

# CRUISE REPORT SS 06/96

November 20 – December 19, 1996

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CSIRO  
AUSTRALIA



MARINE RESEARCH

## ITINERARY

### LEG 2

Departure: Hobart 0900 Wednesday November 20  
Arrival: Eden 1400 Wednesday December 4

### LEG 2

Departure: Eden 1200 Thursday December 5  
Arrival: Hobart 1200 Thursday December 19

## AREA OF OPERATION

The cruise was carried out in waters off the east coast of Tasmania, southeastern Victoria and southern New South Wales between latitudes 36°00'S – 44°00'S and longitudes 144°00'E – 151°00'E.

## RESEARCH BACKGROUND

The research examined ecosystem structure in the South East Fishery region with an emphasis on the relationship of seafloor habitat to fisheries productivity. The continental shelf in eastern Bass Strait and southern NSW in the vicinity of several important commercial fishing grounds was sampled. This was the last in a series of four cruises which provide seasonal coverage for the study.

Biological samples, information on seafloor structure and oceanographic data were collected from the study area in two phases. The first phase, a broad scale survey based on seven cross-shelf transects (Fig. 1), provided information on the primary patterns of distribution and abundance of fish and invertebrate communities. Samples of fish and benthic invertebrates were taken at five sites per transect with a demersal trawl and a benthic sled and camera; phytoplankton and zooplankton were sampled at two sites per transect. Hydrology data were collected at every site, and hydroacoustic data were collected continuously. The second phase was directed at intensive sampling of different habitat types to extend the information gathered in phase one. A towable camera array was used in conjunction with the demersal trawl and benthic sled to sample each habitat. This system provided real-time video to the vessel and 35 mm photographic slides from an in-situ camera. Plankton sampling and pelagic trawling was also carried out at specific sites.

In both phases, the physical association of fish and invertebrate assemblages was determined in relation to the physical character of seafloor habitats and overlying water masses. Relationships between biological species and the habitat they occupy will be determined through analysis of diet, trophic position and morphological adaptation.

Subsequent to the sampling undertaken by the *Southern Surveyor*, the same habitats will be sampled with gill nets and traps deployed from commercial fishing vessels.

A related study is examining the effects of ten years of commercial fishing on the benthic composition and associated fish community off Maria Island, eastern Tasmania. A study site in this area was first examined by CSIRO fisheries scientists in 1984 before the start of commercial trawling. It has been subsequently resampled during cruises SS05/93 and SS05/94. During this cruise an underwater camera was deployed on the benthic sled to photograph the seafloor of the study area.

## CRUISE OBJECTIVES

1. Over a broad area of the continental shelf off eastern Bass Strait and southern NSW:
  - a) determine the summer distribution and abundance of demersal fish species by demersal trawling
  - b) determine the summer distribution and abundance of epifaunal and infaunal invertebrates by sampling with a benthic sled
  - c) identify and determine the distribution of seafloor habitat types through photographic, acoustic, biological and sediment sampling of bottom topography and bottom type, and their associated fish and epibenthic faunas
  - d) determine the characteristics of the primary water masses in the sampling area during the survey
  - e) determine the summer distribution of zooplankton
2. Obtain samples of fish, plankton and seafloor invertebrates for analysis of stable isotopes to identify their positions in the community food web.
3. Sample stomach contents from commercial and other abundant fish species to determine their immediate feeding links and to compare with stable isotope analyses of trophic structure.
4. Collect water column and benthic sediment samples for analysis of phytoplankton pigments and breakdown products.
5. Through an intensive survey of four keys areas determine the composition of the fish and invertebrate communities associated with different habitat types (typically, those associated with acoustically soft, hard and rough bottom), and the overlying water mass(es) by sampling with demersal and pelagic trawls, benthic sled, cameras and acoustics
6. Collect biological samples and photograph fishes for the FRDC-funded 'SEF species guide' and 'seafood guide' projects
7. Collect biological material for collaborative studies with other Australian research institutions and for stock assessment.
8. Collect samples for the SeaWiFS project for use in algorithm development for ocean colour satellite imagery.
9. Collect a range of tissue samples from fishes and invertebrates for a bioprospecting project being undertaken by the Australian Institute of Marine Science.
10. Collect fish for ecomorphological analysis.

## RESULTS

### 1. BROAD-SCALE SURVEY OF THE CONTINENTAL SHELF OFF SOUTHEASTERN VICTORIA AND SOUTHERN NSW – LEG 1

Overall, 31 demersal trawls, 33 benthic sled tows, 33 CTD casts, 33 sediment samples and 14 plankton samples were completed successfully on the transect stations (Appendix 1). (No sampling was attempted in 200 m depth on Transect B where no trawlable bottom was found, or on Transect F where a steeply sloping bottom at the 25 m depth contour was dangerously close to shore.) Two trawls missed on Leg 1 (A3 and D1) were picked up on Leg 2. At all stations the composition of fish catches (total numbers and weights) was recorded by species. The composition of sled catches was recorded by weight, and numbers where possible, of functional taxonomic groups. Many samples of fishes were collected for subsequent biological analysis (Tables 1 and 2).

Zooplankton were collected by bongo and drop nets at all 40 m and 200 m stations. Major species/species groups will be identified in the laboratory and samples used for relative biomass estimation and isotopic analysis. Zooplankton communities will be examined for links with the water masses in which they were found, and for relationships with water column phytoplankton pigments and nutrient levels.

Forms in the shipboard Oracle database were developed to meet the needs of invertebrate sampling, and an interface was developed for the length frequency measuring boards. This permitted the entry and verification of all records for station details, trawl and sled catch compositions, biological and length frequency data at sea.

Acoustic data from the EK500 echosounder were logged continuously throughout the cruise to characterise seafloor types. Transects were run over areas of particular interest which had not been surveyed during previous cruises. These were identified by mapping previous cruise tracks, fishing grounds and recognisable habitat areas in a GIS display.

Two successful trial deployments of the towed camera array (TACOS) were conducted in deep water (>100 m) ahead of its intensive use in similar and greater depths during Leg 2.

Current meter moorings were successfully deployed close the outer edge of Gabo Reef – one just off the reef and one on the reef top. These were retrieved during Leg 2.

## 2. INTENSIVE SURVEY OF DIFFERENT HABITAT TYPES – LEG 2

Three sites had been identified for intensive survey on the second leg based on prior discussions with commercial operators – the Big Gutter off Green Cape; Outer Gabo Reef; and the Big Horseshoe (Everard Reef) off Point Hicks (Fig. 2). Sampling proceeded well on Leg 2 and a fourth site – Broken Reef also off Point Hicks – was sampled in addition. Three habitats at each site – soft or away from reef; hard or close to reef; and rough or reef top – were first identified with acoustics and then sampled with the TACOS. At least the soft and hard habitats were sampled once with the benthic sled and twice with the demersal trawl. Extensive acoustic transecting of the four sites and surrounding areas was used to develop contour maps of bottom type for the survey area. All habitats at the first three sites will be sampled with setnets and traps from a commercial fishing vessel in January.

Biological samples were taken from John dory (*Zeus faber*), bellowsfish (*Macroramphosus scolopax*), ocean perch (*Helicolenus percoides*), redfish (*Centroberyx affinis*), mirror dory (*Zenopsis nebulosus*) and jackass morwong (*Nemadactylus macropterus*) in each habitat (to the extent that fish were available). These samples will be analysed to determine if there are differences in diet for the same species in different habitats. Additional samples were taken where possible to complete the biological collections of Leg 1.

CTDs were taken in lines across the outer edge of Gabo Reef and up the dominant incline of the Big Horseshoe to determine any influence of bottom topography on prevailing water currents. Current moorings deployed at outer Gabo reef on Leg 1 were retrieved successfully and will provide additional information on this influence.

On the way back to Hobart three further commercial fishing sites – the Little Horseshoe, Southeast Reef and Smithy's Corner – were surveyed with the TACOS only. Finally, the benthic sled and Photosea 1000 camera was deployed on Darcy's Patch off Maria Island to determine whether brittlestars were absent just from the area of intensive trawling or from all of this promontory.

### 3. COLLECTIONS FOR STABLE ISOTOPE ANALYSIS

Tissue samples from a diverse range of fish, plankton and seafloor invertebrates were collected for laboratory analysis of stable isotopes. The fish species sampled and the numbers of samples taken are shown in Table 1; many of the invertebrate species sampled await species level identification. Zooplankton were collected in oblique bongo net tows (500 micron mesh) and drop net samples (100 micron mesh) at the 40 m and 200 m stations. Phytoplankton was collected from filtered water samples at the same stations. Analysis of stable isotope ratios will indicate the relative trophic levels of each organism and therefore their position in the community food web. Analysis of stable isotopes and percentages of carbon and nitrogen in the sediment samples should indicate the origins of organic carbon and hence assist in identifying sources of productivity in the system.

### 4. COLLECTIONS FOR DIETARY ANALYSIS

Stomach contents were collected from a diverse range of commercial and other abundant fish species for dietary analysis (Table 1). This work will determine the immediate feeding links and will compliment the results of stable isotope analyses of trophic structure.

### 5. COLLECTIONS FOR PIGMENT ANALYSIS, AND ZOOPLANKTON IDENTIFICATION AND ABUNDANCE

Phytoplankton pigments were taken from filtered water samples and from sediments taken with the benthic sled. Samples were taken from all deployments of both gears and immediately frozen. These samples will be analysed to determine the presence and concentrations of chlorophyll compounds and their breakdown products. This analysis will assist in determining the origin of primary production in the ecosystem, and the organisms responsible for its decomposition. Additionally, there is a possibility that distinct chemical signatures in sediment samples will be associated with different benthic communities.

### 6. COLLECTIONS FOR THE PROJECTS – *HANDBOOK OF AUSTRALIAN SEAFOOD AND UPDATE OF THE FIELD GUIDE TO THE SOUTHEAST FISHERY*

Ten specimens of most target species were collected on SS2/96 for the updated *Field Guide to the Southeast Fishery* and *Handbook of Australian Seafood* projects. These were supplemented with a small number of specimens from trawl catches during this cruise. The material is deposited as vouchers in the CSIRO Munro Fish Collection, retained whole for fillet analysis and used to obtain protein fingerprints for distinguishing between fillets of different species.

Additional specimens of some species were retained for genetic analysis. These will be used to compare closely related species, which are more difficult to distinguish biochemically, using allozyme electrophoresis.

### 7. COLLECTIONS FOR COLLABORATIVE STUDIES AND FOR OTHER INSTITUTIONS

A number of miscellaneous specimen collections were made for collaborative studies, to address requests from workers in other institutions and for stock assessment purposes. Specimens saved from trawl or sled samples were as follows:

- Different size categories of a range of abundant fishes (commercial and non-commercial) for a collaborative project between CSIRO and the Victorian Dept. of Primary Industries to examine mesh selectivity.
- Early settlement stages of morwong (*N. macropterus* and *N. douglasi*) were retained for Dr Barry Bruce, CSIRO Division of Fisheries

- Miscellaneous taxonomic specimens (including *Parapercis* spp. and Brachionichthyidae) were retained for ongoing taxonomic studies by Dr Peter Last, CSIRO Division of Fisheries.
- Live handfish (Brachionichthyidae) for biological studies by Drs Peter Last and Barry Bruce, CSIRO Division of Fisheries.
- Samples of introduced screwshell (*Maoricolpus roseus*) for length frequency measurement.
- A variety of invertebrate species for the Dr Penny Berents of the Australian Museum, Sydney.

#### 8. COLLECT SAMPLES FOR THE SEAWIFS PROJECT FOR USE IN ALGORITHM DEVELOPMENT FOR OCEAN COLOUR SATELLITE IMAGERY.

During leg 1, 72 filtered water samples were taken from 15 stations for pigment analysis and CTD fluorometer calibration. The spectroradiometers (BSI and 'Thunderbird' CSIRO prototype) were successfully deployed on 8 occasions; 37 associated samples for spectral absorption work were collected. In addition, 62 pigment samples were collected for calibration of the underway fluorometer.

