>Aegialitis</i>	21	30	24	18
<i>Avicennia</i>	11	24	37	51
<i>Rhizophora</i>	62	46	32	31
<i>Osbornia</i>	4		1	
<i>Aegiceras</i>	2		4	
<i>Ceriops</i>			2	

TABLE 8 . Basal area mangrove community, expressed in m² and ranked, Pitch Bay, South Trees, Port Curtis, November 1996.

Transect	ONE		TWO		THREE		FOUR	
	Basal Area (m ²)	Rank	Basal Area (m ²)	Rank	Basal Area (m ²)	Rank	Basal Area (m ²)	Rank
<i>Aegialitis</i>	2	3	1.4	3	1	3	1.4	3
<i>Avicennia</i>	15	2	7	2	9.4	1	11.2	2
<i>Rhizophora</i>	69.3	1	8	1	6.9	2	11.4	1
<i>Osbornia</i>	0.3	4			0.9	4		
<i>Aegiceras</i>	0.2	5			0.3	5		
<i>Ceriops</i>					0.1	6		
TOTAL	86.8		16.4		18.6		24	

TABLE 9 . Absolute and relative frequencies mangrove community, Pitch Bay, South Trees, Port Curtis, November 1996.

Transect	ONE		TWO		THREE		FOUR	
	Absolute Frequency	Relative Frequency	Absolute Frequency	Relative Frequency	Absolute Frequency	Relative Frequency	Absolute Frequency	Relative Frequency
<i>Aegialitis</i>	58%	27	100%	39	70%	11	50%	29
<i>Avicennia</i>	67%	30	55%	22	77%	27	72%	42
<i>Rhizophora</i>	75%	35	100%	39	92%	32	50%	29
<i>Osbornia</i>	8%	4			8%	2.8		
<i>Aegiceras</i>	8%	4			31%	24.4		
<i>Cerriops</i>					8%	2.8		
TOTAL	216%		255%		286%		172%	

TABLE 10. Relative dominance mangrove community, Pitch Bay, South Trees, Port Curtis, November 1996.

RELATIVE DOMINANCE

Transect	ONE	TWO	THREE	FOUR
<i>Aegialitis</i>	2.4	7.9	5.4	5.8
<i>Avicennia</i>	17.3	40.8	50.8	46.7
<i>Rhizophora</i>	79.8	51.3	37	47.7
<i>Osbornia</i>	0.3		4.9	
<i>Aegiceras</i>	0.3		1.4	
<i>Cerriops</i>			0.5	

TABLE 11. Importance value mangrove community, Pitch Bay, Port Curtis, November 1996 (sum of relative density, relative frequency and dominance).

IMPORTANCE VALUE

Transect	ONE		TWO		THREE		FOUR	
	Importance Value	Rank	Importance Value	Rank	Importance Value	Rank	Importance Value	Rank
<i>Aegialitis</i>	50.4	3	76.6	3	53.8	3	52.8	3
<i>Avicennia</i>	58.3	2	86.8	2	114.8	1	139.7	1
<i>Rhizophora</i>	176.8	1	136.3	1	101	2	107.5	2
<i>Osbornia</i>	8.3	4			8.7	5		
<i>Aegiceras</i>	6.3	5			16.4	4		
<i>Cerriops</i>					5.3	6		

Figure 1

PITCH BAY

PORT CURTIS

PITCH BAY enlarged

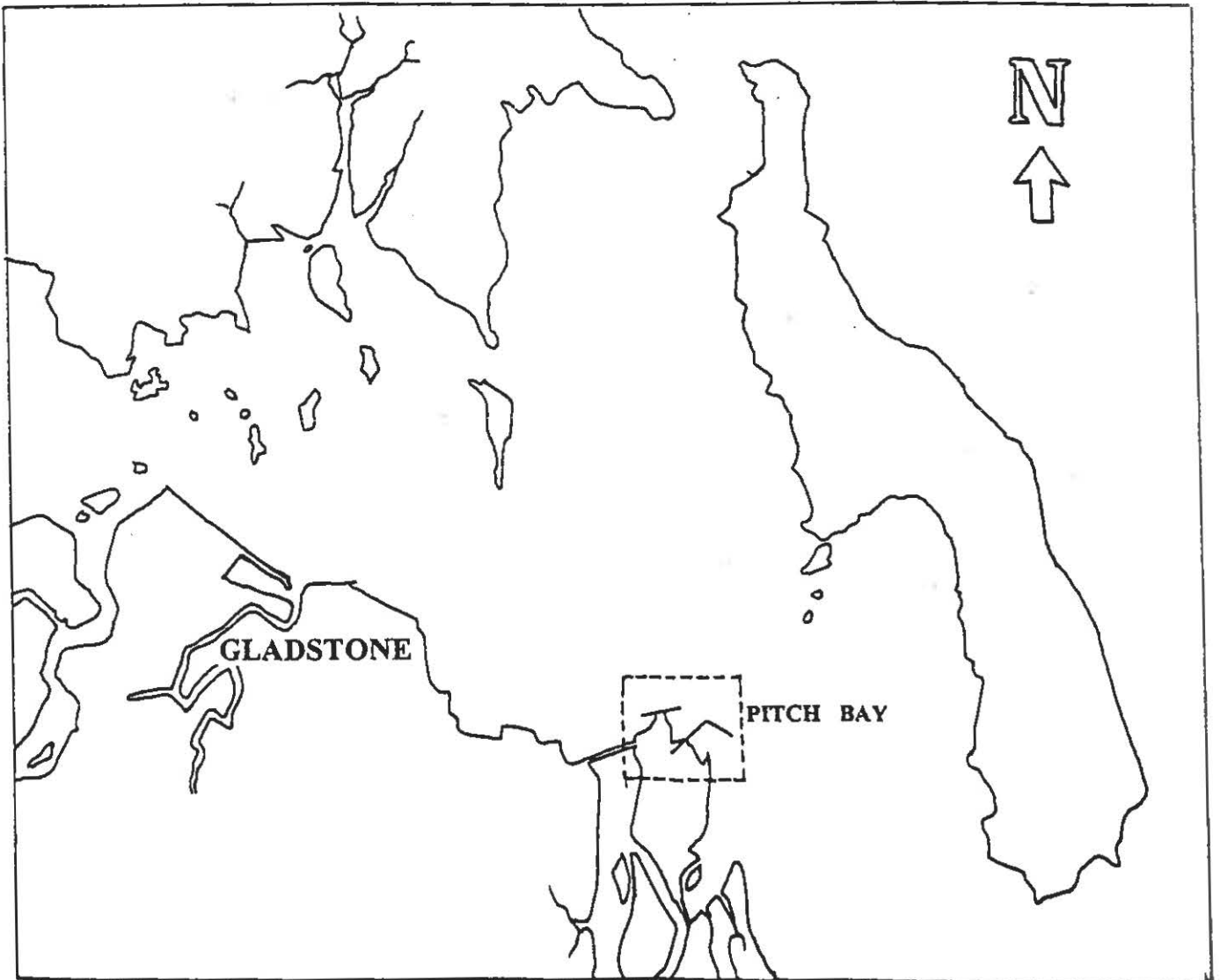
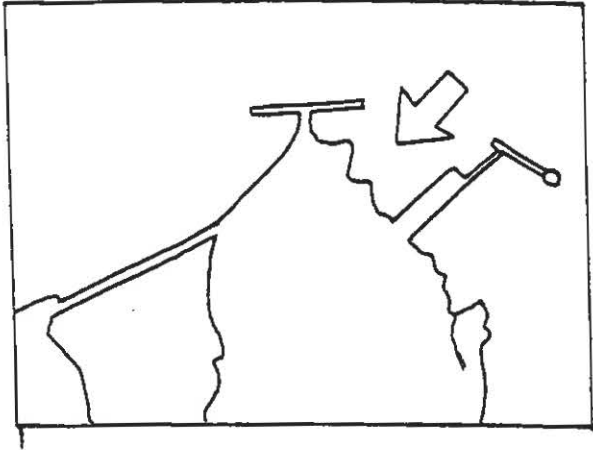


