

FRANKLIN

National Facility
Oceanographic Research Vessel

Tasmania - coastal, shelf and slope currents.

RV FRANKLIN

CRUISE SUMMARY

CRUISE FR 10/97

Leg 1:

Sail: Townsville, QLD 1000 hours Tuesday 25 November, 1997

Arrive: Hobart, TAS 1045 hours Tuesday, 3 December, 1997

Leg 2:

Depart: Hobart, TAS 1500 hours Tuesday, 3 December, 1997

Dock: Bell Bay, TAS 1000 hours Tuesday, 9 December, 1997



PRINCIPAL INVESTIGATOR

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Research voyage FR10/97 — Summary

Prepared by George Cresswell

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ITINERARY

FR10A/97

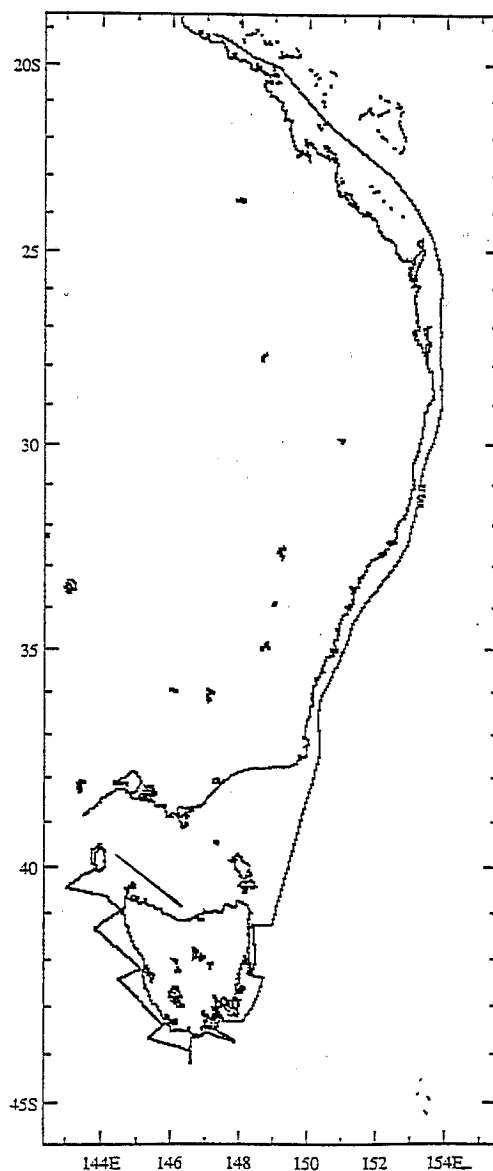
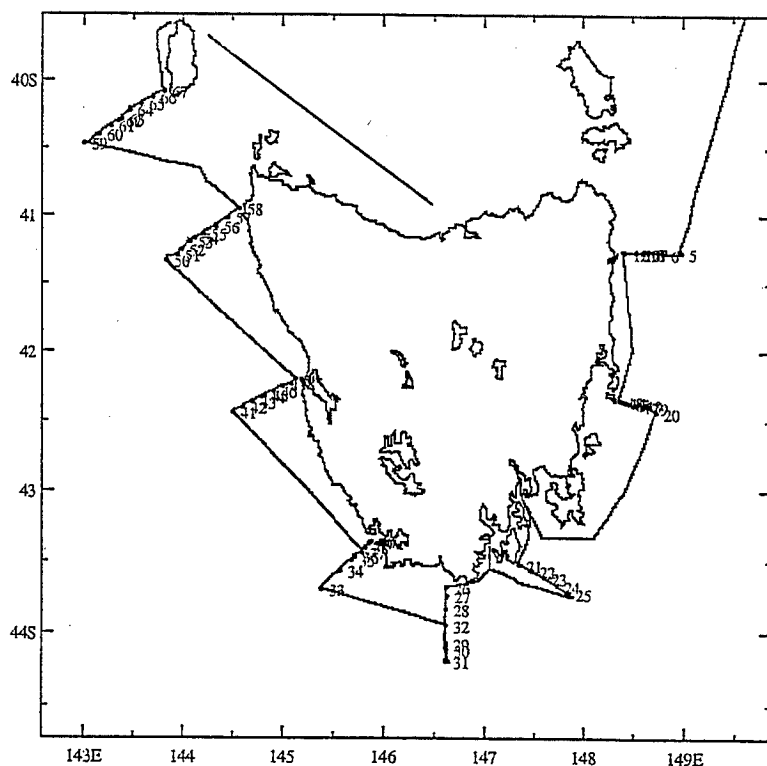
Dep Townsville 1000h 25 November 1997

Arr Hobart 1045h 3 December 1997

FR10B/97

Dep Hobart 1500h 3 December 1997

Arr Bell Bay 0800h 9 December 1997



Ship's complement

"...in a sense, all sailors belong to the one family: all descended from that adventurous and shaggy ancestor who, bestriding a shapeless log and paddling with a crooked branch, accomplished the first coasting trip in a sheltered bay ringing with the admiring howls of his tribe".

Joseph Conrad "The Mirror of the Sea".

