MARINE RESERVE IMPLEMENTATION PROGRAMME: CENTRAL WEST COAST

A COLLABORATIVE PROJECT BETWEEN THE CALM MARINE CONSERVATION BRANCH, MIDWEST REGIONAL OFFICE AND MOORA DISTRICT OFFICE

BIOLOGICAL SURVEY OF THE MAJOR BENTHIC HABITATS OF JURIEN BAY AND SURROUNDING WATERS (CERVANTES-GREEN HEAD): 21 April - 9 May 1997

Field Programme Report: MRIP/MW/J - 03/1997

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Direction

- Kieran McNamara - Director, Nature Conservation Division.
- Dr Chris Simpson - Manager, Marine Conservation Branch (MCB), Nature Conservation Division.
- Greg Leaman - Manager, Midwest Region.

CALM Collaboration

- Jim Burt, Project leader, MCB
- Dr Jeremy Colman, Marine Ecologist, MCB
- Mike Lapwood, Technical Officer, MCB
- Caroline Minton, CALM Volunteer, MCB
- Gilles Monty, CALM Volunteer, MCB
- Emma Parkes, CALM Volunteer, MCB
- David Rose, Manager, Moora District
- Ron Shepherd, Programme Leader, Nature Conservation, Midwest Region
- Dr Neville Marchant, Principal Research Scientist, CALM Herbarium

External Collaboration

- Dr Paul Lavery, Environmental Management Department, Edith Cowan University
- Mat Vanderklift, Environmental Management Department, Edith Cowan University
- Dr Barry Hutchins, Western Australian Museum
- Jane Griffith, Western Australian Museum
- Dr Eric Paling, Murdoch University
- Dr John Huisman, Murdoch University
- Peter McCafferty, Chemistry Centre of Western Australia

Funding and resources

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- Resources including, technical assistance and logistical support have been provided by CALM's Midwest Region and Moora District Offices

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SUMMARY

This report presents details of a field programme proposed from 20 April to 9 May 1997, to undertake a systematic survey and quantitative investigation of the marine flora and fauna of the major benthic habitats for the waters off the central west coast of Western Australia from Cervantes to Green Head.

The field survey is being carried out as part of CALM's Marine Reserve Implementation Programme and is being coordinated by the Marine Conservation Branch of CALM in collaboration with the Western Australian Museum, Edith Cowan and Murdoch University's and CALM's Midwest Regional and Moora District offices

The formal process for considering Jurien Bay and surrounding waters for marine reservation was recently initiated by the Minister for the Environment and the establishment of a marine reserve advisory committee was the first step in the public consultation process.

Quantitative data describing the marine flora and fauna of Jurien Bay and surrounding waters do not exist. The proposed survey will provide the information to assist the advisory committee in the development of management zones within the proposed Jurien marine reserve. This study complements CALM's regional survey of the major habitats types of the Central West Coast and will provide a quantitative description of the marine flora and fauna within the major habitat types for assessing the relative biological importance (in terms of diversity and primary productivity) of these habitats in this area.

1 INTRODUCTION

1.1 General background

This report presents details of a field programme proposed from 20 April to 9 May 1997, to undertake a systematic survey and quantitative description of the marine flora and fauna of the major benthic habitats of the waters off the central west coast of Western Australia from Cervantes to Green Head. These waters include Jurien Bay, an area recommended in *the Report Of The Marine Parks And Reserves Selection Working Group* (CALM, 1994; known as the Wilson Report) as worthy of consideration for reservation (Figure 1).

The CALM Act (1984), allows for the establishment of multiple-use marine reserves for the purposes of conservation of marine flora and fauna and public recreation. Commercial activities, such as fishing, aquaculture and petroleum exploration and production, are also acceptable within specific zones of multiple-use marine reserves. Commercial and recreational fisheries in marine reserves are managed by the Fisheries Department.

The CALM Act specifies the statutory process for the reservation of marine reserves, including a public planning process via an advisory committee for the development of management zones that allow multiple-use and, if necessary, for the spatial separation of incompatible activities within a reserve. In anticipation of this consultative process, the major marine resources and current uses of areas recommended for reservation in the Wilson Report, are being identified and mapped in a Geographical Information System (GIS) by the Marine Conservation Branch (MCB) as part of the Marine Reserve Implementation Programme.

The formal process for considering Jurien Bay and surrounding waters for marine reservation was recently initiated by the Minister for the Environment through the establishment of a marine reserve advisory committee as the first step in the public consultation process. Recent broad-scale biological (Burt, 1996, Burt *et al.*, 1997) and oceanographic (D'Adamo, 1996, D'Adamo, 1997) field programmes conducted by the MCB in the Jurien area, were undertaken to provide a better regional ecological perspective of these waters for input into the consultative process (Figure 1).

Quantitative data describing the marine flora and fauna of Jurien Bay and surrounding waters do not exist. The proposed survey will provide the information to assist the advisory committee in the development of management zones within the proposed Jurien marine reserve. This study complements CALM's regional survey of the major habitats types of the Central West Coast and will provide a quantitative description of the marine flora and fauna within the major habitat types for assessing the relative biological importance (in terms of diversity and primary productivity) of these habitats in this area.

The field survey is being carried out as part of CALM's Marine Reserve Implementation Programme and is being conducted by the Marine Conservation Branch of CALM (Contact: Jim Burt, Marine Ecologist) in collaboration with the Western Australian Museum, Edith Cowan University (Environmental Management Department), University of Western Australia (Botany Department) and CALM's Midwest Regional office (Contact: Ron Shepherd, Programme Leader, Nature Conservation) and Moora District office (Contact: Dave Rose, District Manager).

Jim Burt is the Project and the Field Team Leader.

1.3 Objectives

Primary objectives:

- quantify the relative species richness and abundance of the macro-benthic communities within the major benthic habitat types;

- quantify the relative species richness and abundance of the large and non-cryptic small fishes within the major benthic habitat types;

- quantify physical parameters such as water depth, seabed 'roughness' and sediment mineralogy within the major benthic habitat types as a surrogate for macro-benthic species richness;

- quantify the relative biomass of the macroalgal and seagrass assemblages within the major benthic habitat types as a surrogate for primary production;

Secondary objectives:

- opportunistic collection of qualitative information (still photography and video footage) on visually dominant marine fauna and flora;
- establish reference collections for each of the major phyla in of the study area;
- identification of potential long-term monitoring sites.

2 METHODS

2.1 Survey area

The waters of the proposed Jurien area are considered to be typical of the Central West Coast zone, one of ten primary geomorphic coastal zones recognised along the Western Australian coast, containing excellent examples of all the characteristic habitat types of that zone (CALM, 1994; known as the Wilson Report). This classification is very similar to the results of a marine bioregionalistion, based on demersal shelf fish populations, conducted by CSIRO as part the Interim Marine and Coastal Regionalisation for Australia (IMCRA, Thackway and Cresswell, 1996).