Figure 2

MARINE INTERTIDAL MUFLAT SURVEY

Transects Low Tide

PITCH BAY - PORT CURTIS

surveyed November 1996

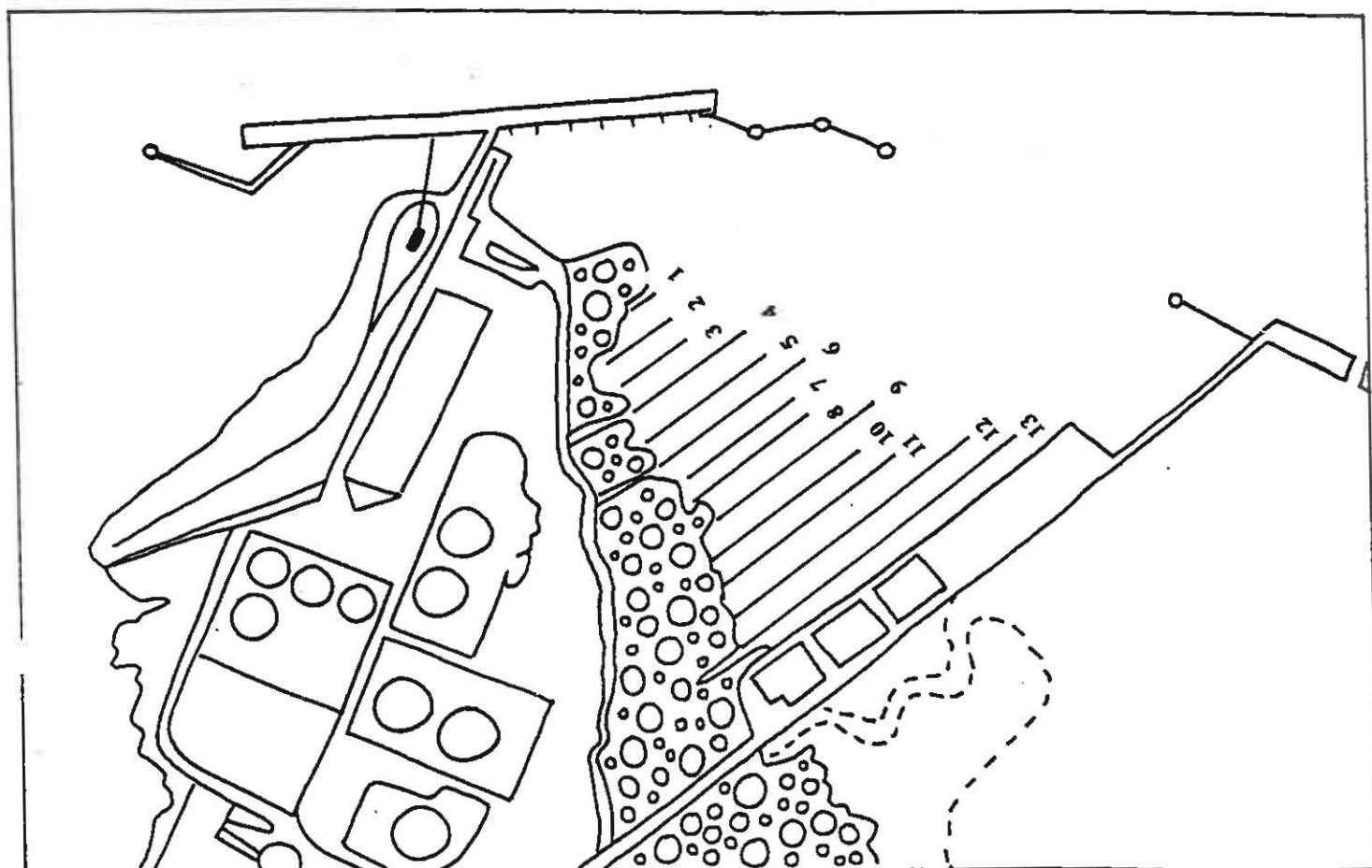


Figure 3

MARINE SUBTIDAL MUDEFLAT SURVEY

High Tide transect

PITCH BAY - PORT CURTIS