SHIP'S OFFICERS AND CREW

Master	Dick Dougal	1st Mate	Arthur Staron
2nd Mate	Allan McCarthy	C/Eng	Dave Lewis
1/Engs	Greg Pearce ^{FR10A} Dave Jonkers ^{FR10B}	Elec/Eng	Andrew McLagan
Bosun	Jannik Hansen	AB	Wayne Browning
AB	Norm Marsh	AB	Gerry O'Halloran
Greaser	Les Clark	C/Cook	Garry Hall
2nd Cook	Peter Dux	C/Stwd	Ron Culliney

SCIENTIFIC PARTY

FR10A/87

George Cresswell	DMR
Erik Madsen	ORV
Helen Beggs	ORV
Jeff Cordell	DMR
Lindsay MacDonald	DMR
Mark Rayner	ORV
Rebecca Deed	ORV
Bill Emery	University of Colorado / CSIRO
Bob Edwards	CSIRO Retired Fellow
Peter Davies	Southern Cross University
Kristen Davey	AODC
Chris Aiken	UNSW

FR10B/97

George Cresswell	DMR
Erik Madsen	ORV
Helen Beggs	ORV
Mark Rayner	ORV
David Terhell	ORV
Michele Hollister	University of Tasmania
Guy Gersbach	University of WA
Denis Abbott	DMR, but representing RAOU
Russell Bradford	DMR (plankton)
Alison Turnbull	DMR (ocean colour)
Kylie Brown	DMR
Alison Walker	DMR

NARRATIVE

The ship sailed on time at 1000 on Tuesday 25 November and shortly after there was a boat muster and talks by the Master and Chief Scientist. The morning saw the activation of the computers and underway instrumentation, the installation on the wings of the bridge of radiometers for satellite sea surface temperature calibration, and the commencement of underway sampling for chlorophylls. The ship headed roughly southeastward into 20 knot trade winds. As it is about 1/12 of the way around the globe from Townsville to Hobart, we were hoping for favourable currents and winds further into the voyage.

The ship's ADCP showed the response of the GBR lagoon and Capricorn Channel to the semi-diurnal tides, with tidal currents of up to 1 knot. The open ocean swell could be detected some 100 km before we reached the shelf edge by the regular pitching and the snarling noises in the hawsepipes. On Wednesday 26 November we spent 3 hours checking the ship's gyro and steering various courses to calibrate the ADCP.

We passed east of Broad Sound, which has the biggest tides in Australia (11 metres). Matthew Flinders correctly opined that these were due to the incoming tidal wave entering two passages in the Great Barrier Reef and interfering at the Sound to give the large tidal range. A tidal bore, according to the "Australia Pilot", comes up St Lawrence Creek on which there is a small settlement of the same name.

On Thursday 27 November we passed Fraser Island and encountered a very welcome East Australian Current (EAC) that added up to 4 1/2 knots to our speed. We commenced dropping expendable bathythermographs (XBTs) every few hours near the shelf edge with the aim of locating regions where slope water was moving onto the shelf. This was a repeat of some work done with Sprightly in the early 1980s.

Peter Davies from Southern Cross University commenced stations each noon (#1-4) with a radiometer and the CTD conductivity-temperature-depth (profiler and its rosette of sampling bottles to gather data for ground-truthing the ocean colour satellite SeaWiFS.

The current died away near Moreton Bay, but picked up again to over 2 knots from Coolangatta to Coffs Hbr. Falling away to very low values it commenced to flow onto the shelf, which continued until Smoky Cape, and was then southward at 2 knots down to Sydney. A southerly buster with mean wind speeds of up to 40 knots arrived at sunset on Friday 28 November. Shortly after this we commenced a grid survey of the seamounts (maybe seahills is a better word) from Smoky Cape to Pt Macquarie. We first saw the surface effects of these features in a radar image from the European satellite ERS-1. With one exception, a well-known ridge near the shelf edge off Pt Macquarie, the bottom features were elusive, probably because tight timing meant that our search grid, roughly between the 170 and 900 m isobaths, had to be coarse. An interesting aside was that the captain of the yacht "Isabella", which had lost its sails in the evening storm, was plotting the positions of passing ships with more than a casual interest. Our variable step grid pattern was something of a plotting challenge for him and he was most relieved to make radio contact with us — and for us to make visual contact with his yacht. He planned to stay put overnight and motor in to port in the morning.

The southerly turned to weak northeasterly during the morning of Saturday 29 November, increasing to 25 knots near sunset. Prior to midnight, when we were near Jervis Bay, there was another southwesterly buster at 30 knots. This moderated to 20 knots, turned to southerly and lasted until sunset on Sunday 30 November when we were in northern Bass Strait. Between Eden and northern Bass Strait we had a current lift of up to 2.8 knots on the edge of an anticyclonic eddy. A little further across the strait the wind built up to 30 knots from the west. The ADCP data showed that between 39° and 41°S the ship crossed an anticyclonic eddy in which the currents reached a maximum of 1.7 knots.

After a rough night and morning, the ship reached station #5 on the 2000 m isobath of the St Helens transect mid-afternoon on Monday 1 December. The CTD was lowered to 1000 m to locate the Antarctic Intermediate Water salinity minimum and a Niskin bottle leakage test was done by triggering all bottles. Two more continental slope stations were done at the 1200 and 500 m isobaths and five shelf stations were done from the 200 m isobath into nearshore station #12, which was completed at 2300. Visibility was very good, with Ben Lomond being readily visible from 70 miles away. There were problems with the bow thruster.