Searle and Semeniuk (1985) divided the coastal environment of the Central West Coast into five distinct sectors with the waters of the Jurien area occurring within the Wedge Island-Dongara sector. This sector of the coast is micro-tidal, relatively high energy, with a moderately narrow shelf, clear waters and predominately carbonate sediments. The nearshore bathymetry is complex, consisting of ridges and depressions, offshore limestone islands with well developed shallow reef systems, extensive sand banks and several semi-enclosed embayments (e.g. Jurien Bay). Inside the 20 m isobath there is a series of prominent, elongated, offshore limestone reefs, more or less parallel to the shore, protecting inshore lagoons. The adjacent coastline is commonly of long sandy beaches scalloped at a large scale with occasional limestone cliffs and headlands and rocky shores with wide rock platforms.

2.2 Site selection

The primary objectives of this survey are to provide a quantitative description of the marine flora and fauna within the major habitat types of the waters around Jurien Bay proposed, in the 'Wilson' report, for consideration as a marine reserve. This survey will facilitate assessment of the **relative** biological importance (in terms of diversity and primary productivity) within and between these habitats. CALM's Marine Conservation Branch recently completed a broad-scale mapping, ground-truthing and classification of the major marine habitats along about 100 km of the Central West Coast between Cervantes and Cliff Head (Burt *et al*. 1997). This regional survey classified these waters into the seven broad habitat types listed below. The 'Bare Sand' habitat typically has a low diversity of macro-benthic flora and fauna and insignificant macrophyte primary production and, as such, was not included in the study. The 'Island' habitat was also excluded.

Approximate sampling locations were selected in each of the five remaining benthic habitat types in areas that were considered to be broadly representative of that habitat, by reference to the habitat map (Figure 1), aerial photographs and relevant bathymetric charts. Weather and sea conditions permitting it is anticipated that a total of 66 sites will be sampled during the 15 days in the field, with at least four sites completed per day. The number of sites in each habitat type (listed below in parenthesis) relate to the anticipated broad-scale heterogeneity of each habitat within the study area. Sites will be located within large areas of each habitat to reduce potential sample bias caused by *edge effects*. A listing of proposed sites and their locations (GPS latitude and longitude coordinates) is provided in Appendix I.

- Seagrass meadows (12)
- Seagrass interspersed with reef and sand patches (12)
- Shallow reef platforms including intertidal reefs (14)
- Subtidal reef interspersed with sand patches (16)
- Offshore limestone pavement interspersed with sand, macroalgae and seagrass (10)
- Large areas of mobile sand with sparse seagrass (0)
- Islands (0)

2.3 Quantitative sampling methodology

Experimental design

A combination of visual census, video transect and quadrate sampling will be used to quantify the relative species diversity and relative abundance of the fish community, and the dominant components of the macro-benthic (specimens > 10 mm) community at each site. The biological survey will consist of four quantitative elements:

- the relative species richness and abundance of the large and non-cryptic small fishes within the major benthic habitat types;
- the relative species richness and abundance of mobile macro-benthic invertebrates (i.e. Molluscs, Echinoderms & Crustaceans) within the major benthic habitat types;
- the relative species richness and abundance of the sessile macro-benthic invertebrates (i.e. sponges, Ascidians Cnidarians) within the major benthic habitat types;
- quantify physical parameters such as water depth, seabed 'roughness' and sediment mineralogy within the major benthic habitat types as a surrogate for macro-benthic species richness;
- the relative biomass of the macroalgal and seagrass assemblages within the major benthic habitat types as a surrogate for primary production.

Four, contiguous 50 m weighted and scaled transect lines will be deployed by Zodiac, in a buoyed square, centred around the anchored *Bidthangara*. As the transect line is deployed numbered quadrates and catch bags will be attached at pre-determined intervals using shark clips. At each site a team of five divers will be used, operating from the *Bidthangara* supported by two diving attendants in a tender vessel (e.g. zodiac). Divers will always dive as buddy-pairs and swim in a clock-wise direction around the transect. On completion of tasks divers will always surface at a buoy and swim on the surface back to the boat. It is estimated that divers will require approximately 30-45 minutes bottom time at each site to complete their tasks. The water depth of most sites will be less than 15 m however at a limited number of offshore sites, maximum water depths will be up to 25 m. The location of each site will be recorded using a differential GPS.

Only approximately horizontal upper surfaces will be sampled using the quadrates, and if a quadrate falls on a vertical surface the nearest horizontal surface will be sampled. Likewise, if more than 75 % of a quadrate is bare sand the quadrate will be moved to the nearest non 'bare sand' habitat. Mobile invertebrates, such as cephalopods, infauna and microbiota, and epiphytic invertebrates attached to the leaves and stems of seagrass and macroalgae will not be actively sampled in this study.

Fish assemblages(two divers)

The species composition of the large and non-cryptic small fish assemblages will be determined at each site using underwater video footage obtained by a diver, swimming at a constant speed (~10 m of transect per minute) and height above the seabed (~2 m), along the 200 m transect line and filming a swathe centred on the transect of approximately 10 m (total sample area of 2000 m^2). The diver will also video each quadrate. A second diver will concurrently record the presence and abundance of common species, particularly important commercial and recreational species, on a Fish Data Sheet (Appendix II). This is an adaptation of the methodology described by Edgar *et al*. (1996). Operating instructions for the underwater video systems are included as Appendix III. Video details for each transect will be recorded on a standard video data sheet (Appendix IV).

In seagrass meadows the census will not include fishes within the canopy, otherwise the methodology will be the same as applied to the hard substrate sites.

The second diver will record water depth (+/- 0.2 m) at 20 m intervals along the transect and the percentage of bare sand along the entire transect. The mean depth and standard deviation of the depth (SDD) will be calculated for each transect. SDD will been used in this study as an approximate index of seabed *roughness*, based on the assumption that, over a 200 m transect, the effect of seabed slope on the SDD will be negligible compared to the effect of variation in seabed topography (Simpson and Ottaway, 1986).

A one kilogram sample of surficial sediment (top 20 mm) will be collected, where possible, at each site and frozen for storage for latter analysis by the Chemistry Centre of Western Australia for grain size and organic content. Further technical details on the analytical methodology can be found in Burt and Ebell (1995).

On completion of these tasks the two divers will surface at a buoy and return to the *Bidthangara*. Upon surfacing a fish attractant device (FAD) will be lowered from the *Bidthangara* to within approximately 1-2 m of the seabed. After the attractant has been in the water for 10 minutes the two divers will descend and record, as before, all the fish within a 10 m radius of the FAD for five minutes.

Invertebrate and macrophyte assemblages (three divers)
Following behind the divers describing the fish assemblages, a third diver will collect all mobile invertebrates and non-encrusting sessile invertebrates such as sponges and ascidians from ten 0.5 m^2 quadrates attached at 20 m intervals along the 200 m transect line (see above). Pieces of hard corals and encrusting sessile invertebrates will be collected and their dimensions recorded in each quadrate. An example of the Invertebrate Data Sheet is provided in Appendix V. A total area of 5 m^2 will be sampled for mobile and sessile invertebrates along each transect line.