#### 9. COLLECT A RANGE OF TISSUE SAMPLES FROM FISHES AND INVERTEBRATES FOR A BIOPROSPECTING PROJECT BEING UNDERTAKEN BY THE AUSTRALIAN INSTITUTE OF MARINE SCIENCE.

During the last four days of Leg 1, frozen and formalin-preserved samples were collected from 141 species of marine invertebrates. Most species were from benthic sled and trawl sampling within the CSIRO study area in the depth range of 25–200 m. In addition, samples were also taken from test deployments of the benthic sled to a depth of 976 m. This material will be screened for useful pharmaceutical or other biochemical properties using a standardised set of assays.

#### 10. COLLECTION OF SPECIMENS FOR ECOMORPHOLOGICAL ANALYSIS

Supplementary specimens of a range of fishes were collected for a study of the relationship of body form to ecology (ecomorphology) (Table 2). Up to five individuals of each of three size classes were needed (small, medium and large specimens based on <30%, 30–70% and >70% max. length), but many had been collected during SS2/96. This study will provide information on morphological and functional adaptations of fishes to their ecological niches and their habitat requirements.

#### ADDITIONAL OBJECTIVE COMPLETED

#### 11. SEAL OBSERVATIONS

Observations of seals were recorded throughout the survey, and details of time, location, depth and gear interactions noted. Seals (probably the Australian fur seal, *Arctocephalus pusillus doriferus*) were observed at times around all the deployed gear types (except the benthic sled). Seals were observed around the sled on previous surveys. Seals were often seen following the trawl net as it was retrieved, and subsequently feeding on discarded fish. Seals also displayed great curiosity around any other deployed gear; however, no seals were caught or entangled.

## CRUISE NARRATIVE

The narrative is maintained as a diary of events; more detailed information will be published when results are analysed.

### WEDNESDAY 20 NOVEMBER

*Southern Surveyor* departed the CSIRO wharf in Hobart at 0900 for first sampling station off Wilson's Promontory in southeastern Victoria. A safety muster and briefing from the Master and a general meeting of the scientific crew to discuss sampling and safety procedures were held whilst steaming to the Tasman Peninsula. Two test deployments of the benthic sled and a pressure test of the CTD bottles were completed successfully en route. However, a problem with data capture from the CTD remains unresolved. Made good headway in small seas.

### THURSDAY 21 NOVEMBER

Conditions remained favourable and we arrived at the first sampling station, the 120 m site on transect A, at 1430. There was sufficient time to complete benthic sled and hydrology sampling at this and the 80 m station before days end. Sampling with the sled progressed smoothly: it was stable during deployment, landed right-way up, and took adequately sized samples. In addition, the Photosea camera deployed with the sled worked well. Catches at both sites indicated an invertebrate fauna dominated by small bryozoans and hydroids on a silty sand substrate. The BSI and Thunderbird fluorometers were deployed successfully, however, the CTD continued to cause problems, recording data on the downcast but not the upcast. A trawl was deployed just before twilight at the 120 m station, but aborted because of a rigging problem. Trawls at these two sites will be picked up later on this leg or on Leg 2.

### FRIDAY 22 NOVEMBER

Steamed into the 40 m station (A2) overnight in strengthening winds. The first trawl, hauled around 0830, contained about 600 kg with jack mackerel (*Trachurus declivis*), Degen's leatherjacket (*Thamnaconus degeni*), butterfly perch (*Caesioperca lepidoptera*) and silver biddies (*Parequula melbournensis*) dominant. The second trawl at the innermost station (A1) was larger (~1500 kg) with broken sponges making up about two thirds of the weight. Dominant fishes included school whiting (*Sillago flindersi*), jack mackerel, Degen's leatherjacket, globefish (*Diodon nichthemerus*) and stingarees (primarily the sparsely-spotted, *Urolophus paucimaculatus*). Broken sponges comprised the bulk of the benthic sled catches at both these stations – photographs from the sled-mounted camera indicating most were about 30–50 cm tall. Picked up Miroslaw Ryba from the charter vessel *Southern Star* at Rabbit Island around 1730 as planned and steamed out to the deep stations on Transect B overnight. Problems with CTD software solved.

### SATURDAY 23 NOVEMBER

Weather fine with calm seas and light winds. Commenced sampling with a trawl on the 120 m station on Transect A. The catch was relatively small (<300 kg) and dominated by cucumberfish (*Chlorophthalmus nigripinnis*) and gurnards (*Lepidotrigla modesta* and *L. mulhalli*). Sampling on Transect B commenced with a trawl shot at the 80 m station (B3) at 0730. The catch was about 300 kg and dominated by barracouta (*Thyrssites atun*). In 120 m, at station B4, a rather similar trawl catch was taken. CTD casts at these stations confirmed the CTD data acquisition system was functioning correctly. After steaming out to the 200 m station (B5), both radiometer samples, CTD cast, and the drop net and bongo samples of plankton were finished by 1500. The same three stations were sampled in reverse order with the benthic sled. An intermittent problem with the camera has caused the loss of some film from the sled shots. Due to the large number of samples taken today, processing of sled samples took until 0030. The trawl at 200 m was squeezed in just before twilight; the catch was sorted but put on ice to be processed the following day.

### SUNDAY 24 NOVEMBER

Weather remains good with bright sunshine and light winds. Work started with the processing of the previous day's trawl catch from 200 m. The catch contained species characteristic of the deep shelf and shelf break, and was dominated by large morwong and three-spined cardinal fish (*Apogonops anomalus*). The remainder of the day was spent taking trawl and sled samples at the 25 m and 40 m stations on Transect B. The shallowest trawl

sample was large: 500 kg containing 46 species. Small jack mackerel, scorpion fish (*Scorpaena papillosa*), juvenile snapper (*Pagrus auratus*) and butterfly perch were most numerous. At 40 m, 40 species were present in a small catch of 187 kg. Scorpion fish, velvet leatherjacket (*Parika scaber*) and silver biddies were dominant. Sled catches at these sites were similar: the substrate comprised large quantities of broken shell in which a small species of scallop, the NZ screw shell and eleven-armed seastars were most numerous. Intermittent problem with the film advance in cameras still evident. Steamed zig-zag transects in a westerly direction overnight to reach Transect C off Pt. Hicks.

#### MONDAY 25 NOVEMBER

Weather still fine: clear sky and virtually no wind. Trawl sampling was on the deeper three stations on the Pt. Hicks transect. A large catch at C5 (1.5 tonnes) was interesting as it included some commercial species – redfish, morwong and gemfish (*Rexea solandri*) – in numbers amongst about a tonne of three-spined cardinal fish. Cucumber fish, mackerel and barracouta were most abundant in another large catch in 120 m (1,250 kg). At 80 m, velvet leatherjackets, silver dory (*Cyttus australis*) and stinkfish (*Synchiropus calauropomus*) were the dominant species in a catch of 487 kg. The sled shot in 200 m had to be done twice after landing upside down on the first deployment. Invertebrate samples at these stations contained many small stringy and lumpy sand sponges and large numbers of live brachiopods in 200 m.

#### TUESDAY 26 NOVEMBER

A passing front has broken our run of fine weather, but conditions remain comfortable. Sampling continued on the inner stations of Transect C. The trawl catch at 25 m was very small (50 kg) and contained mainly small spurdogs (*Squalus megalops*), sparsely-spotted stingarees and jack mackerel. Ruddy gurnard perch (*Neosebastes scorpaenoides*), stinkfish and round-snout gurnard were most abundant in the catch at 40 m. The 40 m sled catch comprised mainly dead shell and gravel, but *Maoricolpus*, sand sponges and bivalves (especially the dog cockle *Glycymeris* spp.) were also evident. Compound ascidians and large bivalves dominated the sled catch at 80 m. Non-linear data from the CTD salinity profiles indicated a problem with the conductivity cell. A replacement was fitted and tested in a deep deployment (2,000 m) during the night. Remaining time during the night was used for sounding transects off Transect D.

#### WEDNESDAY 27 NOVEMBER

Commenced sampling on the outer stations Transect D south of Gabo Island. Trawls were completed at the 200 and 120 m stations, and sleds at these, plus the 80 m station. Three-spined cardinalfish and jack mackerel were dominant in a moderate-sized catch (236 kg) at the 200 m station. In a catch of 281 kg at the 120 m station, cucumber fish and bellowsfish were the most abundant species. Sled samples indicated the seafloor in this region was a muddy sand substrate. Small sponges and ascidians formed the largest fraction of the invertebrate epifauna. Examined the two current meter mooring sites and ran sounding transects over the southern end of Gabo Reef overnight.

#### THURSDAY 28 NOVEMBER

Winds of 35 knots made work uncomfortable today. Most of the inner stations on the Gabo transect were tackled successfully, although the innermost trawl and the radiometer deployments were dropped. A large trawl catch (>600 kg) was taken in 40 m; stingarees (urolophids) and stinkfish were most abundant. At the 80 m station, velvet leatherjacket, round-snout gurnard, cucumber fish, bellowsfish, ocean perch and scorpion fish, were most abundant among the 30 species in the catch. Sled catches at these stations consisted mostly of broken shell substrate with NZ screwshell the most abundant invertebrate. Steamed offshore during the early evening for a trial deployment of the sled in deep water (~1,000 m) – this in preparation for mid-slope sampling planned for January 1997. Used remaining time during the night to run acoustic transects across Gabo Reef.

#### FRIDAY 29 NOVEMBER

Winds moderated overnight and we started sampling on the Disaster Bay transect (E) in a light nor' westerly. The first trawl catch, at the 80 m station, contained about 470 kg. Small scorpaenids (ocean perch and scorpionfish), cucumber fish and stinkfish were dominant among the 39 species present. The following catch in 25 m was small (only 70 kg) and contained mostly sparsely-spotted stingarees and round-snouted gurnards. A larger catch (530 kg) in the last trawl of the day at 40 m contained large numbers of velvet leatherjackets and



school whiting, and also 107 kg of blue warehou (*Seriolella brama*). Steamed to Twofold Bay during the early evening and transferred Alison Turnbull and the AIMS scientist, Carsten Wolff. Due to a gale warning for southern waters we diverted north to start the Bermagui transect (G) the following day.

#### SATURDAY 30 NOVEMBER

Conditions were good at the start of work on Transect G: 5-10 knot easterlies compared to the 25-35 knots forecast for Bass Strait. Two small trawl catches were taken from the inside stations. At 25 m, there were 24 species in the 81 kg catch with juvenile jack mackerel and sparsely-spotted stingarees most numerous. At 40 m, the catch was only 52 kg, with 25 species dominated by stingarees and round-snouted gurnards. Sled catches at these stations showed a sandy/broken shell substrate. Worm tubes (probably *Owenia*) were in abundance with a few *Maoricolpus*. Large numbers of ocean perch, bellowsfish, cucumber fish and velvet leatherjacket occurred in the catch of 22 species at the 80 m station. Two unidentifiable species were also present: an abundant species of *Neosebastes*, and two specimens of a species of flathead. The sled catch at 80 m was dominated by the solitary ascidian *Copracanus*.

#### SUNDAY 1 DECEMBER

The two deep stations were completed today. Only 92 kg of fish were taken in the trawl at 120 m; cucumber fish and bellowsfish were most numerous. At 200 m, a larger catch (260 kg) contained 29 species with three-spined cardinal fish, gargoyle fish (*Caelorinchus mirus*), toothed whiptail (*Lepidorhynchus denticulatus*), and cucumber fish most numerous. The catch also contained many medium-sized redfish and deepwater ocean perch (*Helicolenus barathri*). Sled catches at 120 m were predominantly soft bryozoans and sand sponges. At 200 m, in-sand and compound ascidians were the major items in the sled catch. With this transect finished we steamed a series of zig-zag transects down to the deep stations on Transect E off Disaster Bay.