The ship then sailed to the inshore end of the Schouten Island transect, arriving just before 0500 on Tuesday 2 December. Conditions were perfect, with glassy seas, a slight swell, dolphins, schools of fish, and Schouten shrouded in mist. The transect (stations #13-20) was occupied during the day, finishing at 1400, and then we set a course for the outer end of the Tasman Island transect, hoping to arrive at about 2000. Unfortunately a strong 30-40 knot southwesterly developed and it quickly built up waves of 4-5 m. The ship had to decrease speed to 4-5 knots and plans for stations had to be put aside. Some XBTs were dropped, but the wind blew the wire against the side of the ship. The ship proceeded slowly to round the Tasman Peninsula and then docked at Hobart at 1045 Wednesday 3 December.

Eight scientists and one crewmember were changed over, glass floats were unloaded, and the ship sailed at 1500 for the inner end of a transect at Bruny Island. Station #21 was reached 2000. Weather conditions had improved during the day, but they rapidly deteriorated during the evening with the arrival of yet another front. Five stations (#21-25) were completed across the continental shelf to the 200 m isobath. Two factors combined to truncate the transect: the CTD cable was damaged when the hero platform was lowered in the rough conditions at the 500 m station, and then the weather became too rough to work. The ship proceeded at 4 knots towards the shelter of the southern of D'Entrecasteaux Channel, arriving after sunrise on Thursday 4 December. A few hours were spent in the channel and then the ship set a course at 4-5 knots for the inshore end of the SE Cape transect. While the weather was ameliorating, it was still too bad for station work and so we continued westward for several hours. We then started the SE Cape transect, albeit 15 miles west of its namesake, that comprised stations #26-32 out to the 1500 m isobath. The work on this transect was completed at 0830 on Friday 5 December.

Note that, in addition to the normal regional oceanographic stations and underway observations on this voyage, Russell Bradford took zooplankton hauls at most stations and Alison Turnbull obtained profiles from a radiometer mounted on the rosette and filtered many litres of water for chlorophyll. Denis Abbott spent the daylight hours identifying and counting the seabirds. There will no doubt be a relationship between seabird patterns, ocean currents, water properties, and zooplankton, but unravelling it may not be simple.

The Pt Davey transect of 9 stations (#33-40) was completed in good weather between 1400 and midnight, starting at the 2000 m isobath and working in to the coast.

Stations #41-49 of the Strahan transect were occupied in good weather from 0830-1930 on Saturday 6 December.

Good weather prevailed for the Marawah transect (stations #50-58) from 0300-1500 Sunday 7 December.

The spell of good weather allowed time for another transect, King Island, that was run in excellent conditions from 2330 Sunday until 0930 Monday 8 December working in from the 2000 m isobath with 9 stations to about the 50 m contour along 078°. At 0230 the loom of the King Island lighthouse could be seen from 36 miles out to sea.

After completing the transect the ship passed to the north of King Island and proceeded to Bell Bay, arriving at 0800.

PRELIMINARY RESULTS

Currents — see attached diagrams

The ADCP data from Townsville to Tasmania have been discussed as part of the narrative. Proceeding around Tasmania the currents along the path to the Tasman Peninsula appeared to reflect wind forcing from the successive storms. From Storm Bay around to the Marawah transect the currents on the shelf generally showed a flow down the west coast and then around towards the Tasman Peninsula. This supports the pattern revealed by satellite tracked drifters. The current speeds were usually only about 0.3 knots or less. Near Bruny Island they reached 1 knot to the NNE as the ship returned to the coast during the southerly storm.

On the continental shelf part of the King Island transect the currents were northward; off the shelf they were southward. Sailing northward along the west coast of King Island, however, the currents turned southward, perhaps due to the tides.

Water properties along the Tasmanian transects — see attached diagrams

We noted in the voyage summary for FR3/97 in March that the thermocline was stronger and shallower to the west of Tasmania as compared with the east. On the present voyage the thermocline, by comparison, was not developed. The 9°C isotherm was generally at about 500 m as for FR3/97. As with FR3/97, the 12°C isotherm was shallower on the western side of the island. We now make some brief comments about the individual transects:

St Helens In the upper 100 m the warmest and saltiest waters (15.5°C/35.4) were at the outer end of the transect and probably had an EAC component. These waters appeared to spill onto the shelf.

Schouten Island Again in the upper 100 m, the saltiest waters (>35.2) were offshore and appeared to be spreading in across the shelf. The temperatures in these waters were more difficult to interpret. Between stations 18 and 19 (500 and 1000 m isobath stations) there was a clear slope down to the shelf that would be expected to drive a southward current. This was not obvious in the near-surface ADCP data.

Bruny Island This transect was truncated at the shelf edge by bad weather. Near surface water with salinity exceeding 35.1 and temperature exceeding 13°C appeared to be spreading onto the shelf.

SE Cape Note that station #32 was occupied between 28 and 29, but does not appear on this preliminary plot. Nearshore there was a low salinity lens, probably from river runoff, and the ADCP showed currents in it to be about 0.6 knots. Warm salty water (13.5°C/35.2) spread from offshore to the shelf edge.