Water depth (+/- 0.2 m) and the proportion of bare sand will also be recorded for each of the ten quadrates (Appendix V).

Two divers will harvest the above-ground macrophyte assemblage from five quadrates, at 40 m intervals, along the 200 m transect line and the material placed in buoyed catch bags (see above). Quadrates will be 0.25 m^2 in reef habitats and 0.1 m^2 in seagrass meadows, providing a total area along each transect sampled for macrophytes of 1.25 m^2 and 0.5 m^2 respectively. An example of the Macrophyte Data Sheet is provided in Appendix VI. These divers will also check each quadrate to ensure all the invertebrates have been collected.

On completion of these tasks the three divers will surface at a buoy and return to the *Bidthangara*. Buoyed catch bags and transect lines will be progressively retrieved by attendants in the zodiac and returned to the *Bidthangara*.

2.4 Sorting and preservation of samples

The bulk of the macrophytic material will be sorted into the major phyla on board the *Bidthangara*. This material will be stored in a refrigerator for transport to the laboratory for further sorting and determination of biomass for the common species or groups (e.g. non-coralline, red algae etc.).

Reference collections will be established for each of the major phyla in the study area. Seagrasses and algae will be preserved in 2-4 % seawater/formalin, sponges in 70% alcohol and all invertebrate specimens in 4 % formalin buffered with sodium bicarbonate. Specimens of seagrass and algae will also be pressed and mounted.

2.5 Qualitative sampling

Still photographs and high quality video footage of marine flora and fauna will also be taken as a **secondary** objective. As the collection of this type of information is dependent on good water clarity, it will be undertaken when opportunities become available. The preparation of the video housing, the operation of the camcord underwater video recorder and the maintenance of this equipment is detailed in Appendix III. General information about each sampling site, particularly observations of marine wildlife will be recorded on a standard Habitat Data Sheet (Appendix VII).

A detailed list of all the equipment required for the field survey is provided in Appendix VIII.

3 FIELD PROGRAMME

3.1 Survey team

The survey team will be comprised of the following people.

CALM staff

Jim Burt	Project Leader, Marine Ecologist, MCB
Mike Lapwood	Field Team Leader, Technical Officer, MCB
Jeremy Colman	Marine Ecologist, MCB
Ron Shepherd	Programme Leader, Nature Conservation, Midwest Regional office
Gilles Monty	CALM Volunteer, MCB
Carolyn Minton	CALM Volunteer, MCB
Emma Parkes	CALM Volunteer, MCB

External personal

Ian Stiles	Dive Master, Beagle Island Diving Company
Kevin Bancroft	Murdoch University
Jane Griffith	Western Australian Museum
Eva Boogard	Professional underwater photographer

3.2 Field itinerary

The *Bidthangara* will depart from the Jurien Bay Fishing Boat Harbour at about 6 am so that the vessel can be on-site and diving operations underway by approximately 8 am. If swell/sea conditions prevent diving operations, for all or part of a day, that time will be spent sorting/preserving samples and collating field data.

Table 1: Field itinerary for the Jurien Bay marine habitat survey, April/May 1997.

Date	Day	Activity
15 April 97	Tue	Mike Lapwood and Caroline Minton depart Perth for Jurien Bay. Transfer Bidthangara from hard-stand to DMH jetty, establish wet-lab at APEX, pickup spare vehicle from CALM Cervantes office, and transfer zodiac from Cervantes to Jurien DOT compound.
16	Wed	Mike and Caroline return to Perth (pm)
20	Sun	Survey team departs the MCB Fremantle Field Station (see Appendix IX for locality map) at ~ 1pm, in 2 vehicles with trailers and arrives at Jurien Bay at ~ 4pm. Unpack personal gear and laboratory equipment at the APEX CENTRE. Large field items will be stored at the DOT compound at the Jurien Fishing Boat Harbour.
21	Mon	**Field survey commences (am).**
22	Tue	Field work
23	Wed	Field work
24	Thu	Field work Survey team departs Jurien Bay (~ 2 pm) for the ANZAC Day long weekend, arrives at Perth (~ 5 pm). Mike Lapwood remaining in Jurien.
27	Sun	Survey team, including John Huisman, departs Fremantle (~ 3 pm) arrive at Jurien Bay (~6pm) Jenny Cary and Tim Daly drop off equipment, used in the Shark Bay Monitoring Programme, at Jurien Bay, on their way to Perth.
28	Mon	**Field survey re-commences (am).**
29	Tue	Field work John Huisman returns to Perth
30	Wed	Field work
1	Thu	Field work
2	Fri	Field work
3	Sat	Field work Party, 7 pm till late. *Pickled Seafood Extravaganza*
4	Sun	Rest day
5	Mon	**Field survey re-commences (am).**
6	Tue	Field work. Ron Shepherd from CALM's Midwest Regional office joins the field team.
7	Wed	Field work Sue Osborne (Marine Ecologist, MCB) arrives in Jurien. Sue will be staying at the APEX accommodation until Friday 9 May.
8	Thu	Field work
9	Fri	**Field survey completed.**. Survey team departs Jurien Bay (~2pm) arrives at Perth (~5pm).

3.3 Resources

i) Marine Conservation Branch budget

Costs

Item	**$**
MCB staff	
Jim Burt	9282
Jeremy Colman	2618
Ray Lawrie	230
Mike Lapwood	6929 (3948 *)
Accommodation ($350/week)	1050 *
Meals (7 persons x 16 days @ $12/person/day)	1344 *
Specialist consultancies	
Field work	
Jane Griffith WAM (4 days @ $300/day)	1200 *
Kevin Bancroft (15 days @ $135/day)	2060 *
Emma Parkes (15 days @ $135/day)	2060 *
Laboratory	
Western Australian Museum staff (@ $400/day)	
Shirley Slack-Smith (Molluscs)	400 *
Di Jones (Crustacea)	400 *
Barry Hutchins (Fishes)	400 *
Loisette Marsh (Echinoderms & hard corals)	400 *
Julia Phillips, EDU (3 days @ $160/day)	480 *
Mat Vanderklift, EDU (3 days @ $160/day)	480 *
Equipment	
Vessel costs *Bidthangara* (15 days @ $400/day)	6000
Fuel (15 days, 2 hr./days @ $25/hr)	750 *
Diving gear hire	250 *
Dive supervisor	3150 *
Photography	100 *
C-CAT underwater video cost (12 days @ $25/day)	300
Vehicles	
Hire costs	
i Toyota Hi-lux, 15 days @) $10/day	150
ii Landrover, 15 days @) $10/day	150
Fuel	500 *
Contingency	1500 *
Sub-total (* funding from MCB operations budget)	**$19 972**
Total cost	**$41 683**

CALM staff resources	Days
Preparation	
Ray Lawrie	1
Jim Burt	7
Mike Lapwood	6
Field trip	
Jim Burt (includes 2 days leave-in-lieu)	18
Mike Lapwood (includes 1.5 days leave-in-lieu)	16.5
Jeremy Colman (includes 1 days leave-in-lieu)	11
Carolyn Minton (MCB volunteer)	16
Gilles Monty (MCB volunteer)	16
Emma Parkes (MCB volunteer)	16
Post field trip	
i Storage and maintenance of equipment (e.g. diving gear etc.)	
Mike Lapwood	1
Gilles Monty	5
ii Sample processing (e.g. faunal samples for WAM, S/G biomass estimates etc.)	
Jim Burt	2
Carolyn Minton	10
Gilles Monty (MCB volunteer)	5
iii Data processing (e.g. *Curation of video footage, hardcopy data sheets and electronic data)*	
Jim Burt	2
Carolyn Minton	10
Preparation of data report	
Jim Burt	10
Carolyn Minton	12
Total	**164.5days**

NB. Salaries are normally multiplied by 1.35 to determine the costs to the MCB and 2.7 for the total cost to CALM.