#### MONDAY 2 DECEMBER

Trawl samples were taken at 120 and 200 m, and sled samples at these plus the 80 m stations. The 120 m trawl sample was about 0.5 tonne and contained mostly large jack mackerel, cucumber fish, bellowsfish and ocean perch. In a smaller catch of about 210 kg at 200 m, the most abundant species were three-spine cardinalfish, cucumber fish and redfish. Sled samples contained large proportions of fine material that took until 0130 to sort. At 80 m, a muddy sand substrate with small sponges, bryozoans and polychaete tube dominated epifauna provided a suitable habitat for handfishes. Thirty four were removed from the sled catch and retained alive for ongoing study of this group by scientists in Hobart. After the final sled sample was aboard we steamed out to the edge of Gabo Reef and successfully deployed both current meter moorings at the predetermined sites. Following this, another test deployment of the sled in deep water was carried out. Addition of ballast to the epifaunal sampling side appeared to improve stability: the sled touched down right-way up in 930 m.

#### TUESDAY 3 DECEMBER

Our run of trouble-free sampling ended with serious damage to the demersal trawl at the 200 m station on the Merimbula transect. Damage included loss of a Scanmar board sensor (being used to measure wingspread at the time), a broken back-strop, damaged sweep wire, and ripped trawl. The replacement trawl and a spare sweep were fitted before sampling continued. As had been pre-arranged, details of the mooring positions were faxed out to the fishing coops and processors in Lakes Entrance, Eden and Bermagui to alert the fishing industry to their whereabouts. We switched to the inner stations, leaving the troublesome outer ones for the last day. Trawl and sled sampling at 40 and 80 m was completed without incident; the 25 m depth is not sampled on this transect due to its proximity to the shore. The trawl catch at 40 m was small (136 kg) but diverse (35 species); no single species dominated, but several were moderately abundant – six-spine leatherjacket (*Meuschenia freycineti*), velvet leatherjacket, sparsely-spotted stingaree, and cuttlefish (*Sepia rex*). A larger catch in 80 m (300 kg) contained 21 species with jack mackerel and bellowsfish abundant. The sled catch at 40 m was primarily soft bryozoans and there were many *Maoricolpus*. Soft bryozoans also dominated the 80-m sled catch, but this time with many echinoids.

#### WEDNESDAY 4 DECEMBER

Sampling started early with a view to arriving in Eden by early afternoon. The first CTD and trawl were completed by 0630 at the 120 m station. Despite the trawl pinning up after 20 minutes no damage was done. A

small catch (42 kg) was dominated by bellowfish and cucumber fish. The repeated shot at the outer station was trouble-free; a large catch (544 kg) contained many redfish and ocean perch, as well as cucumber fish and jack mackerel. Benthic sled samples were moderate in size; the last sample of Leg 1 being processed en route to Eden. Arrived in Eden at 1400 hr and finished work in the wet lab around 1530.

#### THURSDAY 5 DECEMBER

Replacement scientific staff arrived on schedule mid-morning and we departed Eden as planned at 1200. Started a gridded acoustic bottom survey over the northern end of the Gabo Reef (Habitat Area 5) – an area of ridges ('rough' or 'on-reef' or 'Position 3') interspersed with gutters ('hard' or 'near-reef' or 'Position 2') running SSW/WNE trawled by the local fleet, and an adjacent area to the east ('soft' or 'off-reef' or 'Position 1'). It was difficult to directly interpret the echograms for roughness and hardness because of the depth. Consequently the first operation (157), a TACOS deployment, was directed at our standard Disaster Bay 120m transect (E4). This deployment started on rough ground with good coverage of sponge and associated fish just south of the regular trawl transect. We soon came off this rough ground and onto the regular transect, that was comparatively bare.

Continued acoustic bottom transecting overnight to build a good bottom relief and habitat map for this area.

#### FRIDAY 6 DECEMBER

Deployed demersal trawl at 05:30 along transect E4 (158; Position 2). Catch of 198 kg dominated by redfish, cucumber fish, bellowsfish, jack mackerel, and John dory. Stomach samples taken from the same three species examined on the shallow habitat areas on SS2/96 (ocean perch, bellowsfish, john dory) and redfish because of its commercial importance and recognised occurrence around reefs. TACOS transect (159) completed west along 37°18' from west of "Big Gutter" to raised ground and over small gutter identified as exit from "Curly's Hole". No obvious differences between areas indicated as trawled or non-trawled.

Moved east for off-reef (Position 1) comparison. Completed two demersal trawls (160 and 161), with very similar catches (233 and 67 kg) dominated by cucumber fish, bellowsfish, ocean perch, and jack mackerel. Took stomachs on bellowsfish, ocean perch, and redfish, but no John dory were caught.

A TACOS deployment (162) along the same habitat completed the days work.

#### SATURDAY 7 DECEMBER

Started with a sled on Position 1 (163). The catches (infaunal 25.5 kg, epifaunal 24.1 kg) were comprised primarily of Porifera – in sand, Ascidacea – solitary sand, Ascidacea – compound, Echinoidea – irregular and Ascidacea – solitary sand *copracanus*. This sled catch is to be compared with the sled catch at E4 from Leg 1. A demersal trawl on Position 2 (164) resulted in a similar catch (295 kg) to the one the previous morning with cucumber fish, bellowsfish, jack mackerel dominating but fewer redfish and John dory. Dominant elements of the catches were similar positions 1 and 2; however, species diversity was greater at Position 2 (32 and 34 species vs 25 and 18 species) and this included commercial species redfish and john dory.

Wind direction changed to southwest and swell increased to a point where final deployment of TACOS for Position 3 transect was not possible. Therefore headed to outer Gabo reef where the two current meter moorings were deployed on Leg 1 (Area 6). The sled was unsuccessfully deployed near to the reef (Position 2) off the current moorings (165) and the operation repeated (166). The catch (infaunal 8.7 kg epifaunal 12.7 kg) was primarily Porifera – low and encrusting, Porifera – in sand, Ascidacea – solitary sand *copracanus*, and Ascidacea – compound, Ascidacea – solitary sand and Echinoidea – irregular. The sediment sample from this sled should be discarded and is replaced by sled 193.

Two trawls at Position 2 (167 and 168) had catches of 311 and 142 kg with 28 and 30 species respectively. Dominant catch components were cucumber fish, three-spined cardinal fish, bellowsfish and jack mackerel, with ocean perch and redfish present in moderate numbers.

The day concluded with two CTD casts (169 and 170), the first over the reef edge and the second a short distance away from the reef. There was a slight discontinuity in the temperature, salinity and sigma-t profiles at 100 m depth over the reef edge but at 90 m away from the reef.

#### SUNDAY 8 DECEMBER

Started the day with a benthic sled off-reef (Position 1; 171). Infaunal and epifaunal catches (11.2 and 32.1 kg) quite similar. Porifera – in sand was the major component, with lesser amounts of Porifera – bushy, anemones, paguroids, Ascidacea – solitary sand. Ascidacea – compound and Ascidacea *copracanus* were also present in moderate amounts in the epifaunal sample. Porifera – low and encrusting, a dominant component of the near-reefsled sample were absent from this sled sample. Anemones, present in this sample were absent in the near-reef sled sample.

The trawl over the same ground (172) had a relatively good catch (570 kg, 33 species), dominated by cucumber fish, redfish, jack mackerel, ocean perch, bellowsfish and two Whitleys skate (*R. whitleyi*). This was a considerably better catch (including commercial species) than the near-reef trawl shots and there were good 'fish marks' on the sounder during the shot. A TACOS transect in the same area (173) showed a bare soft bottom with many trawl marks. A replicate trawl (174) was relatively disappointing (153 kg, 29 species) dominated by cucumber fish, ocean perch and bellowsfish with no commercial species in quantity.

Two on-reef TACOS transects (Position 3), but back from the edge (175 and 176) completed the day's sampling. The transects showed much more invertebrate macrofauna than off the reef and more fish.

#### MONDAY 9 DECEMBER

Started the day with four bongo net deployments (177, 178, 179 and 181), the first and third on the reef and the second and third off the reef. The data need to be checked for a time effect – there was no noticeable descent of the scattering layer before dawn, so we do not know when this occurred. Also operation 178 was on the surface for 5 minutes before the oblique tow started and descended 10 m deeper than the other tows. A third trawl (180) was completed on Position 2 (to balance any diel variation in the near-reef, away-from-reef comparison). The catch was small (121 kg, 23 species) dominated by cucumber fish, jackass morwong, bellowsfish and ocean perch. There are no obvious differences between the near-reef and off-reef trawl catches.

A TACOS transect (182) started on top of the reef south of the current moorings where there was a similar plentiful invertebrate macroinfauna to the previous on reef transects. As the transect descended over the gently sloping reef edge, the invertebrate macrofauna covering disappeared, suggesting that the presence of abundant invertebrate macrofauna in this area is limited to the reef top.

Four CTD casts in a line across the reef edge (183, 184, 185 and 186), close to the current meter moorings, showed the same 10 m upwards displacement of a discontinuity in the T/S profile off the reef compared to on the reef as the samples the previous day. This discontinuity in the T/S profile was not evident in the two samples 1 nm (approx.) either side of the reef edge.

A MIDOC transect (187) that started over the reef, crossed the reef edge, and finished off the reef had very small catches: a handful of jack mackerel, one small morid cod, several small crustaceans and a quantity of gelatinous zooplankton. The day concluded with acoustic transects in Area 6, before heading north to the "Big Gutter" (Area 5).

#### TUESDAY 10 DECEMBER

Started the day with a repeat sled sample (188) to collect sediment from the off-reef transect (position 1). This was followed by four on-reef TACOS transects (189, 190, 191 and 192; position 3) south of trawl station E4. The first transect made slow headway against a strong southerly current and we gained good footage of the transition from open to close to reef only. The current had strengthened and turned westerly by the time of the second transect and the ship was shifted east of the rough ground. The third transect found a small ridge of rough ground, and the fourth more extensive rough ground. The rough ground was overall fairly flat but with a

moderate (10-25%) coverage of attached macro invertebrates (indicating underlying rock close to the surface), in contrast to the soft ground where there few if any epibenthic macroinvertebrates.

Returned to the Gabo reef site (Area 6) to collect a sediment sample (193) on the near-reef station (position 2), followed by a series of 7 CTDs (194 to 200) taken rapidly to describe fine scale features at the reef interface, with only limited water sampling for calibration. There was a difference in water mass structure on and off the reef, but most interesting was an apparent doming of denser bottom water at the reef edge. Data indicate that there is a substantial passage of water up and over the reef edge, providing an opportunity for fish (and other nekton) to gain energetic advantage, maintaining position in an upward current of potential prey organisms. Final interpretation awaits analysis of current meter data.

#### WEDNESDAY 11 DECEMBER

Moved to the "Big Horseshoe" (Area 7) and deployed the benthic sled (201) along a trawl track following the western lip between an area of rough habitat and the slope (position 2). Epifaunal and infaunal samples (2.2 and 12.8 kg) dominated by Porifera – in sand, with soft Bryozoans and irregular Echinoidea also important in the epifaunal sample. There was only one stalked crinoid in each net. A second sled was deployed (202) in an area west and away from the western lip of the "Big Horseshoe", but at the same depth. This area (position 1) was acoustically soft and separated from the hard ground (position 2) by an area of rough ground. The small epifaunal and infaunal catches (2.8 and 2.9 kg) were dominated by soft bryozoans, octopus, Porifera – in sand/low and encrusting and *Clypeaster australis*. We next went east of the Big Horseshoe to an area known as the "Flower Patch" (position 4) by local fishermen for a second sled (203). Catches were larger (27.9 and 17.2 kg), dominated by Porifera – lumpy, regular echinoderms (pancake urchins) and stalked crinoids. This invertebrate infauna is characteristic of hard bottom, whereas that at positions 1 and 2 are characteristic of soft bottom. Position 2 may be misnamed.