surveyed November 1996

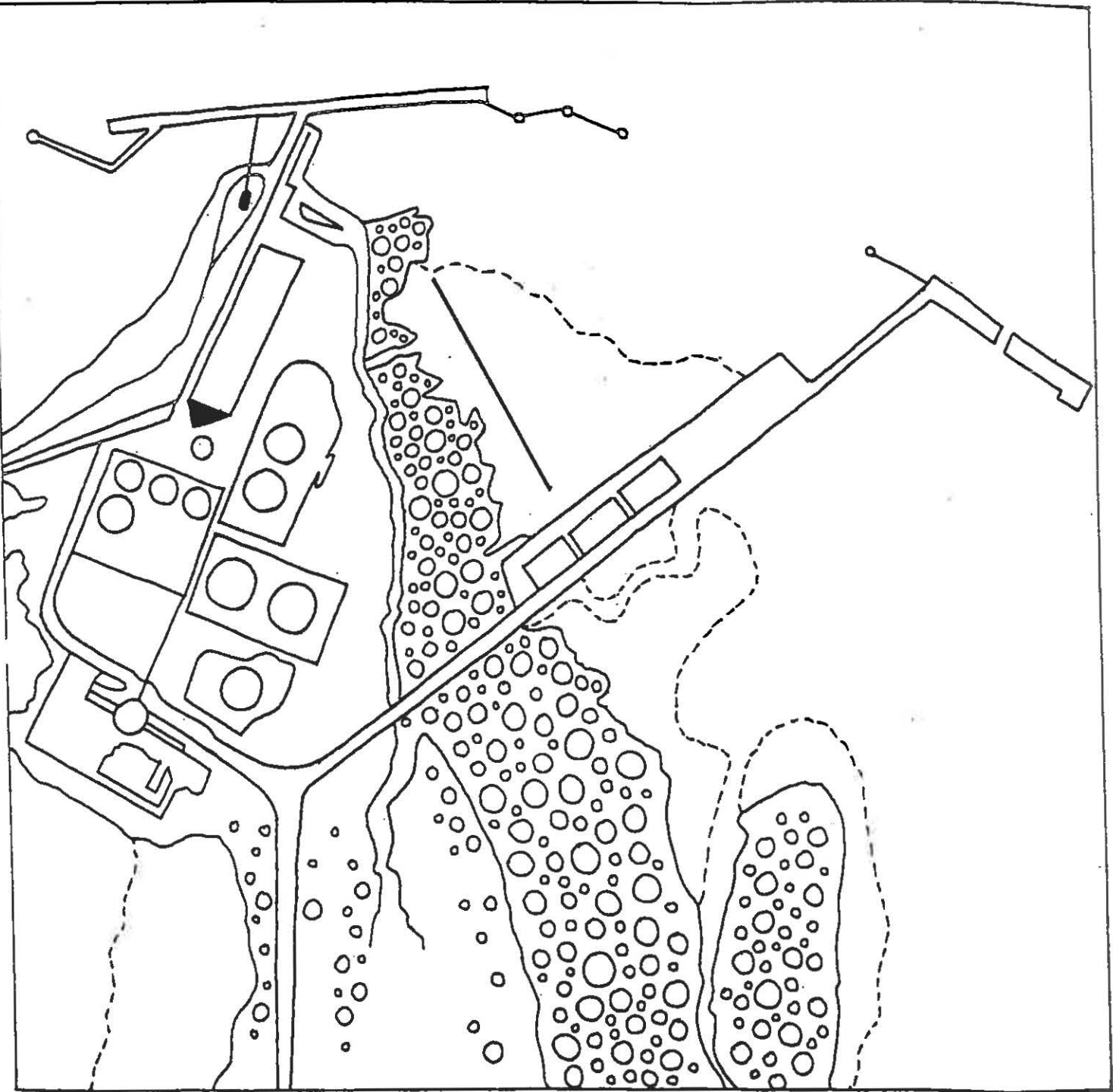


Figure 4

**GRAB SAMPLING
PITCH BAY, SOUTH TREES,
PORT CURTIS**

Surveyed: November 1996



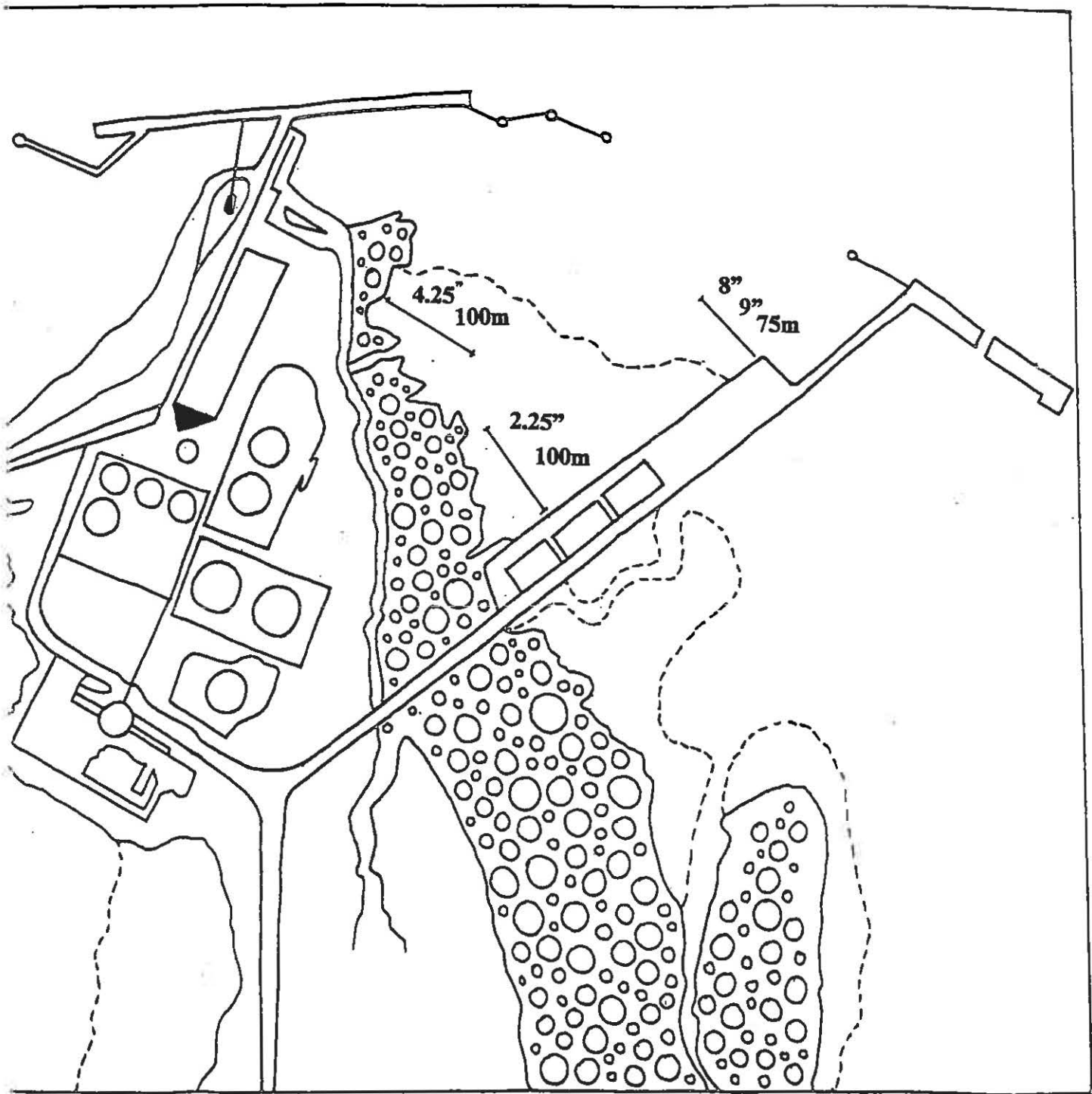
Figure 5

NET FISHING LOCATIONS

Set High Tide at Night