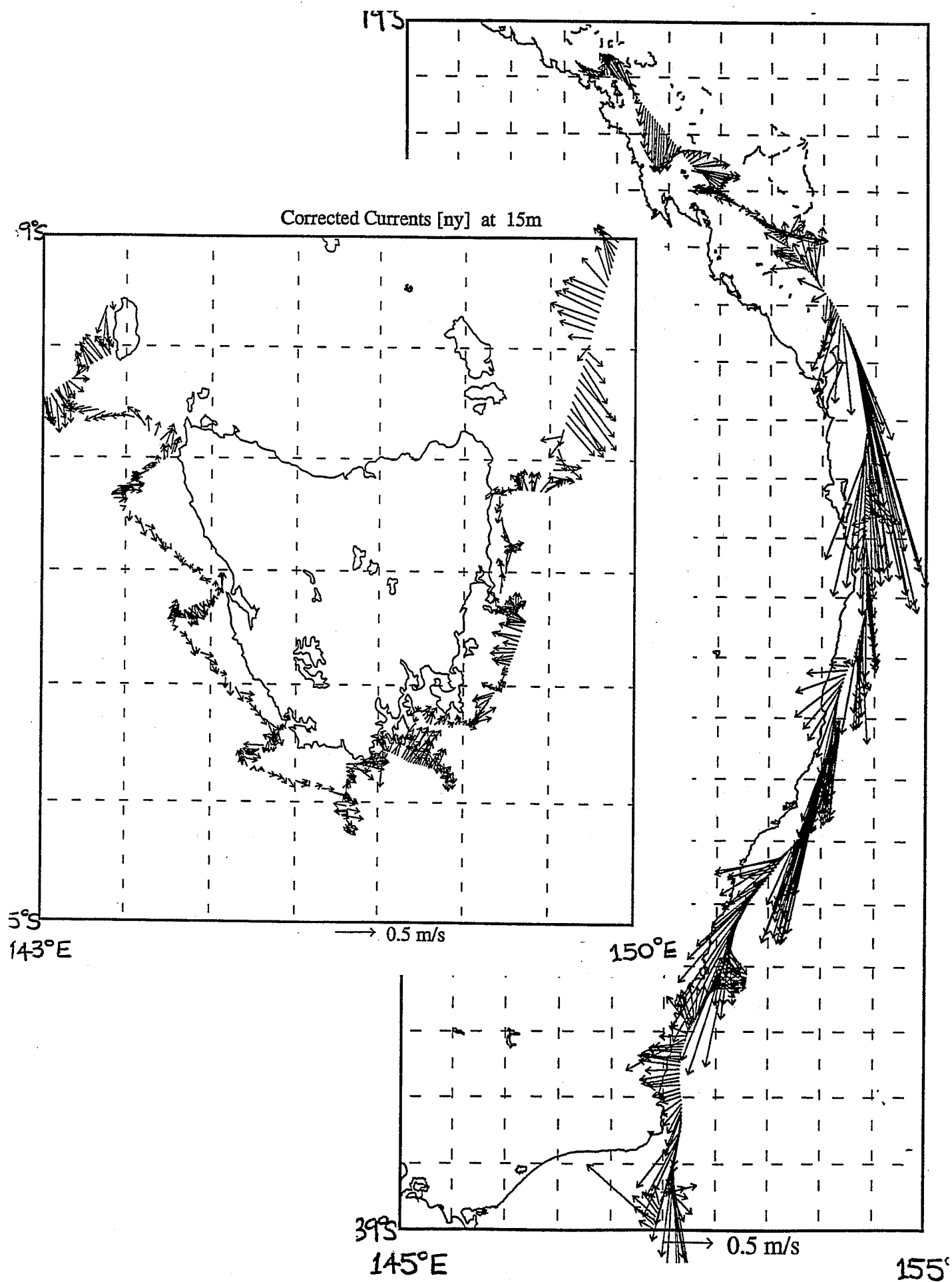
Pt Davey In the upper waters there were two lenses: one high salinity (>35.1) over the 1200 m isobath (station #34) and the other was quite low salinity (<34) due to outflow from Pt Davey. The influence of the latter appeared to extend to the shelf edge, but it may have included a contribution from Macquarie Harbour further north. The low salinity lens had no discernible temperature signature. The deep temperature and salinity structure (see the 9°C isotherm and the 34.6 isohaline) rose very significantly (>300 m) from the upper continental slope 30 km out to sea to station #33. The sea surface temperature at station #33 was 10.5°C.