Following the series of benthic sleds, TACOS transects (stations 204-207) were carried out on the four study positions at Big Horseshoe. The first was in an area known as 'The Flower Patch', an area of the outer shelf on the eastern bank of the Horseshoe supporting stalked crinoids (Position 4). Several small, isolated aggregations of crinoids were seen. The second transect followed the sled shot along Position 2 (a commercial trawl tow on hard bottom) on the West Bank. A southerly current progressively set the vessel to the SW, but the sled track and trawl marks were seen on an otherwise fairly bare seafloor. A NW-SE transect was run over Position 3 (an elongate ridge of rough ground immediately to the west of Position 2). It commenced on flat ground with many trawl marks and ran over the crest of the ridge (141 m) and down the steep eastern edge to the trawl ground on the eastern side. Clusters of sponge and stalked crinoids were seen on isolated outcrops of rock around the reef crest. Fishes, including ling and butterfly perches, were associated with these features. A fine silty sediment covered the areas between rock outcrops. Position 1, an area of flat, soft ground to the west of Position 3, was a bare soft substrate. Trawl tracks were observed in several places but invertebrate animals were sparsely distributed. Acoustic transects of Broken Reef were carried out overnight.

#### THURSDAY 12 DECEMBER

Trawls at positions 1 (209) and 2 (208) in Area 7 (Big Horseshoe) were completed before breakfast. Catches were moderate (352 and 333 kg) with 29 species in each. With the exception of jack mackerel in 209 and redfish in 208, catches were very similar and composed primarily of three-spined cardinalfish, cucumber fish and New Zealand dory. Biologicals for comparison between the two sites were taken from jackass morwong, redfish, mirror dory (*Z. nebulosus*) and warehou.

The vessel then steamed to the northeast to Gabo Reef to recover the current meter moorings (210 and 211). Despite a fresh breeze of about 25-30 knots buffeting the vessel during the retrieval operation, both moorings were brought on board safely. A 10-minute, on-reef, benthic sled (212; Position 3) had large epifaunal and infaunal catches (144 and 44 kg) was dominated by Porifera – lumpy and bushy, Bryozoans – fenestrate, and considerable Cnidaria. We returned to Big Horseshoe on a slightly different course and undertook a series of CTD casts (213-219) along the main axis of the canyon during the evening. These started at the southeastern end in about 400 m and progressed at 1 n.m. intervals in a northwesterly direction with the last (seventh) cast

made in about 120 m, shoreward of the canyon's inner rim. There was a gradual change in the depth of the halocline, but not as dramatic as that seen at Gabo reef. Acoustic transects were run over the West Bank and the northeastern rim of Big Horseshoe overnight to fill in areas with sparse coverage.

#### FRIDAY 13 DECEMBER

Second trawls on positions 1 and 2 were repeated before breakfast (220 and 221 – reverse order to yesterday). Catches (489 and 501 kg; 34 and 28 sp.) were again similar and dominated by three-spined cardinalfish, cucumber fish, New Zealand dory, redfish, jack mackerel and warehou.

We then moved inshore to Area 8 ("Broken Reef"), where a sled (222) was directed at hard ground. Major components of the infaunal and epifaunal samples (41.4 and 21.9 kg) were Porifera – low and encrusting, Porifera – lumpy (epifaunal sample only), Ascidacea *copracanus*, Surime seastar, soft bryozoans and paguroids. These fauna indicated soft ground and subsequent contouring of the acoustic bottom data determined that there were only small patches of harder bottom immediately adjacent to soft areas. A TACOS (223) transect over the same area showed patches of sparsely-scattered small and medium-sized sponges interspersed through areas of bare silty sand. Medium-sized sponges included erect branching types and the yellow compact 'football' species. A strong bottom current made the camera array flighty to control, and reduced overall visibility. A trawl (224) over soft ground (Position 1) west of the earlier operations. Due to a delay (shutdown of the main engine at the point of shooting the trawl), the trawl was carried out in twilight conditions. Tow time was reduced to 20 minutes to complete fishing before darkness. A small catch (140 kg) contained 28 fish species among which jack mackerel, rough gurnard, stingarees (mainly the brown stingaree, *U. bucculentus*), cucumber fish and bellowsfish were abundant.

A second TACOS transect (225) completed the day's sampling and we steamed back to Gabo Is overnight to pick up one of the transect stations (D1) missed on Leg 1.

#### SATURDAY 14 DECEMBER

Sampling commenced with a trawl (226) in 25 m – D1 – and the catch was processed as we steamed back to the Broken Reef area. The benthic sled (227) on soft ground (Position 1) contained predominantly small, stringy sponges and relatively small quantities of soft bryozoans and hydroids. This and the silty sand substrate were consistent with the interpretation of the 'soft' bottom from acoustic data. A second trawl (228) on the soft ground had a catch (152kg, 30 spp.) dominated by cucumber fish, grooved gurnard, bellowsfish, velvet leatherjackets and ocean perch. Following this, a trawl (229) was targetted on the hardest ground detected in Area 8 (Position 2). Confirmation that the ground was indeed hard came after 22 minutes on the bottom when the trawl hooked up. Damage was significant (bridles missing from one wing and a parted headline), however, it is all repairable on board if necessary. The small catch (87 kg) contained mostly ocean perch, grooved gurnard, bellowsfish and rough-nosed skate (*Raja* sp. A). This catch was not noticeably different from those on soft ground in this area, although there have been fewer cucumber fish. Comparative biologicals were limited to cosmopolitan dogfish – this will need attention during the commercial boat sampling. Replacement of the trawl was postponed to allow a TACOS drop (230) over the same ground. This commenced at 2230 and showed one area of hard, exposed rock adorned with sponges, several patches of less dense sponge aggregations (coinciding with areas of slightly increased hardness on the sounder), and numerous trawl tracks which criss-crossed through the area. During subsequent transecting it was realised that the largest rock areas had not been seen. These lay to the northeast in two clusters: one, where the trawl pinned up, with a rise of about 6 m, the other in the form of isolated pinnacles rising abruptly by about 10 m.

Continued acoustic transecting overnight and head to Sand Patch Point for a TACOS transect over what had been identified as sponge garden on an earlier cruise.

#### SUNDAY 15 DECEMBER

Acoustic transects over Sand Patch Point showed a ridge of pinnacles (up to 10 m high) extending from the inshore promontory. The TACOS transect (231) aimed at this area showed a flat sandy bottom with scattered sponge, until towards the ridge we came across an area of 2 m high boulders with extensive sponge gardens.

Unfortunately the video recorder had a dirty head and most of this footage was lost. It was interesting to note that the 2 m high boulder field did not show up on the acoustics, presumably because of the patchy nature of the bottom and because the TACOS was set off to the side of the ship. We returned to Area 8 by a different route.

A sled tow (232; 10-minutes to minimise excess catch) on hard ground east of operation 229 (position 2) caught 56.7 and 22.8 kg in the epi- and infaunal nets. The catch was dominated by bushy, lumpy and low and encrusting sponge, with minimal soft bryozoans. This invertebrate fauna is characteristic of hard ground, and quite different from the fauna sampled with the sled on operation 227 (position 1).

A TACOS tow (233) was attempted over the hardest ground in the Broken Reef area after tea. A drift tow was necessary due to strong northeasterly winds. We found that the gear was driven under the boat by a westerly current which was presumably flowing at a greater speed than the boat was drifting. The same thing happened on the second attempt. Due to two potential risks – having the TVP cable go around the prop, or the lighting cable severed by the tow wire as they ran over the corner of the stern ramp together – the tow was called off. Headed south to complete acoustic transects of Big Horseshoe overnight, using an expanded bottom range to capture first and second bottom echoes.

#### MONDAY 16 DECEMBER

Duplicate trawl samples (234 and 235) in the Flower Patch (Area 7; Position 4) were the first operations today. Trawl positions may have been too far removed from the reef edge to pick up the fish associated with this habitat. Catches were small (87 and 125 kg; 24 and 23 spp.), dominated by three-spined cardinal fish in the first trawl and by cucumber fish and gurnards in the second. Mirror dory and jackass morwong were taken for biologicals.

'Fill-in' acoustic transects of Big Horseshoe were completed as we headed westwards leaving the canyon area for the last time. Another fishing ground on the shelf edge – the Little Horseshoe – was the next sampling area. Several sounding runs showed this to be a narrow tongue of hard bottom in about 150 m sloping steeply to a ledge on its seaward perimeter to 180 m and then dropping rapidly to beyond 200 m. A TACOS tow (236) along the main axis to the south touched down in about 160 m and tracked bottom down to the ledge losing contact at a precipitous edge in about 190 m. The bottom for the most part was hard rock with soft sediment covering flat areas; small encrusting sponges were numerous. The rock edge in 190 m was bare, with deep rounded crevices at the margin. From here we headed to South East Reef – possibly the most extensive area of low-relief limestone in the eastern Bass Strait region – for more TACOS sampling. Due to the reef's position in the oil rig "limited access zone" we obtained permission from the Esso control room before arriving. We steered a course to give acoustic records over previously unsurveyed seafloor. Winds freshened and swell increased during the four-hour steam making conditions the worst for a TACOS deployment so far (237). We were able to keep head to wind with about 1.6 knots of speed and took a southerly course over the main body of the reef, dropping over its hard southerly margin. The bottom was variable with flat, bare rock, coarse, rippled sand, *Maoricolpus* aggregations, and spectacular gardens of large lumpy and branched sponges interspersed along our track. Perhaps the best test of the camera system so far, smooth tracking was obtained for much of the tow despite the vessel pitching severely and taking water up the stern ramp. Overnight we steamed south to the 10 x 10 Reef and completed a grid of acoustic transects prior to a planned TACOS drop the following day.

#### TUESDAY 17 DECEMBER

The TACOS operation on 10 x 10 reef (238) was not successful. Acoustic transecting had shown a sharp escarpment running north-south. To maintain steerage into the large swell from the southwest, would have required towing into this sharp escarpment. This was considered too dangerous, so we attempted a drift from the southwest, but the TACOS could not be set straight out off the stern and the deployment was canceled.

The 80 m station on Transect A – a second trawl missing from the broad-scale work on Leg 1 – was picked up late in the morning (operation 239). A medium-sized catch (224 kg) contained only 21 species, but included substantial numbers of commercial species – mostly banded morwong, tiger flathead and silver dory. Other abundant species included velvet leatherjacket, spurdog, grooved gurnard and cucumber fish. A large quantity (33 kg) of the white spider crab *Leptomithrax* sp. was also taken. From here we headed across to another of the key commercial fishing grounds, Smithy's Corner, for the final TACOS shot of the cruise (240). After

considerable transecting we identified a route up a more gently shelving section of this east-west escarpment. The transect started in 160 m and we moved to the southwest at about 1.8 knots. Good footage was obtained as we tracked up the 20 m escarpment (in about a minute). The bottom was bare sand all the way with sparse macrofauna coverage.

This completed sampling in the eastern Bass Strait region and we headed south towards Tasmania at 1500.

### WEDNESDAY 18 DECEMBER

Heading south to Hobart. We made several deployments of the CTD to test sensors on an archival tag and one test deployment of the sled to 1200 m. The sled landed upside down and some damage was done to the camera frame. Test deployments were not given operation numbers. The frame was straightened by the engineers to enable the use of the sled with camera off Maria Island. The sled was deployed (241) on Darcys patch at 2200 with the Photosea 1000. The shot started in 350 m water and went along and down the promontory to end in about 600 m. This should have covered the extent of the commercial trawl grounds in this area. The catch was sorted roughly on deck to obtain specimens that could help in identifying photographed fauna. Anemones, sepunculid worms and a brittlestar were retained.

An unexpected visitor provided a source of great merriment for all scientific staff and crew.