PITCH BAY - PORT CURTIS

surveyed November 1996



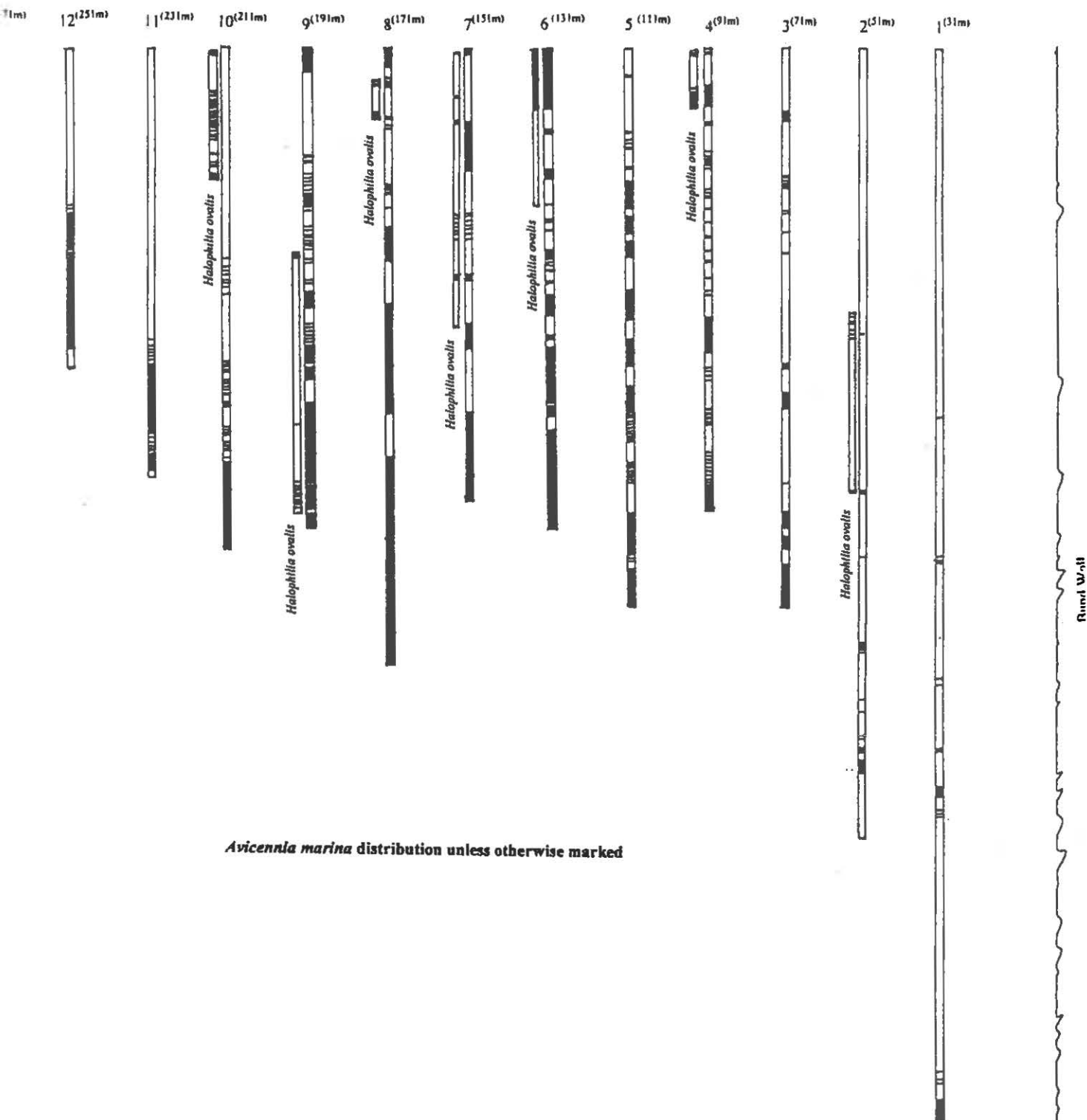
Flora Survey - Pitch Bay

South Trees, Port Curtis

Distribution of Seagrass, Mudflat - Low Tide

Surveyed: November 1996

sect No



Mangrove Creek