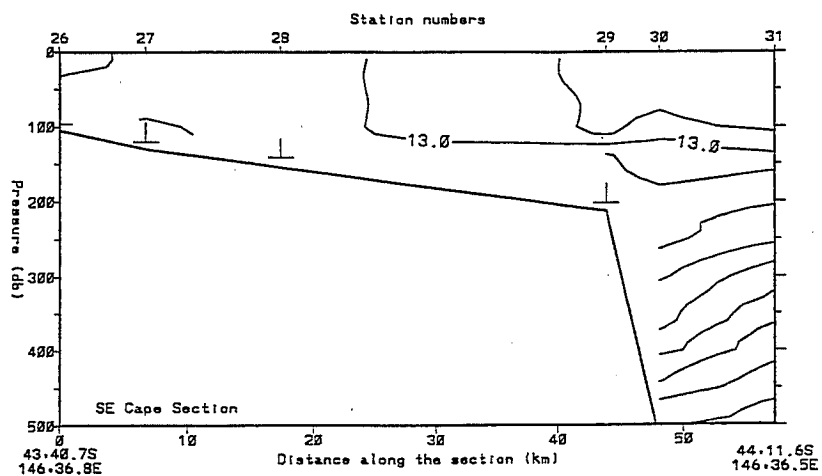
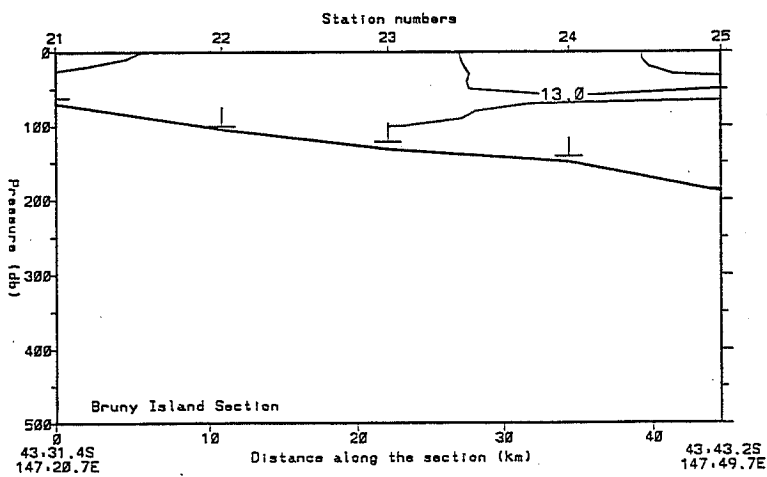
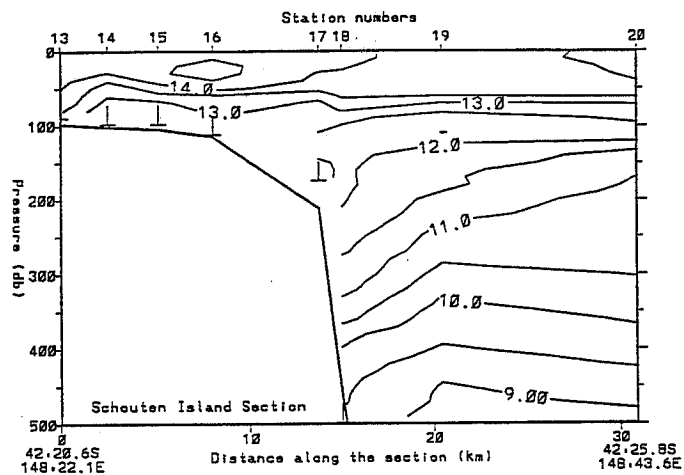
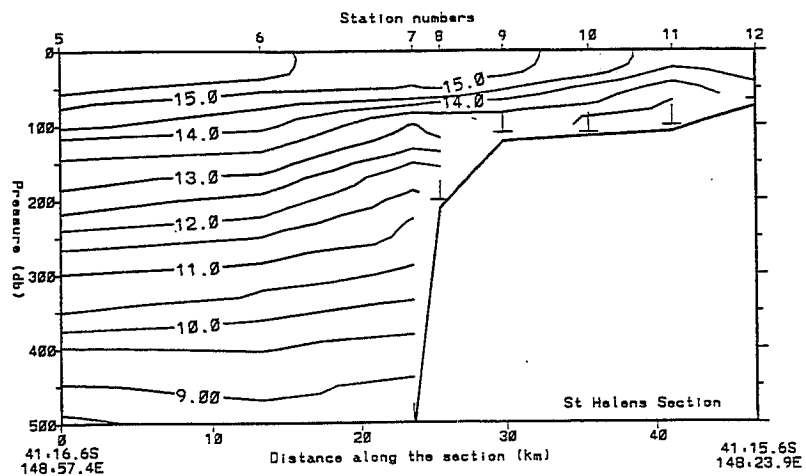
Strahan The low salinity lens from Macquarie Harbour was, as compared with the Pt Davey lens, warmer than the marine water and so should show up in satellite imagery. This was not the case on FR3/97, when the plume had no significant temperature signature.

Marawah There was also a low salinity lens (as for Strahan it was slightly warmer than the ambient marine water), but this seemed to be at least partially de-coupled from the land, so may have been part of the Macquarie Harbour outflow.