### THURSDAY 19 DECEMBER

Arrived in our home port of Hobart at midday, after passing through the D'Entrecasteaux Channel to maintain the skipper's Port of Hobart pilot exemption.

## SUMMARY

### LEG 1:

A broad-scale sampling program was completed along seven transects between Wilson's Promontory to the south and Bermagui to the north in five depth strata from 25 m to 200 m. Overall, 31 demersal trawls, 33 benthic sled and sediment samples, 33 CTD casts, and 14 plankton samples were completed. The two trawls missed were sampled on Leg 2. Fish assemblage structure will be determined from these data. About 1,800 photographic images of the seafloor from the sled-mounted camera were processed and catalogued on board. Stomach contents were collected from a diverse range of commercial and other abundant fish species for analysis of their immediate feeding links (Table 1). Tissue samples from a diverse range of fish, plankton and seafloor invertebrates were collected for laboratory analysis of stable isotopes to indicate the relative trophic levels of each organism and therefore their position in the community food web (Table 1). Zooplankton communities will be analysed to determine their relationships with hydrology, water column phytoplankton pigments and nutrient levels. Analysis of phytoplankton pigments in plankton samples will determine the presence and concentrations of chlorophyll compounds and their breakdown products to identify the origin of primary production in this ecosystem, and the herbivores responsible for its decomposition. Invertebrate samples from the benthic sled will permit description of the infaunal and epifaunal assemblages at each site. Data and biological material were collected for several other collaborative projects and for other agencies.

Current meter moorings were deployed off the outer edge of Gabo Reef and recovered during Leg 2. Their positions were broadcast to the fishing industry via the key processing companies in Eden, Bermagui and Lakes Entrance.

Acoustic data from the EK500 echosounder were logged continuously throughout the cruise to provide information on seafloor topography and structure. Nighttime acoustic surveys were completed over areas without coverage from previous surveys.

Station details, trawl and benthic sled catch compositions, biological data, and length frequency data (about 22,000 records) for fishes and invertebrates were entered into the Oracle database and checked at sea.

## LEG 2:

Four different areas were identified and mapped with acoustics. From these maps, we identified 3 to 4 distinct habitats in each. We subsequently sampled these habitats with benthic sled, trawl and video. Invertebrate faunas were distinctly different in each habitat (but similar in the same habitat in different areas). Fish faunas were not as distinctly different, although several reef-associated species were taken from hard ground catches. Our extensive biological sampling (dietary and isotopic) may show up differences in fish diets between the habitats. Because we were not able to trawl the rough habitats for fish the same areas will be sampled with setnets and traps from a commercial boat in January 1997.

We obtained good video coverage of several commercial fishing grounds presently fished with traps and setnets but may soon be fished by trawlers, with a potential for alteration of bottom habitat. The TACOS worked well, providing a stable platform for video and still photography over a wide variety of substrate and topography and successfully damped the ships pitching in a large swell.

We were fortunate (with help from the Division of Oceanography) to obtain some very interesting oceanographic data, with moored current meters and CTDs set around Gabo reef, that should go a long way towards explaining the influences of bottom topography on fish distribution in this area. The current meters were retrieved successfully.

The final benthic sled with Photosea 1000 camera across Darcy's Patch, appeared to cover the favoured trawl ground off Maria Island as planned. The pictures will be used to determine the present distribution of brittlestars that have disappeared from the center of this area in the last 10 years.

All catch and biological data were entered on the Oracle database and checked at sea.



**PERSONNEL****LEG**


Dr Alan Williams (Cruise leader/Assist. Cruise Leader)	1, 2
Dr Nic Bax (Cruise leader)	2
Dr Sebastian Rainer (Assist. Cruise leader)	1
Ms Stephanie Davenport	1, 2
Mr Bruce Barker	1, 2
Ms Karen Gowlett-Holmes	1, 2
Dr Vicki Wadley	2
Mr Rudy Kloster	2
Ms Di Furlani	1
Ms Franzis Althaus	1
Mr Mark Lewis	1
Mr Miroslaw Ryba	1
Ms Catriona Macleod	2
Mr Mark Rayner	1
Mr Dave Terhell	2
Mr Matt Sherlock	2
Mr Jeff Cordell	1
Mr Lindsay MacDonald	2
Ms Alison Turnbull (20/11/96-30/11/96)	1
Mr Carsten Woolf (AIMS) (30/11/96-4/12/96)	1
Mr Harold Zenger (US National Marine Fisheries Service)	2

**SHIP'S COMPANY**

Mr Ian Taylor, Master	1, 2
Mr Roger Pepper, First Mate	1, 2
Mr John Boyes, 2nd Mate	1, 2
Mr Bob Agoni, Chief Engineer	1, 2
Mr Rick Miller, 2nd Engineer	1, 2
Mr John Hinchliffe, Electrical Engineer	1, 2
Mr Don Collins, Head Cook	1, 2
Mr Wayne Hatton, 2nd Cook	1, 2
Mr Terry Lightfoot, Chief Steward	1, 2
Mr Kooka Darling	1, 2
Mr Alan Brownlie, Bosun	1, 2
Mr Tony Hearne	1, 2
Mr Mal McDougall	1, 2
Mr Phil Lee	1, 2
Mr Lou Jacomis	1, 2
Mr Graham McDougall	1, 2
Mr Jim Carson	1, 2

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Alan Williams  
Cruise Leaders



Nic Bax

Date: 9/4/97



Chris Fandry  
Acting Chief, CSIRO Marine Research

Date: 28/4/97

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## DISTRIBUTION

Normal distribution

Cruise participants

Ship's company

Ms Toni Daniels

The Director, BRS

Mr Paul Ryan; Mr Alex Fry, AFMA

Dr Dave Smith, Dept. Cons. & Nat. Resources, Queenscliffe

Mr John Moore, Dept. Cons. & Nat. Resources, Lakes Entrance

Mr Steve McCormack, Dept. Cons. & Nat. Resources, Melbourne

Mr Jeff North, Mr Tom Davies & Mr Dennis Sheperd, Lakes Entrance Fishing Co-op

Mr Jason Cottier, SMP, Lakes Entrance

Dr John Glaister, Director, NSW Fisheries

Dr Doug Ferrel, NSW Fisheries Research Institute

Mr P. O'Connor, NSW Fisheries, Sydney

Mr Peter Angel, NSW Fisheries, Eden

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Mr Jeff Nemec, SMP, Eden

Mr Allan Broadhurst, Bermagui Fishing Co-op

Dr Jeremy Lyle, Mr Alan Jordan & Mr Richard McLoughlin, Tas. Dept. Primary Industry & Fisheries

Dr Penny Berents, AMS

Dr Libby Evans-Illidge, AIMS

Table 1. Numbers of fish sampled for biological analysis (stomachs for direct dietary analysis, otoliths, spines and vertebrae for ageing, and muscle for stable isotope analysis of trophic position)

Species	Common name	Species code	Stomachs	Muscle	Otoliths	Verte rae	Spines	Ref. Otoliths
<i>Allomycterus pilatus</i>	Deepwater burrefish	469002	4					
<i>Apogonops anomalus</i>	Three-Spined cardinalfish	311053	39	10				
<i>Bassenago bulbiceps</i>	Swollen-headed conger eel	067012		1				
<i>Caelorinchus australis</i>	Southern whiptail	232001		5	4			
<i>Caelorinchus mirus</i>	Gargoylefish	232003	12					
<i>Callorhynchus milii</i>	Elephantfish	43001				1		
<i>Centroberyx affinis</i>	Redfish	258003	90	25				
<i>Cephaloscyllium laticeps</i>	Swellshark	15001	25	15		1		
<i>Chlorophthalmus nigripinnis</i>	Cucumberfish	120001	50	5				
<i>Cyttus australis</i>	Silver dory	264002	45	20				
<i>Cyttus novaezelandiae</i>	New Zealand dory	264005	20					
<i>Diodon nichthemerus</i>	Globefish	469001	21					
<i>Emmelichthys nitidus</i>	Redbait	345001	19					
<i>Genypterus blacodes</i>	Pink Ling	228002	48	5				
<i>Helicolenus percoides</i>	Ocean perch	287001	152	42				
<i>Heterodontus portusjacksoni</i>	Port Jackson shark	007001				1		
<i>Kathetostoma canaster</i>	Speckled stargazer	400018	3	3				
<i>Kathetostoma laeve</i>	Common stargazer	400003	3		3			
<i>Lepidoperca pulchella</i>	Eastern orange perch	311001			3			
<i>Lepidotrigla modesta</i>	Grooved gurnard	288007	42	21				
<i>Lepidotrigla mulhalli</i>	Round-Snouted gurnard	288008	25	5				
<i>Macroramphosus scolopax</i>	Common bellowsfish	279002	75	7				
<i>Meuschenia freycineti</i>	Six-spined leatherjacket	465036	30	5				
<i>Mustelus antarcticus</i>	Gummy shark	017001				1		
<i>Myliobatis australis</i>	Southern eagle ray	39001				1		
<i>Narcine tasmaniensis</i>	Tasmanian numbfish	28002	11	11		1		
<i>Nemadactylus macropterus</i>	Jackass morwong	377003	64	25				
<i>Neoplatycephalus richardsoni</i>	Tiger flathead	296001	59	20				
<i>Pagrus auratus</i>	Snapper	353001			3			
<i>Paramonacanthus filicarda?</i>					2			
<i>Paratrachichthys sp. 1</i>	Sandpaper fish	255003			5			1
<i>Parika scaber</i>	Velvet leatherjacket	465005	20					
<i>Platycephalus bassensis</i>	Sand flathead	296033	10	10				
<i>Raja sp. A</i>	Longnose Skate	31005	24					1
<i>Rexea solandri</i>	Gemfish	439002						1
<i>Seriotelella brama</i>	Warehou	445005	18	15				
<i>Seriotelella punctata</i>	Spotted trevalla	445006	15	10				
<i>Sillago flindersi</i>	Eastern school whiting	330014	5	5				
<i>Squalus megalops</i>	Cosmopolitan spurdog	20006	66	6		1		
<i>Squatina australis</i>	Australian angel shark	24001	16			1		
<i>Squatina sp. A</i>	Angel shark	024004				1		
<i>Synchiropus calauropomus</i>	Stinkfish	427001	20	10				
<i>Thyrssites atun</i>	Barracouta	439001	16	9				
<i>Trachurus declivis</i>	Jack mackerel	337002	50	25				
<i>Trygonorrhina fasciata</i>	Southern fiddler ray	027002				1		
<i>Trygonorrhina sp. A</i>	Eastern fiddler ray	027006				1		
<i>Urolophus bucculentus</i>	Sandyback stingaree	38001			4	1		
<i>Urolophus cruciatus</i>	Banded stingaree	38002	48	5		1		
<i>Urolophus paucimaculatus</i>	Sparingly-spotted stingaree	38004	46	11		1		
<i>Urolophus sp. B</i>	Unidentified stingaree	38018				1		
<i>Urolophus viridis</i>	Green-backed stingaree	38007	49			1		
<i>Urolophus sp.</i>				5				
<i>Zenopsis nebulosus</i>	Mirror dory	264003	21	5				
<i>Zeus faber</i>	John dory	264004	20	21				
<i>Nototodarus gouldi</i>	Arrow squid	600001	10	5				
<b>TOTAL</b>			<b>1291</b>	<b>367</b>	<b>24</b>	<b>16</b>	<b>0</b>	<b>3</b>

Table 2. Numbers of fish collected for morphometric analysis (small, medium and large specimens based on &lt;30%, 30-70% and &gt;70% max. length).