3.4 Safety

All safety procedures relating to navigation and associated vessel activities, and the personal safety of crew and passengers of CALM's research vessel *Bidthangara* during this field survey are the responsibility of the skipper of the vessel (Mike Lapwood). Alterations to survey procedures based on safety aspects related to weather conditions and sea-state are the responsibility of the skipper of the vessel. Decisions to modify the methods of the field survey will be made by the project leader and dive master, in consultation with the vessel's skipper and the survey team.

The Project Leader has responsibility for ensuring that all field work undertaken by members of the survey team is conducted according to CALM's departmental safety procedures and protocols.

The Dive Master has responsibility for all personnel participating in diving operations and for ensuring that all diving operations are conducted according to the CALM dive code and to an approved dive plan.

The dive plan for this survey has been approved by the departmental diving officer. No decompression dives will be undertaken. Divers are to surface at site buoys where possible particularly if a tender boat, such as a zodiac, is in operation. External participants in this field survey will dive according to their own diving codes of practice where appropriate and are required to sign an indemnity form (CLM 154.

CALM has written to the Jurien Bay Professional Fisherman's Association to provide members with some background and details of the proposed survey and in particular draw their attention to the safety issues associated with CALM's diving operations in that area (Appendix X).

3.5 Emergency contacts

Field team
APEX; Jurien: Ph 096 52 1010, Fx 096 52 1467

Emergency services
Jurien Police: Ph. 096 521 017

Jurien Silver Chain Nursing Post: Ph. 096 521 050

Fremantle Hyperbaric/Diving Service: 09 431 2233 or 09 431 3333

Diving operations
Jurien Bay Dive and Hire: Scott Wuillemin, 096 52 1534

Beagle Island Diving Company (Leeman): Ian Stiles, Ph 099 53 1190, Fx 099 53 1185 fx

Departmental offices
CALM, Moora: Ph. 096 51 1424, Fx 096 51 1698

CALM, Cervantes: Ph. 096 52 7043, Fx 096 52 7340

CALM, Marine Conservation Branch, Fremantle: Ph 09 432 5100

Department of Fisheries, Jurien: Ph. 096 521 048

Radio
Marine HF - channel 2182, 4620. These channels will establish contact with:

VIP Perth radio (09 30 20104), VIC Canarvan radio
Dept of Transport, Jurien Bay Marina: 096 521323

Marine VHF: channel 16 (any station)

CALM VHF: channel 12 Wedge Island
channel 16 Jurien Bay. There will be a hand-held VHF radio at the field station.

3.6 Post field trip

Boats
After the completion of the survey the *Bidthangara* will remain at a berth in the Jurien Bay Fishing Boat Harbour for approximately two weeks before returning to Fremantle, the zodiac will be returned to CALM's Cervantes office and the MCB's 4 m round-about will be trailered back to Perth.

A report briefly summarising the broad outcomes of the field survey in relation to the primary objectives and other important issues such as equipment/maintenance, safety and costings will be provided to the MCB Manager within 2-3 weeks of completing the trip.

Figure 1. Satellite image of the study area, showing the sampling sites and a map of the major benthic habitat types in these waters (from Burt et al., 1997).

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APPENDIX I

Site locations

SITE	LONG DEG	LONG MIN	LAT DEG	LAT MIN
1	114	57.908	-30	-4.705
2	114	58.391	-30	-5.263
3	114	54.233	-30	-4.687
4	114	55.151	-30	-4.728
5	114	57.487	-30	-6.113
6	114	56.629	-30	-7.567
7	114	58.859	-30	-6.816
8	114	58.654	-30	-8.490
9	114	59.885	-30	-9.020
10	114	58.862	-30	-10.450
11	114	55.286	-30	-7.625
12	114	56.518	-30	-10.000
13	114	56.023	-30	-10.580
14	114	58.863	-30	-11.820
15	114	57.707	-30	-12.260
16	114	59.348	-30	-13.880
17	114	57.575	-30	-14.010
18	115	0.182	-30	-14.470
19	114	58.642	-30	-15.840
20	115	1.597	-30	-14.600
21	115	1.518	-30	-16.300
22	115	1.982	-30	-17.260
23	115	1.424	-30	-17.950
24	115	0.270	-30	-18.310
25	114	57.331	-30	-15.910
26	114	58.082	-30	-17.490
27	114	58.585	-30	-17.310
28	114	58.454	-30	-19.260
29	114	59.665	-30	-19.870
30	114	59.059	-30	-20.670
31	115	1.502	-30	-20.850
32	115	1.100	-30	-22.630
33	114	58.142	-30	-21.890
34	114	59.774	-30	-21.900
35	115	1.871	-30	-22.790
36	115	0.421	-30	-24.280
37	115	0.578	-30	-24.710
38	115	2.533	-30	-23.690
39	115	1.549	-30	-25.310
40	115	0.758	-30	-26.240
41	114	59.672	-30	-26.130
42	114	58.318	-30	-25.810
43	115	0.411	-30	-26.970
44	115	2.846	-30	-26.170
45	115	2.239	-30	-27.080
46	115	1.639	-30	-27.580
47	115	3.154	-30	-28.180
48	115	2.545	-30	-29.150
49	115	3.683	-30	-28.960
50	115	0.692	-30	-29.490
51	115	3.392	-30	-29.920
52	115	1.070	-30	-31.040
53	115	2.731	-30	-31.180
54	115	1.375	-30	-30.180

SITE	LONG DEG	LONG MIN	LAT DEG	LAT MIN

55	114	59.390	-30	-30.320
56	114	58.959	-30	-28.470
57	114	59.536	-30	-24.700
58	114	59.071	-30	-23.770
59	114	57.472	-30	-19.270
60	115	0.268	-30	-16.890
61	114	59.414	-30	-15.830
62	114	58.282	-30	-12.200
63	114	59.371	-30	-10.250
64	114	59.435	-30	-23.900
65	114	59.364	-30	-19.310
66	115	0.634	-30	-14.240

APPENDIX II

Fish Data Sheet

FISH DATA SHEET

LOCALITY/AREA		SITE NO		DATE	
SITE DESCRIPTOR		RECORDER			
VIDEO REFERENCE		SLIDE REF			

SPECIES	LENGTH (INCHES)												
	1	2	3	4	5	6	8	10	12	15	20	25	30+

APPENDIX III

Underwater Video System

Operating Instructions

Preparation of underwater housing and video camcorder

Step-by-step instructions on preparing the StingRay SR-700 housing and Blaupunkt CC894 camcorder are given below. This procedure is adapted from the AIMS Standard Operational Procedure Number 2: "Surveys of sessile benthic communities using the video technique" (Christie *et al.,* 1996).