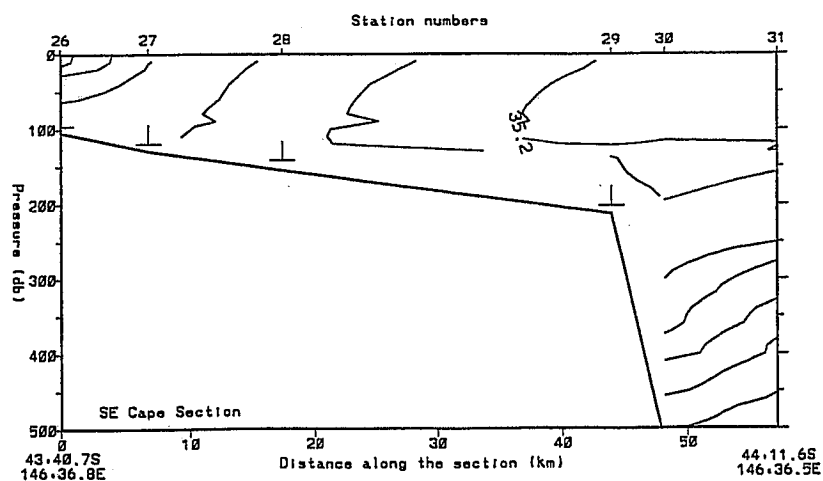
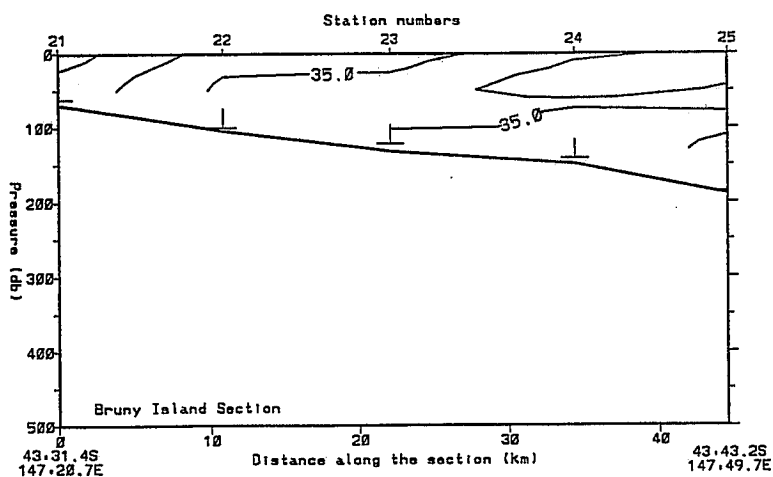
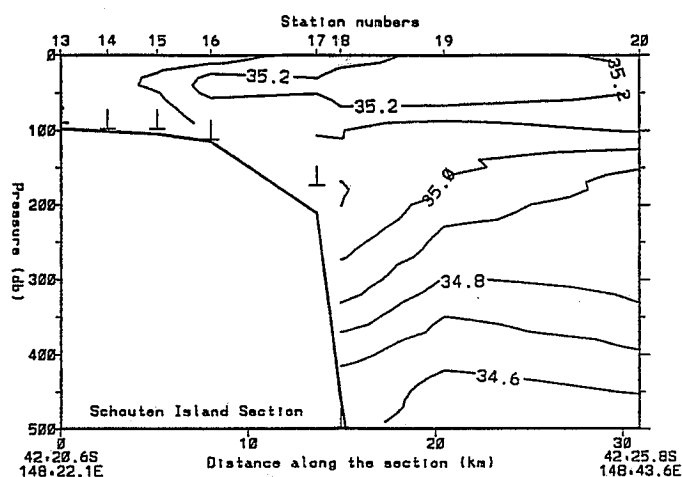
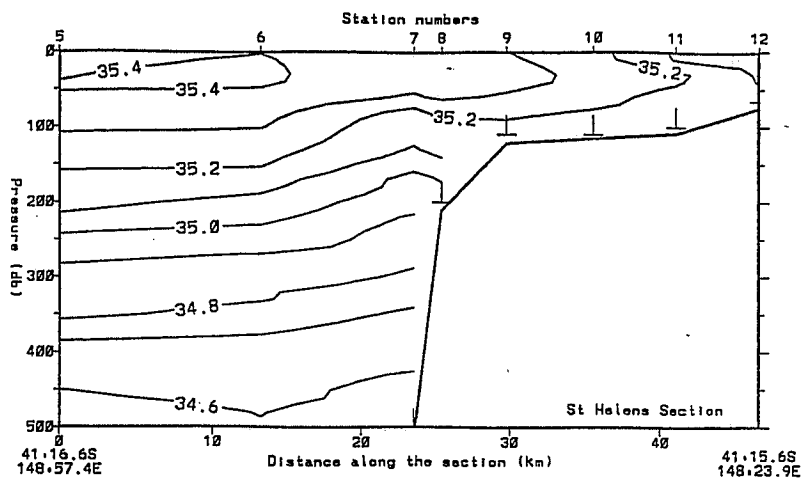
King Island From 150 m down there was domed structure suggesting a cyclonic (cold core) eddy. The near surface ADCP data do not reveal such an eddy, but it may show up in the deeper ADCP data. Of interest, the shelf waters were near-mixed in salinity (e.g. station #64), while there was a thermocline (14.5°-13°C).