Species	Common Name	Species Code	Actual sizes collected		
			S	M	L
<i>Cephaloscyllium laticeps</i>	Spotted swellshark	15001	>5<	>1<	>4<
<i>Asymbolus sp. D</i>	Orange-spotted catshark	15024	1	>5<	>5<
<i>Asymbolus analis</i>	Grey spotted catshark	15027	>5<	>5<	
<i>Mustelus antarcticus</i>	Gummy shark	17001		>1<	
<i>Squalus megalops</i>	Cosmopolitan spurdog	20006	2		
<i>Pristiophorus cirratus</i>	Common sawshark	23002		>1<	>2<
<i>Trygonorhina sp. A</i>	Eastern fiddler ray	27006		>1<	>1<
<i>Narcine tasmaniensis</i>	Tasmanian numbfish	28002	>5<		
<i>Raja australis</i>	Sydney skate	31002			>4<
<i>Raja sp.A</i>	Rough-nose skate	31005		>1<	>1<
<i>Pavoraja nitida</i>	Peacock skate	31009			>1<
<i>Urolophus bucculentus</i>	Sandyback stingaree	38001	1	>1<	>2<
<i>Urolophus paucimaculatus</i>	Sparsely-spot stingaree	38002	>5<	>1<	
<i>Aulopus purpurissatus</i>	Sergeant Baker	117001			>1<
<i>Pseudophycis bachus</i>	Red cod	224006			2
<i>Macruronus novaezelandiae</i>	Blue grenadier	227001		>1<	
<i>Caelorhincus australis</i>	Southern whiptail	232002		>1<	
<i>Centroberyx affinis</i>	Redfish	258003			>2<
<i>Zenopsis nebulosus</i>	Mirror dory	264003			3
<i>Cyttus novaezelandiae</i>	New Zealand Dory	264005	1	>1<	>5<
<i>Neosebastes scorpaenoides</i>	Ruddy gurnard perch	287005	1	>1<	>3<
<i>Helicolenus barathri</i>	Deep ocean perch	287008	>5<		
<i>Pterygotrigla picta</i>	Spotted gurnard	288005	>5<	>2<	>1<
<i>Pterygotrigla polyommata</i>	Latchet	288006			3
<i>Lepidotrigla modesta</i>	Grooved gurnard	288007		2	
<i>Neoplatycephalus richardsoni</i>	Tiger flathead	296001	>1<		
<i>P. caeruleopunctatus</i>	Blue-spotted flathead	296007			>2<
<i>Platycephalus bassensis</i>	Sand flathead	296033		2	>2<
<i>Platycephalus aurimaculatus</i>	Gold-spot flathead	296035			>2<
<i>Platycephalus longispinis</i>	Long-spined flathead	296036			>3<
<i>Parequula melbournensis</i>	Silverbelly	349001			>1<
<i>Pentaceropsis recurvirostris</i>	Long snout boarfish	367003			>1<
<i>Zanclistius elevatus</i>	Long finned boarfish	367005			2
<i>Nemadactylus douglasi</i>	Blue morwong	377002	>1<		
<i>Nemadactylus macropterus</i>	Jackass morwong	377003	>2<		
<i>Bodianus sp.</i>	Pigfish	384035		>1<	>1<
<i>Parapercis allporti</i>	Barred grubfish	390001	>5<		>1<
<i>Kathetostoma canaster</i>	Speckled stargazer	400018	3	>2<	
<i>Synchiropus calauropomus</i>	Common stinkfish	427001	>4<		
<i>Rexea solandri</i>	Gemfish	439002	3	5	
<i>Parika scaber</i>	Velvet leatherjacket	465005	>3<		>1<
<i>Nelusetta ayraudi</i>	Chinaman leatherjacket	465006		>1<	>1<
<i>Anoplocapros inermis</i>	Eastern smooth boxfish	466002	>2<		>1<

Fig. 1 Location of transects sampled during broad-scale phase of ecosystem study (Leg 1).

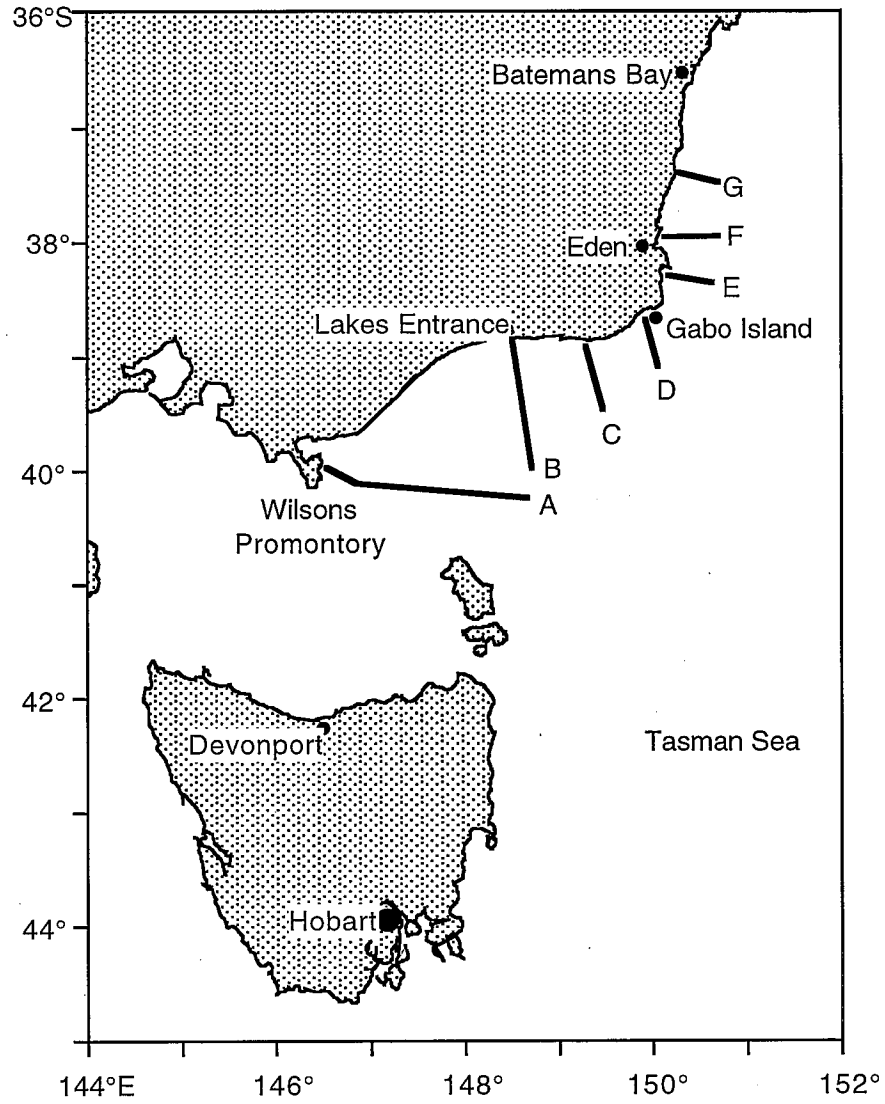
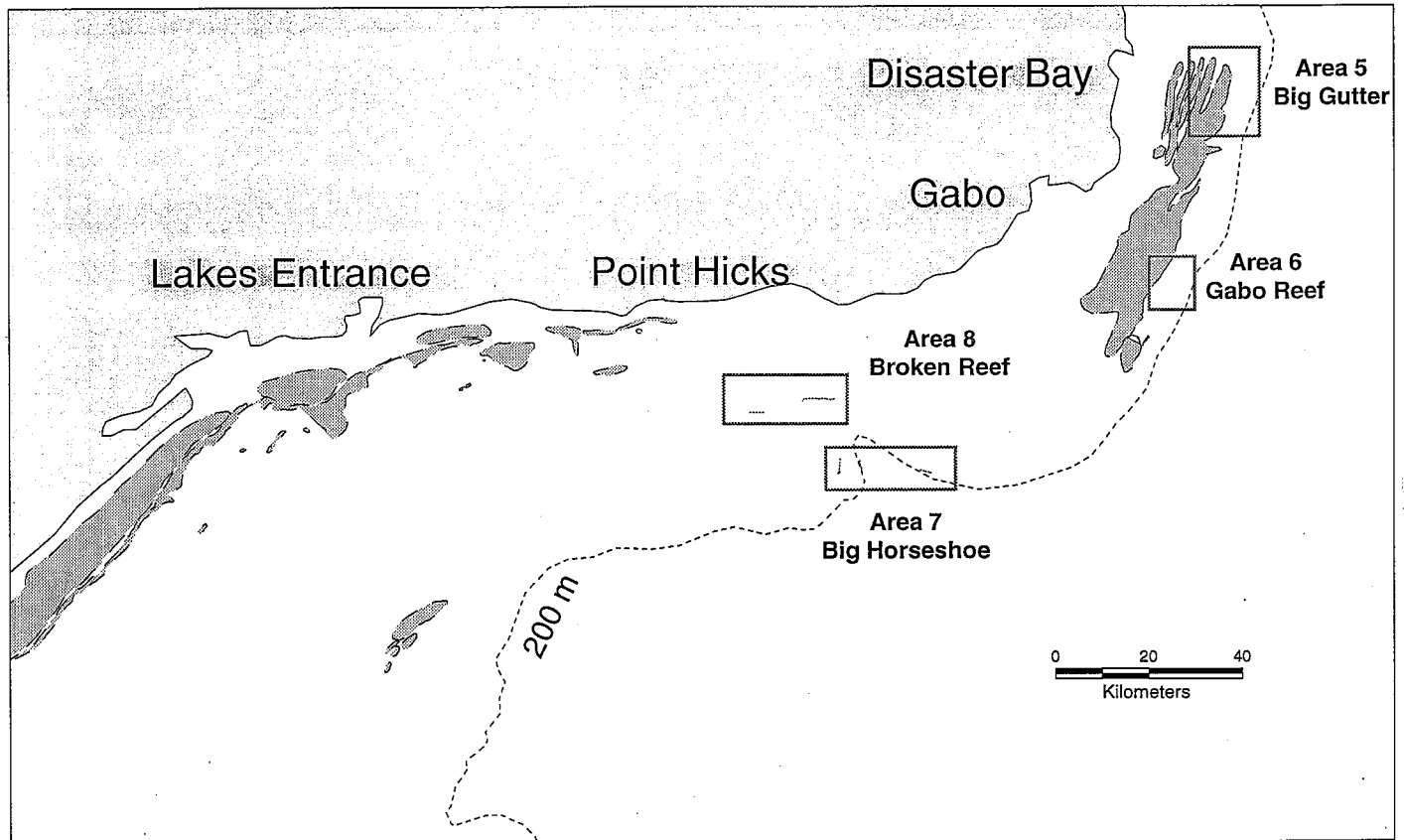


Fig. 2 Sampling locations of intensive survey areas (Leg 2).