Flora Survey - Pitch Bay

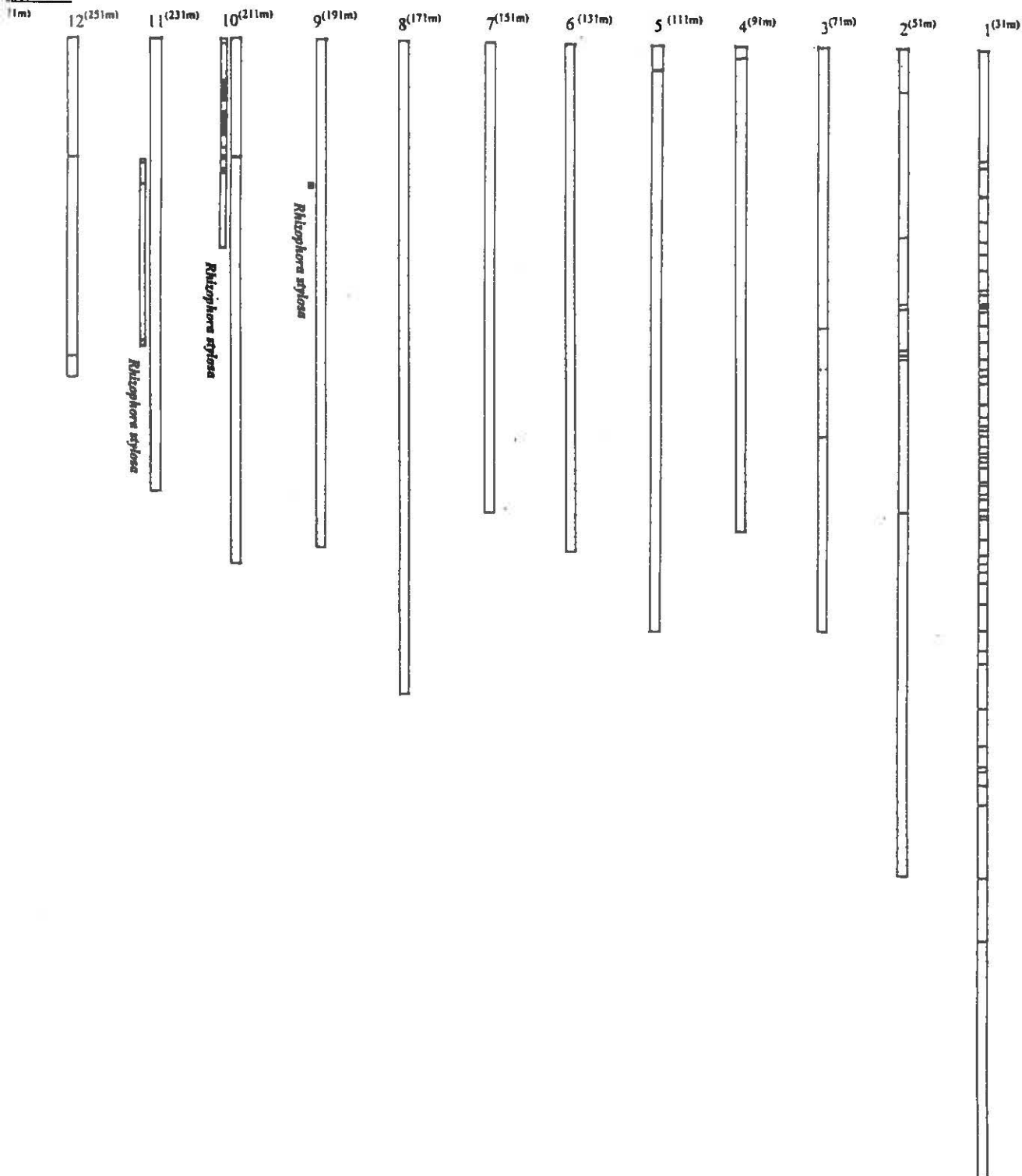
South Trees, Port Curtis

Distribution of Mangroves,

Mudflat - Low Tide

Surveyed: November 1996

Insect No



Mangrove Creek

Figure 8

Fauna Survey - Pitch Bay

South Trees, Port Curtis.