Where possible, store and prepare the equipment at room temperature to prevent condensation on the lenses of the camcorder and housing. Carry out these preparations in a dry, dust and spray-free environment. For more details refer to the relevant instruction manual.

Housing

1) Open the housing by simultaneously releasing and rotating the two black plastic catches at the rear of the housing. Carefully remove the monitor back and place to one side. Remove the camera tray by depressing the small black plastic catch on the left hand side and simultaneously sliding out the tray. Check the inside of the housing for any dust or other particulate matter, and clean out using a lens cloth and blower brush if necessary. Check the inside of the lens and the red filter and clean using blower brush, lens tissues and lens cleaning fluid if necessary. Check which lens is attached to the housing - super wide-angle (the shorter of the two available optics) or zoom-macro. **For transect work the super wide-angle lens is required.**

2) If using the SunRay lighting system, install a fully charged battery in each of the battery pods mounted on both sides of the housing (see StingRay instruction manual).

3) Remove the two O-rings from the monitor back, clean them with lens tissues and check for any cracks or scratches. If there is any damage to the O-rings, discard and replace with new ones. Apply a small amount of silicone grease (2-3 mm) between thumb and index finger and run the O-ring through several times to spread this evenly. Repeat with the second O-ring. **Ensure that you do not use too much grease as this could cause the seal to leak!** Remember that the grease is there to keep the O-rings supple and not to actually form a seal.

4) Clean out each O-ring groove with a cotton bud, and carefully replace the clean and greased O-rings back into the grooves without twisting them. Ensure that there is no particulate matter sticking to the O-rings. The housing is now ready for the camcorder to be inserted.

Camcorder

5) Place the camcorder on a clean, dry, flat surface and attach the StingRay battery adapter to the rear. Attach a fully charged Sony NP-78 battery pack to the battery adapter. Remove the lens cap, check the lens and clean if necessary. Attach a yellow or orange filter if required (see point No. 24).

6) If the housing zoom-macro lens system is being used, attach the zoom-macro adaptor to the front of the camcorder. This accessory lens pushes on in front of the camcorder lens, so that it lies flush with the manual focusing ring.

7) Press the eject switch (small switch with blue button on top of camcorder) and insert a blank Hi 8 video tape into the cassette holder, ensuring that the red copy protection switch is switched off. Close the cassette holder by gently pressing the 'PUSH' mark on the right side - the top section of the cassette holder will then close down automatically. **Do not push it down manually.**

8) Switch the camcorder on by sliding the OPERATE switch (front left side with green button) to CAMERA. Turn the REC switch (rear left side with red button) to STANDBY.

9) Select the camcorder settings. Turn the IMAGE STABILIZER switch (below the AUTO MODE cover on left side) to ON. Open the AUTO MODE cover and set the functions as follows:

FOCUS- the focus mode can be selected when the camcorder is inside the housing.

EXPOSURE - leave the exposure mode in automatic setting (no exposure indicator on the left side of the LCD display).

PROGRAM - select the desired shutter speed by pressing the PROGRAM button. The SPORTS setting (indicated by a running figure on the LCD display) gives a shutter speed of 1/50 to 1/500 of a second. **This will be suitable for most video transect work**. On occasions when camcorder shake may be excessive, or when trying to video fast-

moving subjects such as marine mammals or fish it would probably be better to select the HIGH SPEED setting (indicated by a golfing figure on the LCD display), giving a shutter speed of 1/4000 sec.

WHITE- the white balance setting can be selected when the camcorder is inside the housing (see point No. 18).

10) Ensure the viewfinder lens is removed, and the viewfinder is locked in the down position (see camcorder instruction manual for details).

11) Ensure that the timecode function is switched on (TC displayed on the top right side of the LCD display). If it is off, press the COUNTER/TIMECODE button below the LCD display so that TC is displayed.

12) Mount the camcorder on the StingRay camera tray, ensuring that the camcorder is correctly aligned and that the screw on the bottom of the tray is tightened firmly. Attach the cables from the tray to the camcorder, in the following order:

    i) attach the video cable (yellow label) to the VIDEO OUT plug (front right side), ensuring that it is routed snugly under the base of the battery and inside the camcorder grip strap (otherwise it will not reach the plug);

    ii) attach the power-out cable (green label) from the battery adapter to the DC power jack on the camera tray;

    iii) attach the remote cable (blue label) to the blue REMOTE plug (back right side);

    iv) attach the microphone cable (red label) to the red MIC plug (front right side),ensuring that it is routed under the lens and clear of the camera tray.

13) Slide the camera tray assembly into the grooves in the housing and push forward gently until it will not go in any further. Check that the assembly is locked in place and cannot be withdrawn without depressing the small black plastic locking button at the rear left hand side of the camera tray.

14) Ensure that the two black plastic catches on the outside of the housing are in the vertical position with the slots facing towards you. Place the monitor back onto the rear of the housing, ensuring that the two black plastic guide pins go into the guide holes on the camera tray. Simultaneously rotate the locking catches towards you, ensuring that the stainless steel guide pins on the monitor back enter the slots on the catches. Continue to rotate the catches until they lock in the horizontal position. Inspect around the circumference of the monitor back to ensure that it is properly seated.

15) Assemble the monitor back screen shade and place it in the tracks of the monitor back. Slide it down until it locks in place.

Pre-filming checks

16) Power up the camcorder by sliding the PWR switch (right side rear) towards you and holding it in place for 2 seconds. A green LED comes on at the bottom centre of the monitor back, and the screen display will come on. Check the screen display to ensure that all the camcorder functions are set correctly. At the top right side of the display there should be Hi8 and SP (indicating that the tape is Hi8 format and record mode is set for short play), and STBY (indicating that the camcorder is in standby mode). Underneath these symbols the time code indicator and the remaining tape indicator, will be displayed. At the bottom right side the battery indicator will be displayed. At the top left side there will be a hand symbol (indicating that the image stabilization system is on), and a running figure symbol (indicating that the shutter speed is set to SPORTS mode), and a hand symbol with the letter F inside (indicating that the manual focus mode is on). Check the manual focus by holding the focus switch (left side front) to both N (near) and F (far) positions.

17) To switch to autofocus mode, toggle (push and immediately release) the PWR switch towards you. Do not hold the switch in place or the camcorder will turn off. To return to manual focus mode, toggle the AF switch away from you. Use automatic focus for panoramic shots and manual focus for filming the transects.