## Appendix 1 List of stations sampled, Cruise SS06/96.

Operation number	Date	Start Time	End Time	Operation Name	Transect Name*	Transect Position	Depth (m)	Start Latitude	Start Longitude
1	20-Nov-96	14:30		CTD test	Test				
2	20-Nov-96	18:45	18:52	Sled test			81	42.6100	148.2183
3	20-Nov-96	21:00		CTD pressure test	test		1100	42.3683	148.6050
4	21-Nov-96	14:20	14:50	Benthic sled	A	4	125	38.9933	148.5050
5	21-Nov-96	15:35		BSI cast	A	4	116	38.9467	148.4433
6	21-Nov-96	15:00		Thunderbird cast	A	4	117	38.9667	148.4600
7	21-Nov-96	17:59	18:32	Benthic sled	A	3	82	38.9333	148.3200
8	21-Nov-96	19:00	19:45	CTD cast	A	3	94	38.9167	148.3333
9	21-Nov-96	21:00		CTD cast	A	4	132	38.9783	148.5167
10	22-Nov-96	7:30	8:10	Market Trawl	A	2	41	38.9850	146.6150
11	22-Nov-96	9:00		CTD cast	A	2	41	38.9967	146.5933
12	22-Nov-96	9:20		Plankton Sample	A	2	40	38.9933	146.5883
13	22-Nov-96	9:45		Bongo Net	A	2	34	38.9817	146.5833
14	22-Nov-96	10:30		Market Trawl	A	1	26	38.9633	146.5750
15	22-Nov-96	11:50		BSI radiometer	A	1	25	38.9650	146.5750
16	22-Nov-96	12:10		Thunderbird radiometer	A	1	25	38.9633	146.5750
17	22-Nov-96	12:50		CTD cast	A	1	22	38.9583	146.5683
18	22-Nov-96	14:00	14:40	Benthic sled	A	1	26	38.9683	146.5733
19	22-Nov-96	16:35	16:40	Benthic sled	A	2	39	38.9883	146.6100
20	23-Nov-96	5:45	6:20	Market Trawl	A	4	126	38.9967	148.5234
21	23-Nov-96	8:25		CTD cast	A	3	89	38.7150	148.2734
22	23-Nov-96	9:15	9:55	Market Trawl	B	3	82	38.6983	148.2717
23	23-Nov-96	10:30		CTD cast	B	3	110	38.5517	148.4183
24	23-Nov-96	11:05	11:50	Market Trawl	B	4	113	38.6450	148.3333
25	23-Nov-96	12:50		BSI Radiometer	B	5	225	38.5500	148.4217
26	23-Nov-96	13:00		Thunderbird Radiometer	B	5	232	38.5500	148.4250
27	23-Nov-96	13:40		CTD cast	B	5	261	38.5500	148.4367
28	23-Nov-96	14:20		Plankton Sample	B	5	242	38.5450	148.4500
29	23-Nov-96	14:40		Bongo Net	B	5	264	38.5400	148.4567
30	23-Nov-96	15:20	13:50	Benthic sled	B	5	257	38.5400	148.4317
31	23-Nov-96	16:35	17:05	Benthic sled	B	4	116	38.6267	148.3483
32	23-Nov-96	18:35	19:05	Benthic sled	B	3	83	38.6950	148.2867
33	23-Nov-96	20:25	21:05	Market Trawl	B	5	219	38.5433	148.4167
34	24-Nov-96	5:30	6:20	Market Trawl	B	2	42	37.8983	148.2833
35	24-Nov-96	8:15		CTD cast	B	2	43	37.9100	148.2567
36	24-Nov-96	8:45		Plankton Sample	B	2	40	37.9033	148.2567
37	24-Nov-96	9:15		Bongo Net	B	2	42	37.9117	148.2583
38	24-Nov-96	10:25		CTD cast	B	1	27	37.8550	148.2150
39	24-Nov-96	11:15	11:45	Market Trawl	B	1	26	37.8517	148.2367
40	24-Nov-96	13:25	13:55	Benthic sled	B	1	28	37.8983	148.2383
41	24-Nov-96	14:50		BSI radiometer	B	2	41	37.9250	148.2500
42	24-Nov-96	15:05		Thunderbird	B	2	41	37.9250	148.2500
43	24-Nov-96	15:25		CTD cast	B	2	41	37.9233	148.2467
44	24-Nov-96	18:10	18:35	Benthic sled	B	2	42	37.9067	148.2800
45	25-Nov-96	5:45	6:15	Market Trawl	C	3	70	37.8883	149.0717
46	25-Nov-96	8:30		CTD cast	C	3	69	37.8900	149.0550
47	25-Nov-96	10:10	10:50	Market Trawl	C	4	114	38.0367	149.1067
48	25-Nov-96	11:25		CTD cast	C	4	114	38.0283	149.0567
49	25-Nov-96	13:25	14:20	Market Trawl	C	5	210	38.1983	149.2617
50	25-Nov-96	14:55		BSI Radiometer	C	5	280	38.1900	149.3183
51	25-Nov-96	15:05		Thunderbird	C	5	286	38.1933	149.3200
52	25-Nov-96	15:57		CTD cast	C	5	284	38.1967	149.3117
53	25-Nov-96	16:40	17:30	Benthic sled	C	5	276	38.2000	149.3067
54	25-Nov-96	18:20		Plankton Sample	C	5	242	38.1917	149.2900
55	25-Nov-96	18:40		Bongo Net	C	5	248	38.1967	149.2900



## Appendix 1 List of stations sampled, Cruise SS06/96.

Operation number	Date	Start Time	End Time	Operation Name	Transect Name*	Transect Position	Depth (m)	Start Latitude	Start Longitude
56	25-Nov-96	19:30	20:10	Benthic sled	C	5	230	38.1950	149.2734
57	25-Nov-96	21:00	21:50	Benthic sled	C	4	120	38.0567	149.1567
58	26-Nov-96	5:35	6:15	Market Trawl	C	1	24	37.8083	149.0383
59	26-Nov-96	8:00		CTD cast	C	1	32	37.8150	149.0217
60	26-Nov-96	9:05	9:40	Benthic sled	C	1	25	37.8100	149.0100
61	26-Nov-96	10:30		Plankton Sample	C	3	71	37.8900	149.0667
62	26-Nov-96	11:15		Plankton Sample	C	2	41	37.8267	149.0783
63	26-Nov-96	11:30		Bongo Net	C	2	41	37.8283	149.0817
64	26-Nov-96	11:40		BSI Radiometer	C	2	40	37.8983	
65	26-Nov-96	12:30		CTD cast	C	2	40	37.8283	149.0750
66	26-Nov-96	13:20		Benthic sled	C	2	37	37.8217	149.0867
67	26-Nov-96	14:45	15:15	Benthic sled	C	3	75	37.9017	149.0667
68	26-Nov-96	16:05	16:35	Benthic sled	C	1	22	37.8050	149.0400
69	26-Nov-96	17:10	17:50	Market Trawl	C	2	40	37.8267	149.0883
70	27-Nov-96	0:20		CTD cast	deep test			37.9883	150.3000
71	27-Nov-96	5:45		Market Trawl	D	5	217	37.9367	150.0317
72	27-Nov-96	8:30	9:20	Market Trawl	D	4	129	37.8017	149.9017
73	27-Nov-96	10:30		Plankton Sample	D	5	203	37.9250	150.0283
74	27-Nov-96	10:50		Bongo Net	D	5	205	37.9283	150.0283
75	27-Nov-96	11:35	12:05	Benthic sled	D	5	205	37.9017	150.0400
76	27-Nov-96	12:50		BSI Radiometer	D	5	216	37.8883	150.0433
77	27-Nov-96	13:05		Thunderbird	D	5	217	37.8933	150.0433
78	27-Nov-96	13:45		CTD cast	D	5	220	37.9100	150.0433
79	27-Nov-96	15:25	16:00	Benthic sled	D	4	129	37.8050	149.8967
80	27-Nov-96	16:20	17:00	Benthic sled	D	4	131	37.8283	149.8850
81	27-Nov-96	17:25		CTD cast	D	4	129	37.8000	149.9283
82	27-Nov-96	19:25	19:55	Benthic sled	D	3	79	37.6000	149.8984
83	27-Nov-96	20:30		CTD cast	test		82	37.6050	149.8917
84	28-Nov-96	5:30	6:20	Market Trawl	D	3	84	37.5967	149.9133
85	28-Nov-96	8:05		CTD cast	D	3	95	37.6300	149.9017
86	28-Nov-96	9:35	10:25	Market Trawl	D	2	45	37.5833	149.8950
87	28-Nov-96	11:10		CTD cast	D	2	63	37.6017	149.8700
88	28-Nov-96	11:40		Drop Net	D	2	56	37.5917	149.8867
89	28-Nov-96	12:45		Benthic sled	D	2	44	37.5850	149.8850
90	28-Nov-96	14:20		CTD cast	D	1	28	37.5683	149.8800
91	28-Nov-96	14:40	15:20	Benthic sled	D	1	29	37.5683	149.8833
92	28-Nov-96	16:00		Bongo Net	D	2	41	37.5883	149.8633
93	28-Nov-96	21:10		Benthic sled	deep test		1198	37.3250	150.3867
94	29-Nov-96	5:45	6:15	Market Trawl	E	3	85	37.3150	150.0800
95	29-Nov-96	8:15		CTD cast	E	3	72	37.3067	150.0567
96	29-Nov-96	9:05	9:45	Market Trawl	E	1	25	37.2700	149.9967
97	29-Nov-96	10:30		CTD cast	E	1	26	37.2767	149.9917
98	29-Nov-96	11:00	11:25	Benthic sled	E	1	27	37.2833	149.9883
99	29-Nov-96	11:45		Plankton Sample	E	2	42	37.3200	150.0017
100	29-Nov-96	12:00		Bongo Net	E	2	40	37.3167	150.0000
101	29-Nov-96	12:45	13:15	Benthic sled	E	2	38	37.2967	150.0133
102	29-Nov-96	13:30		BSI Radiometer	E	2	41	37.3083	150.0100
103	29-Nov-96	13:40		Thunderbird	E	2	40	37.3100	150.0067
104	29-Nov-96	14:00		CTD cast	E	2	42	37.3183	150.0033
105	29-Nov-96	15:25		Market Trawl	E	2	37	37.2783	150.0317
106	30-Nov-96	5:30	6:20	Market Trawl	G	1	28	36.3533	150.1283
107	30-Nov-96	8:15		CTD cast	G	1	28	36.3717	150.1117
108	30-Nov-96	8:50	9:30	Market Trawl	G	2	39	36.3650	150.1450
109	30-Nov-96	10:00		CTD cast	G	2	41	36.3600	150.1500
110	30-Nov-96	10:20		Plankton Sample	G	2	41	36.3633	150.1484