Distribution of Crab and Mud Skipper Holes, Mud flat - Low Tide

Surveyed: November 1996

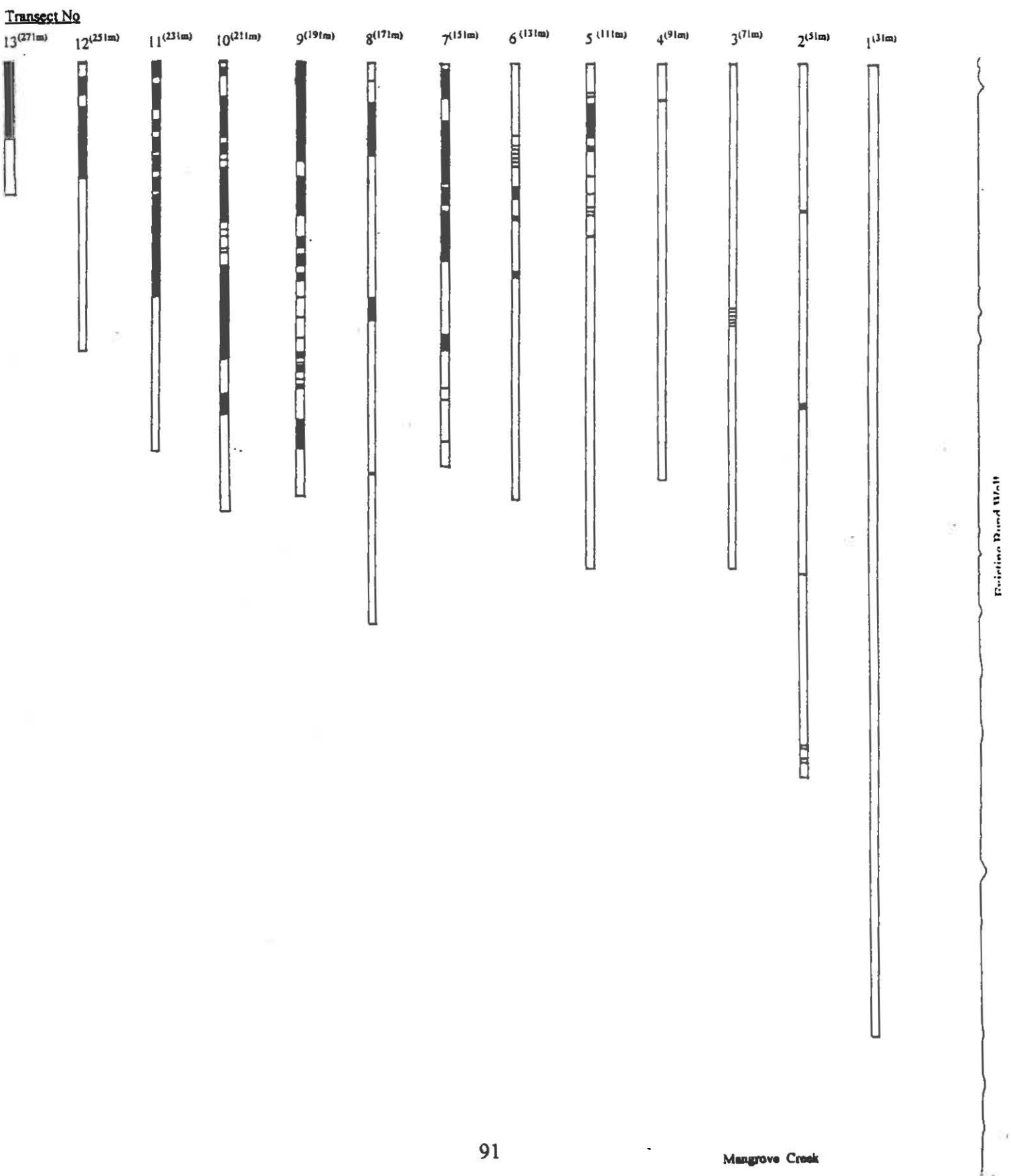


Figure 9

MANGROVE TRANSECTS, PITCH BAY,

South Trees, Port Curtis

Surveyed: November 1996

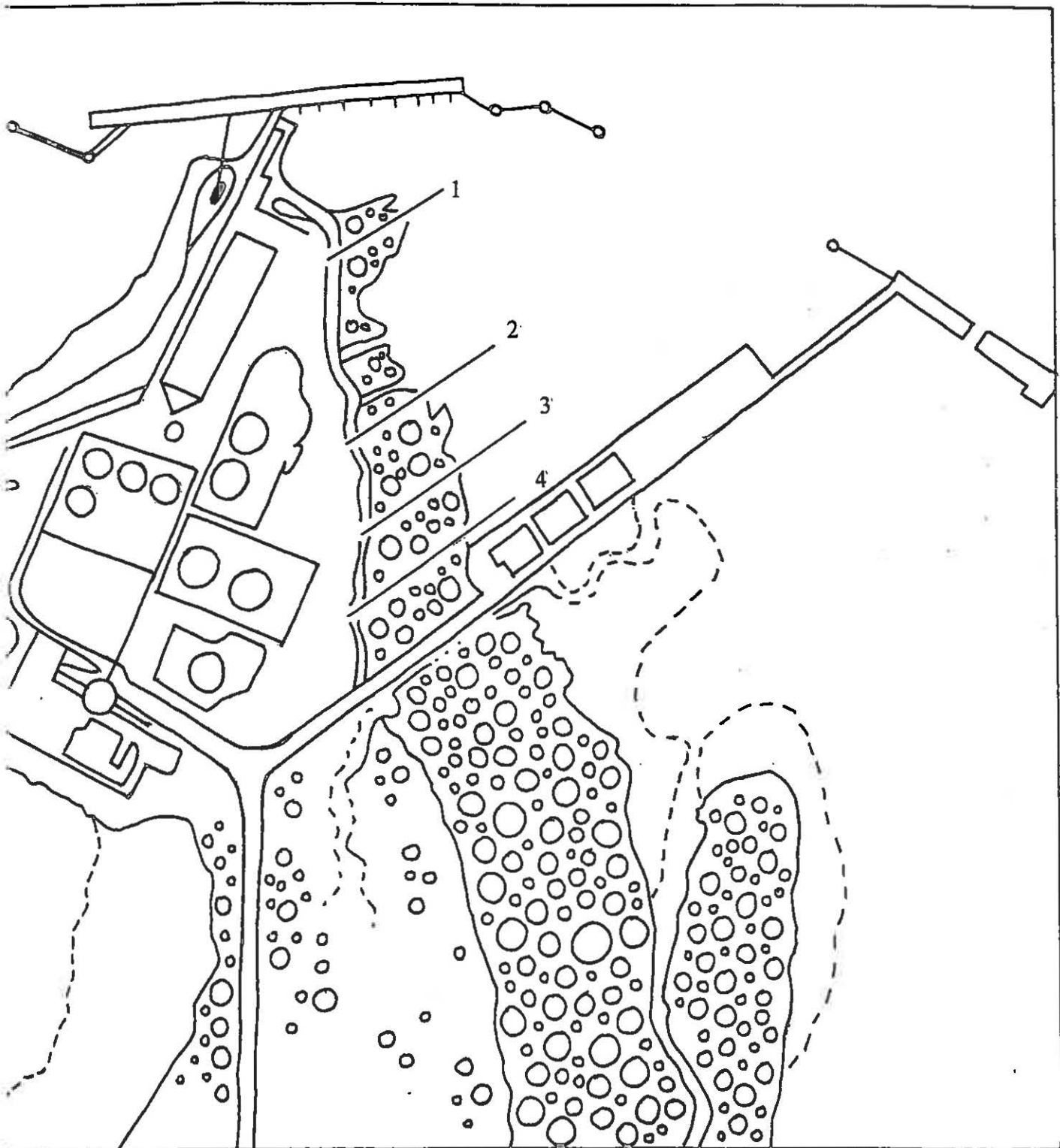


PLATE 1
GENERAL HABITAT - PITCH BAY,
SOUTH TREES, NOVEMBER, 1996.



**1.1 VIEW OF BUNDWALL AND NEW
PITCH TANKS**



**1.2 MANGROVES ON LOWER REACHES
OF BUNDWALL *Avicennia marina* AND
*Rhizophora stylosa***



**1.3 LOWER REACHES OF BUNDWALL MANGROVE
COMMUNITY AND MANGROVE CREEK
Rhizophora stylosa SEEDLINGS IN FOREGROUND
HIGH TIDE**