Near-surface (15 m depth) ADCP measurements from Franklin

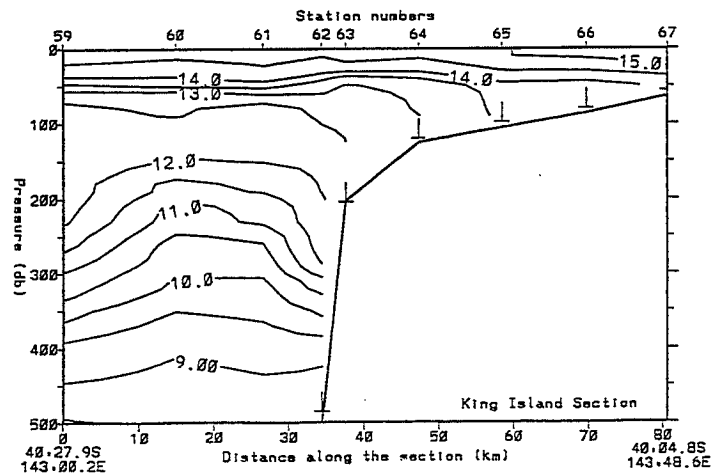
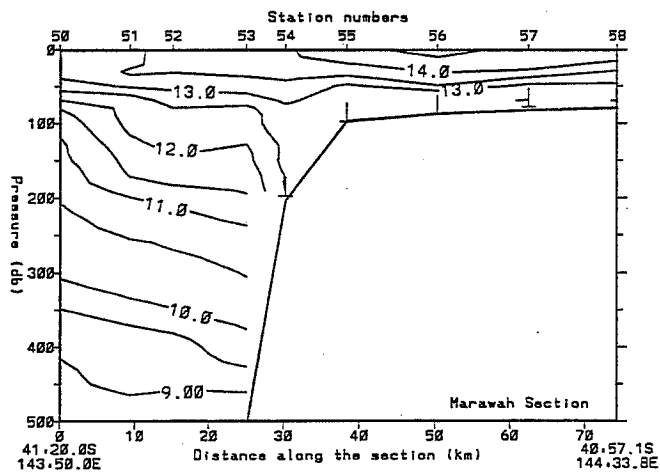
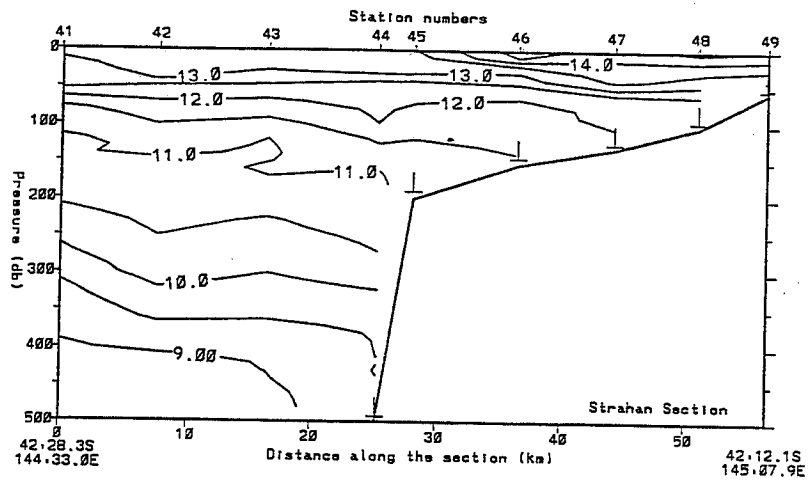
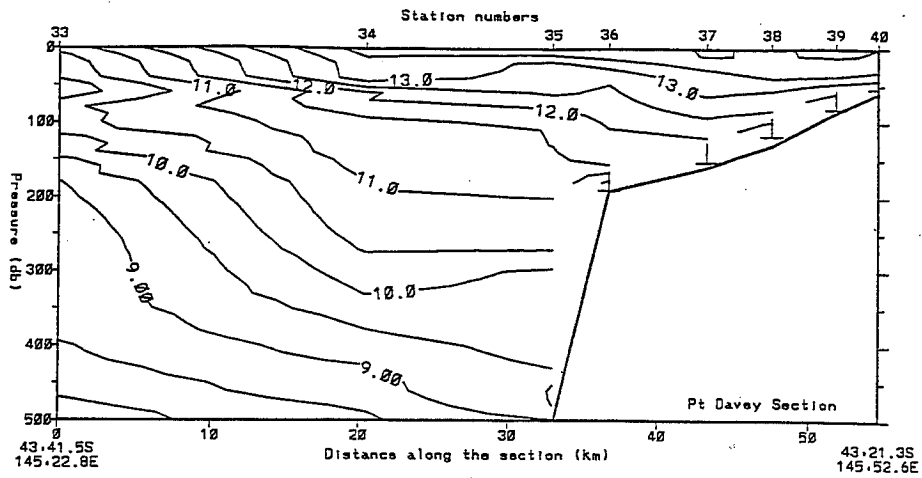