## Appendix 1 List of stations sampled, Cruise SS06/96.

Operation number	Date	Start Time	End Time	Operation Name	Transect Name*	Transect Position	Depth (m)	Start Latitude	Start Longitude
111	30-Nov-96	10:45		Bongo Net	G	2	43	36.3667	150.1484
112	30-Nov-96	11:20	11:55	Benthic sled	G	2	45	36.3667	150.1517
113	30-Nov-96	12:40	13:16	Benthic sled	G	1	30	36.3667	150.1150
114	30-Nov-96	14:20		Benthic sled	G	3	78	36.3550	150.1567
115	30-Nov-96	16:00	16:50	Market Trawl	G	3	78	36.3950	150.1800
116	30-Nov-96	20:25	21:10	Video Transect	test		40	36.3400	150.1750
117	1-Dec-96	5:50	6:30	Market Trawl	G	5	220	36.4750	150.2133
118	1-Dec-96	8:25		CTD cast	G	5	252	36.4800	150.3050
119	1-Dec-96	9:35	10:25	Market Trawl	G	4	118	36.4650	150.2167
120	1-Dec-96	11:30	12:10	Benthic sled	G	4	118	36.4617	150.2167
121	1-Dec-96	12:42		CTD cast	G	4	123	36.4817	150.2150
122	1-Dec-96	13:45		Plankton Sample	G	5	252	36.4833	150.3033
123	1-Dec-96	14:15		Bongo Net	G	5	211	36.4700	150.3033
124	1-Dec-96	14:55	15:40	Benthic sled	G	5	206	36.4650	150.3033
125	1-Dec-96	16:45		CTD cast	G	3	67	36.3967	150.1683
126	1-Dec-96	20:50	21:26	Video Transect	test		115	36.9533	150.2133
127	2-Dec-96	5:30	6:30	Market Trawl	E	5	155	37.4600	150.2583
128	2-Dec-96	8:15		CTD cast	E	5	156	37.4433	150.2683
129	2-Dec-96	10:15	11:00	Market Trawl	E	4	118	37.3300	150.2133
130	2-Dec-96	12:35	13:10	Benthic sled	E	3	79	37.2867	150.0717
131	2-Dec-96	14:00		CTD cast	E	4	112	37.3150	150.1900
132	2-Dec-96	15:30		Benthic sled	E	4	112	37.3383	150.2100
133	2-Dec-96	16:15		Plankton Sample	E	5	164	37.4200	150.2817
134	2-Dec-96	16:40		Bongo Net	E	5	155	37.4200	150.2817
135	2-Dec-96	18:10		Benthic sled	E	5	154	37.4200	150.2750
136	2-Dec-96	21:23		Mooring (entered as grab)	off reef		130	37.7217	150.0517
137	2-Dec-96	21:34		Mooring (entered as grab)	on reef		114	37.7217	150.0433
138	2-Dec-96	23:10	23:50	Benthic sled	deep test		932	37.7117	150.3217
139	3-Dec-96	5:30		Market Trawl	ABORT	5	210	36.8700	150.3117
140	3-Dec-96	13:40		Market Trawl	F	2	43	36.9217	149.9633
141	3-Dec-96	14:35		CTD cast	F	2	50	36.9250	149.9633
142	3-Dec-96	15:00		Plankton Sample	F	2	49	36.9467	149.9767
143	3-Dec-96	15:15		Bongo Net	F	2	48	36.9450	149.9750
144	3-Dec-96	16:00	16:45	Market Trawl	F	3	72	36.9483	150.0483
145	3-Dec-96	16:15		CTD cast	F	3	70	36.9650	150.0567
146	3-Dec-96	18:10	18:40	Benthic sled	F	3	74	36.9850	150.0500
147	3-Dec-96	19:30	20:00	Benthic sled	F	2	41	36.8950	149.9633
148	3-Dec-96	0:10		Benthic sled	deep test		976	36.9100	150.3617
149	4-Dec-96	5:05		CTD cast	F	4	120	36.9150	150.2233
150	4-Dec-96	5:45		Market Trawl	F	4	119	36.9333	150.2217
151	4-Dec-96	7:50		CTD cast	F	5	147	36.8400	150.3050
152	4-Dec-96	8:35	9:10	Market Trawl	F	5	140	36.8567	150.2983
153	4-Dec-96	9:50		Plankton Sample	F	5	140	36.8717	150.2983
154	4-Dec-96	10:00		Bongo Net	F	5	140	36.8717	150.2967
155	4-Dec-96	10:40	11:10	Benthic sled	F	5	140	36.8633	150.3000
156	4-Dec-96	11:45	12:20	Benthic sled	F	4	120	36.9233	150.2183
157	5-Dec-96	20:52	21:50	Video Transect	Area 5	soft /hard	117	37.3350	150.2150
158	6-Dec-96	5:15	6:00	Market Trawl	Area 5	hard	116	37.3283	150.2117
159	6-Dec-96	10:24	11:55	Video Transect	Area 5	soft	110	37.2983	150.2117
160	6-Dec-96	14:05	14:48	Market Trawl	Area 5	soft	126	37.3383	150.2683
161	6-Dec-96	15:35	16:22	Market Trawl	Area 5	soft	125	37.3000	150.2883
162	6-Dec-96	19:50	21:20	Video Transect	Area 5	soft	129	37.3533	150.2617
163	7-Dec-96	4:05	4:28	Benthic sled	Area 5	soft	125	37.3167	150.2833
164	7-Dec-96	5:05	6:15	Market Trawl	Area 5	hard	115	37.2900	150.2783
165	7-Dec-96	14:05	14:30	Benthic sled	ABORT		133	37.7667	150.0667

## Appendix 1 List of stations sampled, Cruise SS06/96.

Operation number	Date	Start Time	End Time	Operation Name	Transect Name*	Transect Position	Depth (m)	Start Latitude	Start Longitude
166	7-Dec-96	15:00	15:40	Benthic sled	Area 6	hard	139	37.7333	150.0633
167	7-Dec-96	16:05	17:15	Market Trawl	Area 6	hard	133	37.7867	150.0617
168	7-Dec-96	19:15	19:50	Market Trawl	Area 6	hard	132	37.7333	150.0667
169	7-Dec-96	21:53	22:19	CTD cast	Area 6	on edge	116	37.7200	150.0483
170	8-Dec-96	23:25	0:13	CTD cast	Area 6	off edge	137	37.7250	150.0800
171	8-Dec-96	4:20	4:45	Benthic sled	Area 6	soft	142	37.7233	150.1100
172	8-Dec-96	5:30	6:15	Market Trawl	Area 6	soft	138	37.7600	150.1000
173	8-Dec-96	14:27	15:45	Video Transect	Area 6	soft	138	37.7483	150.1033
174	8-Dec-96	16:50	17:35	Market Trawl	Area 6	soft	137	37.7217	150.1150
175	8-Dec-96	19:26	21:15	Video Transect	Area 6	rough	108	37.7617	150.0050
176	8-Dec-96	22:36	0:01	Video Transect	Area 6	rough	108	37.7250	150.0167
177	9-Dec-96	4:42	5:00	Bongo Net	Area 6	rough	116	37.7117	150.0483
178	9-Dec-96	5:18	5:48	Bongo Net	Area 6	soft	130	37.7183	150.0550
179	9-Dec-96	6:05	6:45	Bongo Net	Area 6	rough	117	37.7300	150.0467
180	9-Dec-96	8:15	9:05	Market Trawl	Area 6	hard	132	37.7150	150.0600
181	9-Dec-96	9:35	10:00	Bongo Net	Area 6	soft	132	37.7467	150.0517
182	9-Dec-96	13:28	14:42	Video Transect	Area 6	soft/rough	113	37.7283	150.0417
183	9-Dec-96	15:19	15:42	CTD cast	Area 6		113	37.7233	150.0367
184	9-Dec-96	16:40	17:03	CTD cast	Area 6		130	37.7217	150.0533
185	9-Dec-96	18:29	18:52	CTD cast	Area 6		115	37.7233	150.0300
186	9-Dec-96	19:27	19:54	CTD cast	Area 6		133	37.7217	150.0767
187	9-Dec-96	21:37	22:15	Midoc Sampling	Area 6	over edge	115	37.7217	150.0133
188	10-Dec-96	4:30	5:00	Benthic sled	Area 5	soft	123	37.3117	150.2783
189	10-Dec-96	5:56	9:00	Video Transect	Area 5	rough	111	37.3217	150.2200
190	10-Dec-96	9:00	10:29	Video Transect	Area 5	rough	111	37.3300	150.2183
191	10-Dec-96	13:38	14:10	Video Transect	Area 5	rough	112	37.3333	150.2167
192	10-Dec-96	15:05	16:02	Video Transect	Area 5	rough	111	37.3417	150.2150
193	10-Dec-96	20:50	21:30	Benthic sled	Area 6	hard	128	37.7100	150.0600
194	10-Dec-96	21:56	22:05	CTD cast	Area 6		115	37.7267	150.0367
195	10-Dec-96	22:23	22:31	CTD cast	Area 6		115	37.7283	150.0417
196	10-Dec-96	22:43	22:54	CTD cast	Area 6		130	37.7267	150.0483
197	11-Dec-96	23:10		CTD cast	Area 6		132	37.7300	150.0533
198	11-Dec-96	23:30		CTD cast	Area 6		134	37.7267	150.0550
199	11-Dec-96	23:55	0:02	CTD cast	Area 6		132	37.7233	150.0767
200	11-Dec-96	0:27	0:35	CTD cast	Area 6		111	37.7217	150.0217
201	11-Dec-96	6:00	6:33	Benthic sled	Area 7	hard	152	37.3233	150.2183
202	11-Dec-96	8:30	9:05	Benthic sled	Area 7	soft	151	38.1317	149.2883
203	11-Dec-96	11:10	11:40	Benthic Sled	Area 7	crinoid	159	38.1383	149.5317
204	11-Dec-96	13:22	14:51	Video Transect	Area 7	crinoid	170	38.1350	149.5200
205	11-Dec-96	16:37	17:43	Video Transect	Area 7	hard	154	38.1267	149.3467
206	11-Dec-96	19:12	20:41	Video Transect	Area 7	rough	148	38.0933	149.2983
207	11-Dec-96	21:54	23:12	Video Transect	Area 7	soft	146	38.0833	149.2950
208	12-Dec-96	5:25	6:05	Market Trawl	Area 7	hard	155	38.1300	149.3450
209	12-Dec-96	6:38	7:30	Market Trawl	Area 7	soft	150	38.1150	149.3150
210	12-Dec-96	13:15	13:15	Mooring Recovery	off reef		130	37.7150	150.0500
211	12-Dec-96	13:32	13:40	Mooring Recovery	on reef		114	37.7200	150.0433
212	12-Dec-96	15:20	15:35	Benthic sled	Area 6	rough	108	37.7533	150.0050
213	12-Dec-96	20:20	20:45	CTD cast	Area 7		487	38.1183	149.4183
214	12-Dec-96	21:07	21:28	CTD cast	Area 7		404	38.1150	149.4083
215	12-Dec-96	21:49	22:03	CTD cast	Area 7		303	38.0850	149.3867
216	12-Dec-96	22:25	22:33	CTD cast	Area 7		177	38.0650	149.3667
217	12-Dec-96	22:53	22:58	CTD cast	Area 7		131	38.0483	149.3600
218	13-Dec-96	23:00		CTD cast	Area 7		117	38.0333	149.3600
219	13-Dec-96	23:40	0:08	CTD cast	Area 7		117	38.0133	149.3533
220	13-Dec-96	5:08	6:05	Market Trawl	Area 7	soft	146	38.1467	149.2950

## Appendix 1 List of stations sampled, Cruise SS06/96.

Operation number	Date	Start Time	End Time	Operation Name	Transect Name*	Transect Position	Depth (m)	Start Latitude	Start Longitude
221	13-Dec-96	7:00	8:00	Market Trawl	Area 7	hard	153	38.1300	149.3417
222	13-Dec-96	11:25	12:05	Benthic sled	Area 8	hard	112	37.9717	149.2717
223	13-Dec-96	15:10	16:35	Video Transect	Area 8	soft	110	37.9567	149.2467
224	13-Dec-96	16:50	21:14	Market Trawl	Area 8	soft	107	37.9817	149.0867
225	13-Dec-96	22:14	23:26	Video Transect	Area 8	soft?	107	37.9800	149.0667
226	14-Dec-96	5:33	6:15	Market Trawl	D	1	24	37.5833	149.8067
227	14-Dec-96	11:58	12:20	Benthic sled	Area 8	soft	110	37.9983	149.0883
228	14-Dec-96	14:25	14:55	Market Trawl	Area 8	soft	110	38.0000	149.0883
229	14-Dec-96	18:00	20:00	Market Trawl	Area 8	hard	107	37.9367	149.2967
230	14-Dec-96	22:18	0:11	Video Transect	Area 8	soft-rough	107	37.9400	149.2583
231	15-Dec-96	10:18	11:58	Video Transect	Area 8A	rough	72	37.7633	149.5850
232	15-Dec-96	14:30	14:45	Benthic sled	Area 8	hard	111	37.9383	149.2650
233	15-Dec-96	18:08	21:30	Video Transect	ABORT			37.9367	149.2717
234	16-Dec-96	5:05	6:00	Market Trawl	Area 7	crinoid	150	38.1283	149.5567
235	16-Dec-96	8:00	8:45	Market Trawl	Area 7	crinoid	147	38.1133	149.5850
236	16-Dec-96	16:40	15:10	Video Transect	Area 9		157	38.3033	148.7050
237	16-Dec-96	21:20	22:50	Video Transect	Area 10		62	38.4467	148.2550
238	17-Dec-96	6:07	18:15	Video Transect	ABORT		120	38.5433	148.3917
239	17-Dec-96	11:00	11:45	Market Trawl	A	3	80	38.9150	148.3000
240	17-Dec-96	14:30	15:20	Video Transect	Area 12		146	38.8717	148.3950
241	18-Dec-96	23:00	23:46	Benthic sled	Maria Island		338	42.6983	148.4067

\*A= Wilsons Promontory; B= Lakes Entrance; C=Pt. Hicks; D= Gabo; E= Disaster Bay; F= Merimbula; G= Bermagui