1.4 MANGROVE CREEK LOW TIDE



1.5 FORESHORE BEHIND MANGROVES

PLATE 2
MUD FLAT SURVEY, SOUTH TREES,
PITCH BAY, HIGH AND LOW TIDES



**2.1 SETTING UP THE TRANSECT LINE
FOR SURVEY HIGH TIDE**



2.2 SURVEY UNDERWAY (1)



**2.3 SURVEY UNDERWAY (2) SHOWING NEW
PITCH TANKS AND BUNDWALL**



**2.5 MUD FLAT SURVEY UNDERWAY SHOWING
SEAWARD STAKE FOR TRANSECT LINE**



**2.4 TAKING LANDWARD SURVEY STAKE
FOR TRANSECT LINE ADJACENT TO CREEK**

PLATE 3
BOTTOM SAMPLING PITCH BAY,
SOUTH TREES, NOVEMBER 1996



**3.1 LHS CONVEYOR TO RHS CORNER OF BAUXITE STORAGE SHED SITES
FOR POSITIONING THE 20 STATIONS**



**3.2 HAULING 0.1M² VAN VEEN
GRAB ABOARD**



3.3 TIPPING OUT SEDIMENT

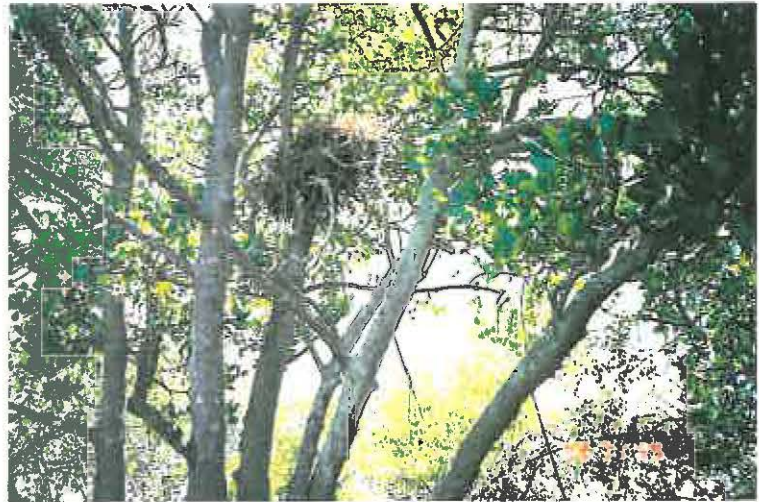


**3.4 WASHING SEDIMENT THROUGH A 0.1MM SIEVE
AND SORTING OF SAMPLES**

PLATE 4
MANGROVE SURVEY PITCH BAY,
SOUTH TREES, NOVEMBER 1996



4.1 SETTING UP OF TRANSECT LINE 240°



4.2 OSPREY NEST IN A RED MANGROVE *Rhizophora stylosa*



4.3 UNDERTAKING TRANSECT SEAWARD EDGE

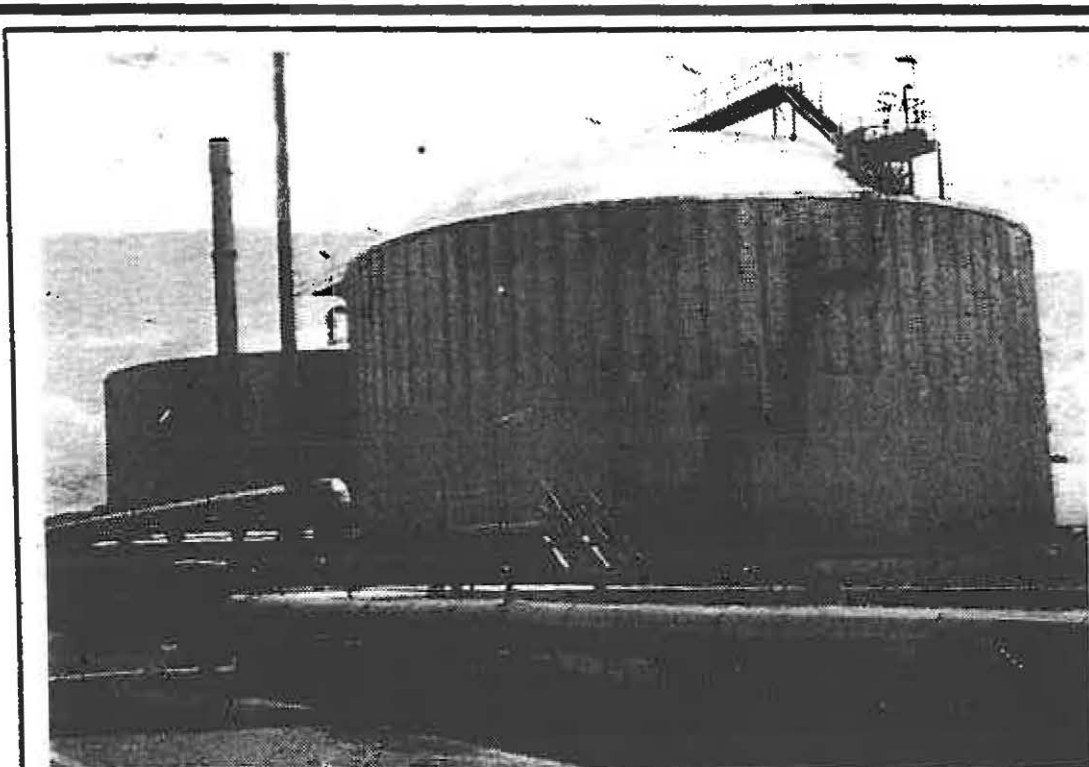


4.4 TRANSECT MIDWAY THROUGH MANGROVE COMMUNITY



4.5 TRANSECT LANDWARD THROUGH MANGROVE COMMUNITY

Appendix 1 "Tanks take shape on skyline" newspaper article, Gladstone Observer, 3rd December, 1996



□ The shipping of liquid pitch to these 12.5 metre high holding tanks at BSL will reduce the heavy vehicle traffic to the site.

Tanks take shape on skyline

Heavy vehicle traffic to Boyne Smelters Limited will be reduced by up to 90 trucks a month due to a change to sea shipment for a major raw material.

Two large conical holding tanks that have taken shape on BSL's waterfront skyline during

the past eight months will store liquid pitch shipments. The first shipment of liquid pitch arrived last week marking the beginning of the new supply system. A second shipment is due next week.