18) Toggle the WB switch (left side) towards you repeatedly to change the white balance mode (as indicated by symbols in the top left side of display). The settings available are:

AUTO MODE- (no symbol): automatic white balance setting.

HOLD MODE - (HOLD): the last automatic white balance setting is locked and maintained, even if lighting conditions change.

OUTDOOR MODE - (sun symbol).

INDOOR MODE - (light bulb symbol).

For video transect work the most suitable settings are AUTO or OUTDOOR. Use the OUTDOOR mode in shallow (<3 m) water, on bright sunny days when the water visibility exceeds 8 m. Otherwise, leave the white balance in AUTO mode.

19) If there are any other symbols displayed on the screen check the camcorder instruction manual to determine what they represent.

20) Ensure that the zoom function is set to full wide-angle. Move the zoom switch (right side front) to the W position and hold it there. Check the zoom indicator on the left side of the screen display. (*Note: When using the super wide-angle lens and the auto focus mode, the camcorder will only zoom in and stay in focus for about 50 % of the full range before going out of focus. To zoom in closer than 50 % the zoom-macro lens system should be fitted).*

21) Turn the power off by moving the power/record switch to PWR and holding it there for 5 seconds. the screen display and the green LED will turn off.

22) Check that there is no condensation on the camcorder lens or housing lens. If condensation is present, delay filming until it disappears (approximately 10 minutes). The housing should be kept out of the sun during transport.

23) Once in the water, if visibility is good (>8 m) and transects are in water >3 m deep, slide the red filter down over the lens by turning the knob on the front plate of the housing. If transect is in water <3 m deep, or if the visibility is poor it will probably be necessary to use a yellow or orange filter that screws on to the camcorder, directly in front of the lens.

24) Check the housing for leaks. This may be indicated by a moisture condensation symbol on the screen display (refer to camcorder instruction manual), bubbles coming from the housing, or water droplets visible inside the housing when you look through the housing lens.

25) Before starting to film, check the front of the housing lens for small air bubbles. Gently wipe away any that are present with your hand. Check for air bubbles regularly.

26) If lighting conditions are poor, switch on both SunRay lamps.

27) Turn the power on (move the power/record switch to PWR position and hold it there for 2 seconds) and commence recording (toggle the switch to the REC/STBY position. A red LED will come on at the bottom centre of the monitor back, and the REC symbol will appear at the top left side of the screen display.

Post-dive procedure

28) After every dive immerse the housing in fresh water. Leave it there for 10-15 minutes and wash the controls and monitor back with running water. Remove the monitor back screen shade.

29) Wipe the housing with a clean, dry towel and leave in a clean, dry, airy and salt-free environment to dry completely.

30) Wipe carefully around the rear seal of the housing before opening so that no water gets onto the camcorder. Open the housing by simultaneously rotating the black plastic catches at the rear of the housing. Remove the camera tray assembly by depressing the small black plastic locking button at the rear left side and sliding the tray out. Detach the cables and remove the camcorder from the tray. Attach caps to both housing and camcorder lens. **Do not open the housing where salt spray is present.**

31) Switch the camcorder to video by sliding the OPERATE button to VTR. Rewind the tape using the either the controls on the top of the camcorder or the remote commander. Connect the camcorder to the TV monitor (refer to camcorder instruction manual) and view the footage. Transcribe the system settings and time code information onto the main Video Transect Data Sheet (Appendix II). Label the tape clearly (using a permanent marker pen) with the designated tape number, the site number and the date of recording.

Tape numbering

The video tapes should be consecutively numbered according to the following coding system:

Project acronym (MRIP/SC/)/Site numbers - Date/Tape number (#1 onwards).

Thus, the first tape would be labelled as: **MRIP/SC/F1-5 - 07-10/03/97/TAPE#1**

If the tape contains footage spanning more than one day the tape number should indicate this.

32) A total of three sites should be recorded on each 90 minute Hi8 tape. Before commencing filming at another site, ensure that the tape is wound forward to the end of the footage recorded at the previous site. This will ensure that no data is recorded over accidentally. Once a tape is complete the red copy protect switch on the tape should be switched on to prevent any loss of site data. The tapes should be stored in a waterproof container and duplicated at the end of the field trip.

33) Clean the video heads with the head cleaning cassette after approximately 10 hours of use. Follow the instructions carefully to avoid damage to the video heads. Refer to the camcorder instruction manual for more details.

Recharging the battery packs

34) New batteries should be fully charged and discharged several times before use to prolong their life. The Sony NP-78 batteries should last between 75 and 90 mins, when using the monitor back. Before recharging a used battery, make sure it is fully discharged first (use the REFRESH function on the battery charger or a battery discharger). Once the battery is totally discharged, slide the indicator switch on the top of the battery so that a red dot is visible. This serves as a reminder that the battery is totally discharged. Connect it to a battery charger and charge it completely. This will take approximately 2 hours and 20 minutes for a Sony NP-78 battery. Once it is charged, slide the indicator switch to hide the red dot, indicating that the battery is fully charged and ready to be used. At the end of the field trip, leave all batteries discharged.

APPENDIX IV

Video Data Sheet

VIDEO DATA SHEET

Project	JURIEN BAY MARINE BIOLOGICAL SURVEY			**Field Survey**	April 1997		
Site No.		**Site Location**		**Date**	/ /97	**Recorder**	
Start time		**Finish time**		**Depth (m)**		**Visibility (m)**	

Video System	Blaupunkt CC894 camcorder in StingRay SR-700 housing														
Focus mode				**Exposure mode**				**Program mode**				**White balance mode**			
Auto	☐	Manual	☐	Auto	☐	Manual	☐	Sports	☐	High-speed	☐	Auto	☐	Outdoor	☐
Lens system				**Filters**								**Lights**			
Wide-angle	☐	Zoom-macro	☐	None	☐	Red	☐	Yellow	☐	Orange	☐	On	☐	Off	☐

Video operator		**Tape no.**	MRIP/SC/ /#	**Height above substrate (cm)**	
Time coding for all video footage at site:		**From:**	: : :	**To:**	: : :

Transect time coding	**Start**	**Finish**	**Total time (mins/secs)**
T1	: : :	: : :	.
T2	: : :	: : :	.
T3	: : :	: : :	.

Notes:

APPENDIX V

Invertebrate Data Sheet

INVERTEBRATE DATA SHEET

LOCALITY/AREA		SITE NO		DATE	
SITE DESCRIPTOR		RECORDER			
VIDEO REFERENCE		SLIDE REF			

SPECIES	QUADRAT NO									
	1	2	3	4	5	6	7	8	9	10
DEPTH (m)										
% of Hard Substrate										

APPENDIX VI

Macrophyte Data Sheet

MACROPHYTE DATA SHEET

Locality/area		Site No.		Date	
Site descriptor.				Recorder	
Video reference		Slide ref.			