Previously, 60 to 90 trucks a month transported pencil pitch

to the site from a Newcastle supplier.

Pitch is used in the production of carbon anodes — an integral component of the smelting process.

The 12.5 metres high, 24 metre diameter holding tanks have a capacity of 6,000 tonnes.

Appendix 2 Biological data for fishes from set nets Pitch Bay, South Trees, November 1996.

Shovel nosed ray	TL 1.08 m.
Black tip whaler shark	TL 71.0cm, wt 1.95 kg.
Spotted herring	LCF 21.4 cm , wt 100g.
Herring (2)	LCF 30cm, wt 40g;LCF 140cm,wt 60g.
Dusky flathead (7)	TL 59.5cm, wt 1.42 kg; TL 70.5cm , wt 0.91kg; TL 60cm, wt 1.57kg; TL 51.2 cm, wt 0.91 kg; TL 45.0cm, wt 0.61 kg; TL 44.5cm, wt 0.55kg; TL 47.2cm, wt 0.54 kg.
Bar tailed flathead (3)	TL 32.0cm, wt 0.2kg; TL 35.0cm,wt 0.21kg; TL 27.5cm, wt 0.11kg.
Nothern whiting	LCF 29.5cm, wt 0.211kg.
Spotted javelin fish	LCF 37.5cm, wt 0.81kg.
Brown sweetlip	LCF 58.5 cm, wt 4.54kg.
Yellow finned bream(2)	LCF 28.5cm, wt 0.52kg ; LCF 22.8cm, wt 0.45kg.
Pikey bream (2)	LCF 24.8cm, wt 0.41kg; LCF 27.5cm, wt 0.51 kg.
Sickle fish(2)	TL 39.5, wt 1.37 kg; TL 20cm, wt 0.22 kg.
Striped butterflyfish (2)	TL 23.2 cm, wt 0.21kg; TL 15.0cm, wt0.075kg.
Sea mullet (8)	LCF 34.4cm, wt 0.611kg; LCF 30.0cm, wt 0.311kg; LCF 34.8cm, wt 0.630kg; LCF 30.5cm, wt 0.511kg; LCF 27.4 cm, wt 0.340kg; LCF 26.8 cm, wt 0.295kg; LCF 32.2cm, wt 0.51kg; LCF 27.5cm, wt 0.355kg.
Fan tailed mullet (2)	LCF 28.5 cm, wt 0.341kg; LCF 22.8cm, wt 0.111kg.
Fan tailed mullet (41)	LCF 20.5, 24.2, 24.0, 20.0, 21.0, 19.5, 21.0, 24.2, 25.0, 24.0, 21.5, 22.8, 22.0, ,23.0, 25.0, 20.5, 25.2, 21.5, 20.0,20.5, 23.2, 22.5, 22.0, 24.8, 22.5, 22.4, 23.0, 24.5, 24.0,22.4, 24.0, 22.4, 24.0, 22.5, 23.2, 24.5, 25.0,22.8, 23.8,20.5, 22.5.
Striped Sea pike	LCF 37.5cm, wt 0.275kg
Blue salmon/threadfin	LCF 30.5cm, wt 0.345kg.
Flat salmon	LCF 19.0cm, wt 0.075kg.
Sole	TL 12.4cm, wt 0.040kg.