Species	Quadrat number									
	1	2	3	4	5	6	7	8	9	10

APPENDIX VII

Habitat Data Sheet

HABITAT DATA SHEET

Project	JURIEN BAY MARINE BIOLOGICAL SURVEY			**Field Survey**		APRIL 1997	
Site No.		**Site Location**		**Date**	/ /97	**Recorder**	
Vessel		**Time**		**Weather**			
Sea		**Water depth (m)**		**Water visibility (m)**			
GPS Latitude		**GPS Longitude**		**Differential**			
° ' S		° ' E		**Yes**	☐	**No**	☐
Habitat Type							

Habitat Description

Dominant Species

Sea-grass	
Macro-algae	
Coral	
Fish	
Invertebrates	

Other Features

Impact or Activity

Video reference	MRIP/SC/ /#	**Aerial reference**	/WA /RUN /
Slide reference		**Print reference**	

Marine Conservation Branch, Department of Conservation and Land Management

Habitat Data Sheet Guidelines

To assist with the standardisation of data recording and survey methodologies used in field surveys by CALM's Marine Conservation Branch the following is a brief explanation of the terms and methodologies to be used in the attached habitat data sheet.

Site No: All sites visited were designated a site number. Each site number should begin with F (denoting Fitzgerald) and ends in a number or number/letter combination. It is anticipated that these site numbers will remain with these locations in all future CALM studies and are therefore key designators for any other information or records kept relating to each site.

Site Name: Most sites have been given a name, chosen either as one that is formally recognised (such as a chart location) or a name introduced by the study team to enable quick identification.

Date and Time: This is the date and time at which the data at the site were collected.

Recorder: This is the name of the person who was primarily responsible for the recording of original notes.

Vessel Name: Name of survey vessel.

Weather: The percent cloud cover and wind speed (km/hr) and direction (degrees) were estimated.

Sea: The sea state was described as calm (no wind, calm sea), slight (breeze was influencing surface water), moderate (wind was generating wind waves up to 1 metre) or rough (windy with wind waves greater than 1 metre).

Water Depth: Depths are approximate and were read off an echo sounder.

Water Visibility: This is an estimation of horizontal in-water visibility at the time of observation.

GPS Lat and GPS Long: The GPS coordinates of a site are recorded as degrees, minutes, seconds and decimals of a second. The GPS **must be** setup to use the AGD 66 or AGD 84 datum.

Differential: If a differential GPS was used then 'yes' is noted. GPS readings utilising a differential system allowed for position fixing described by latitude and longitude to within about 3 m or less.

Location of site with ref. to lat/long: On occasions observations were made after swimming some distance from the position of the anchored vessel. Hence, a note of the actual location of the observations and/or visual recordings that were made is given with respect to the latitude and longitude of the anchored vessel.

Habitat description: This is a general note of the habitat type and its percentage cover. As cover can vary within the general vicinity of a site the described percentage cover can have an error of approximately 20%.

Dominant Species: This is a list of the most common or readily observed species of marine life at the site. It reflects what an observer might expect to see when visiting the site in the future. Taxa are usually described to genus .

Other Habitat Notes: Features of interest at or nearby the site are noted.

Activity or Impact Noted: Signs of activity or impacts that were observed at the site are noted.

Video reference: Video image taken of the site is referred to as:

MRIP/SC/F45 - 070397/TAPE#2

MRIP is the program descriptor (Marine Reserve Implementation Study)
SC is the regional descriptor (South Coast)
F45 is the area descriptor (Fitzgerald) and site number
070397 is the date

Photo reference and Slide reference: A photograph or slide image taken of the site is referred to as:

MRIP/SC/F10-150397/01p where:

01 is the photo or slide number
p refers to 'photo' (alternatively *s* refers to 'slide')

Aerial reference: Aerial photographs of the site are referred to as:

5193/WA 2957/RUN39/20.2.91 where:

5193 is the photograph number
WA 2957 is the series number
RUN 39 is the flight run number
20.2.91 is the date that the photograph was taken

APPENDIX VIII

Equipment List

1. Underwater camera equipment

Video system

- 1 Blaupunkt CC894 Hi 8 video camcorders, with battery packs (6), battery chargers (4), battery discharger (2), yellow and orange filters
- 1 StingRay SR-700 underwater video housings with colour monitor backs, super wide-angle and zoom-macro lenses, and built-in red filters
- 1 SunRay underwater lighting system with battery pack (3), battery charger (1), and spare lamps (2)
- Instruction manuals
- 30 Sony professional 90 min Hi 8 video tapes
- Housing O-ring kits and silicone grease
- Cleaning kit
- Sony 8mm camera system (backup)
- Colour monitor

Still photography

- Nikonos V camera, 35 mm lens, SB102 strobe unit, close up kit
- 28 mm lens
- Canon EOS camera and lens
- 40 rolls of 36 exposure slide film
- 20 rolls of 36 exposure print film
- Log books for all cameras
- Kit of camera spares

2. Diving

- 5 SCUBA cylinders
- 5 BCDs
- 3 regulator sets
- 5 weight belts, each with 24 lb of weights
- Spare weights
- 2 u/w torches
- 4 compasses
- 2 masks and snorkels
- 2 pairs of fins
- Spare straps
- 1 underwater viewfinder

Accessories

- 2 dive flags
- Diving spares/repair kit
- Dive compressor with spares/repair kit

3. Sampling

- 5 x 100m weighted and scaled transect lines, with reels
- 3 x 0.50m^2 quadrats
- 3 x 0.50m^2 quadrats, with cross wires
- 3 x 0.25m^2 quadrats
- 3 x 0.1m^2 quadrats
- 6 pairs of clippers
- 40 calico bags
- 3 gear crates
- Pimple floats and lines
- Railway line weights
- 10 catch bags
- Dredge
- 230 m rope

4. Data recording
- 6 underwater slates, grips and pencils
- 300 sheets waterproof paper
- 1 box of rubber bands
- 1 box of pencils

5. Sample preservation
- 6 sorting trays
- 6 plastic screw-top polydrums (20 litre)
- Naly crates with lids (35l, 55l)
- 500 plastic sample containers (250 ml)
- Large sealable plastic bags (various sizes)
- Plastic tie wraps
- Permanent marker pens, rotoring or 'uni-ball micro deluxe waterproof'
- Labels
- Field notebooks
- Stationary
- 70-75% ethanol (60 litres)
- Formaldehyde (3 litres)
- Borax (15 gm)
- Forceps (3 pairs)
- 5 Absorbent paper towels 'kitchen towel'
- Disposable latex gloves
- Engel portable refrigerator
- Sartorius balance
- Magnification lamp
- Binocular microscope
- Plant pressing materials
-

6. Safety
- Comprehensive diving first aid kit
- Emergency response flow-sheet
- Emergency contact flow chart
- Patient information log
- Log sheets for accidents
- Oxygen therapy equipment
- Spare oxygen D cylinder
- Sunscreen

7. Information
- Marine Charts: DMH 171, DMH 422, DMH 628, WA 705, WA728
- Field identification guides for temperate water fishes, macro-algae, seagrasses, benthic invertebrates
- Reference books on temperate Australian seabirds and marine mammals
- CALM GIS habitat maps of the Central West Coast
- Aerial photographs and satellite image of the Central West Coast
- Habitat data log sheets
- Laptop computer and accessories
- 20 high density discs
- Small white-board and marker pens

8. Position Fixing
- 1 Scoutmaster hand held GPS unit, antennae and accessories

9. Mechanical/electrical repairs
- Comprehensive mechanical tool kit
- Comprehensive electrical repair kit
- Equipment log book

10. Accessories

- 20 AA batteries
- 50 D batteries
- 50 C batteries

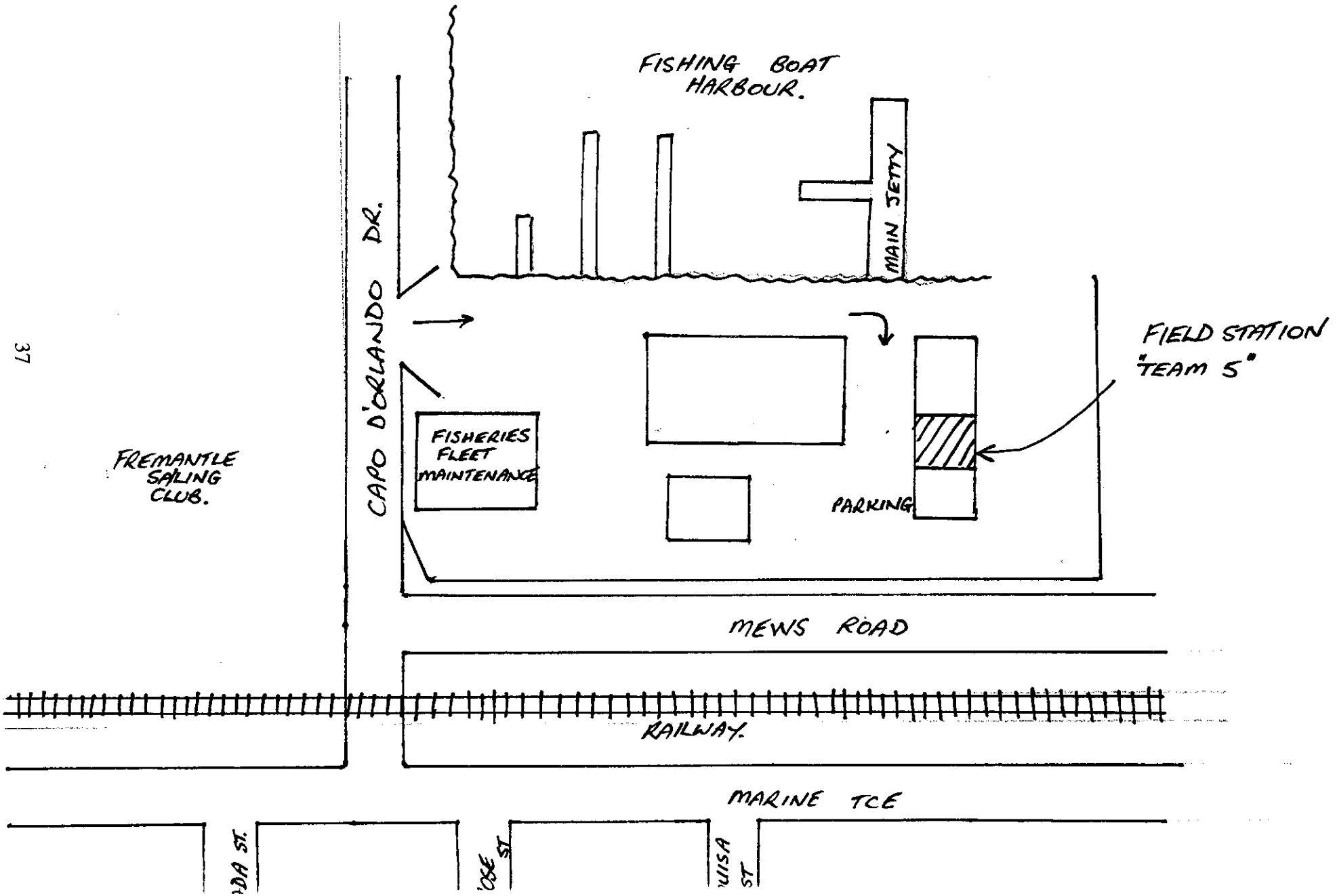
11. Equipment suppliers and relevant contacts

- Scoutmaster GPS: Benchmark, Rob Ferguson, Ph. 08 232 5405

APPENDIX IX

Location of the MCB's Field Station

LOCATION OF CALM, MARINE CONSERVATION BRANCH FIELD STATION



APPENDIX X

Correspondence

038661F4130
Dr Chris Simpson
(09) 432 5100 Fax (09) 430 5408

Marine Conservation Branch
47 Henry Street
FREMANTLE WA 6160

Mr Ian Boyd
President
Central West Coast Professional Fishermen's Association
P O Box 544
JURIEN WA 6516

Dear Ian

I write seeking your co-operation in relation to CALM's activities in the Jurien area over the next month or so.

As you are aware CALM's Marine Conservation Branch is gathering basic scientific information on the marine environment of the Jurien area for input to the community consultative process, via an advisory committee, which will consider the issue of a marine reserve in the Jurien area. Field trips in January concentrated on broad mapping and ground-truthing of the major marine habitats over about 100 km of the central west coast and the validation of computer simulations of water movement between different parts of the Cervantes-Jurien area. These studies were undertaken to ensure the advisory committee will have a better regional ecological perspective of the Jurien area and an adequate understanding of the hydraulic connections between different parts of the proposed area for consideration as a marine reserve. The results of both studies will be available by the end of April.

In particular, I draw your attention to the proposed activities of CALM's Marine Conservation Branch which will be co-ordinating a more detailed biological survey in the Jurien area between 21 April and 9 May. This survey will provide a quantitative biological description of the diversity of the local marine flora and fauna and will provide the 'hard' data for assessing the relative biological importance (in terms of diversity and primary production) of different habitats of the Jurien area. Again this information will be a crucial component of the consultative process mentioned above.

The survey will be carried out from the CALM's vessel, Bidthangara, and smaller runabouts and involve intensive diving operations over the three week period. I would appreciate it if you could inform your members of the timing and nature of this survey and request they take additional precautions when they are in the vicinity of these operations. All CALM vessel and diving operations are required to strictly adhere to departmental codes to ensure adequate levels of safety are being maintained. As such, compressed air diving is closely supervised and dive flags will be clearly visible when diving operations are in progress.

I will ensure you are given a copy of the Field Report, which provides the detailed planning of the proposed survey, before it begins. In the interim, please contact myself or Jim Burt at the above address if you require additional information.

Yours sincerely

Dr Chris Simpson
MANAGER
MARINE CONSERVATION BRANCH

24 November, 1998