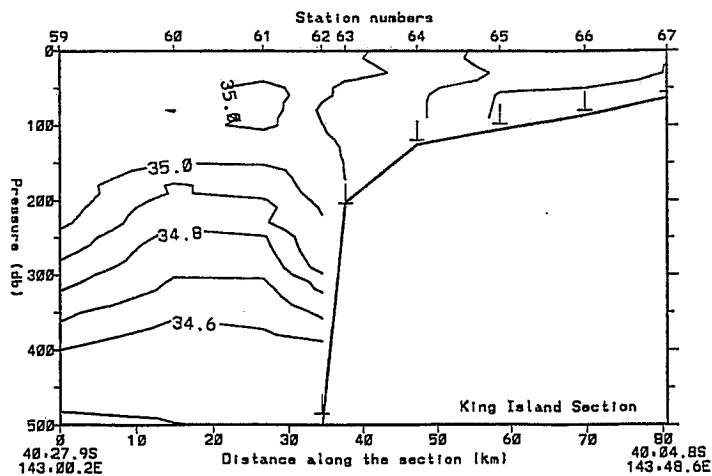
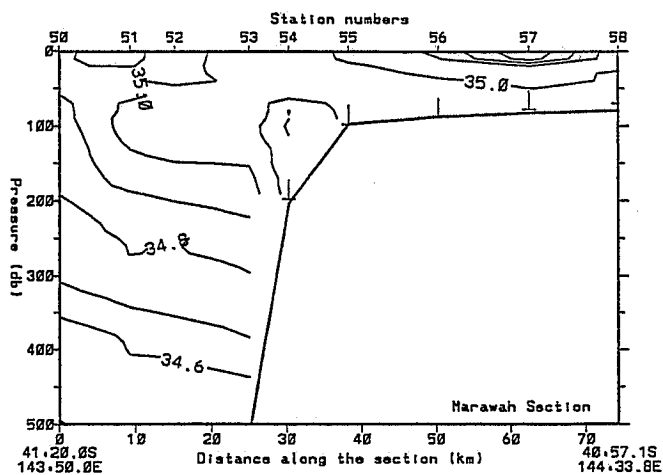
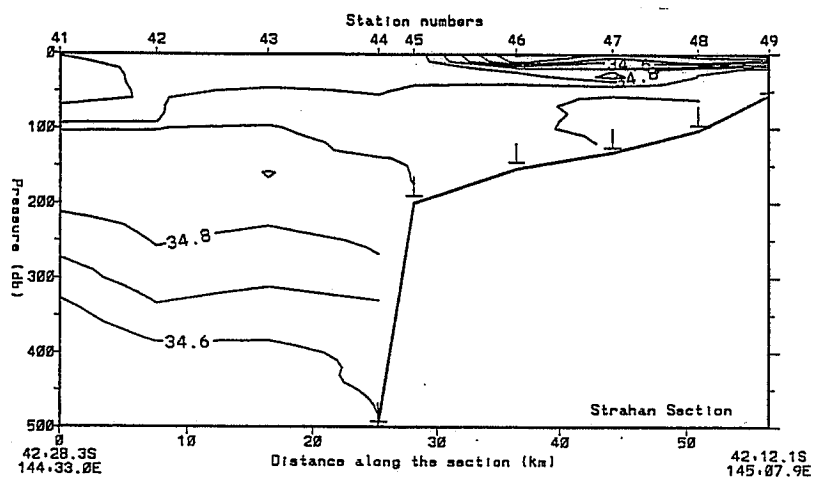
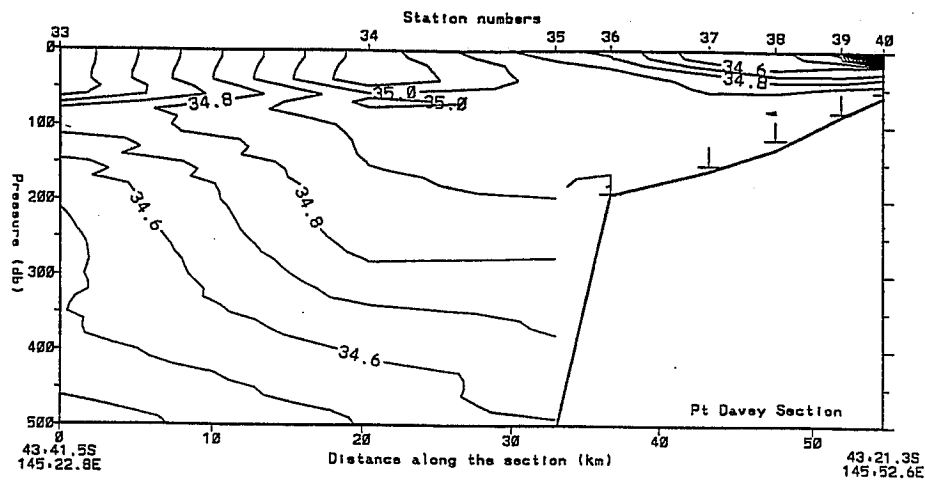
Tasmania temperature sections — east and south coast



Tasmania salinity sections — east and south coast



Tasmania temperature sections — west coast



Tasmania salinity sections — west coast

Initial comments on the zooplankton tows taken on FR10/97 (Russell Bradford).

As on the previous round Tasmania cruise (FR3/97) in February 1997 we used a surface net with a mouth area of 1m² and a mesh size of 1000µm to collect zooplankton. Tows of approximately 10 minutes duration were made following each CTD cast; filtering roughly 800 to 1000m³ of water each tow. In all, collections were made at 45 stations along the six transects occupied. No time was lost due to equipment failures, testimony to the skill of the Franklin crew. This combined with the generally good weather allowed the Franklin to make good time between transects, leaving little time for sleep. Following the final station I put in a much needed 17 hours sleep.

Our primary aim was to collect the larval stages of rock lobsters (phyllosoma). In contrast to the previous cruise, FR3/97, no mid to late stage phyllosoma were collected at stations along the same transects. In fact only one late stage (possibly stage 11) phyllosoma was collected the entire cruise; this was at the outermost station into King Island, a transect not sampled on the previous cruise. However, early stage phyllosoma may have been present as these stages being very small and transparent when alive are difficult to see without magnification. The samples will be sorted more thoroughly once they are back in the lab.

Our secondary aim was to collect larval fish species, of particular interest were the cheilodactylid and latrid species. About half of the samples contained larval fish, however, only several of these larvae resembled those of the cheilodactylids and latrids. All larval fish were removed from the samples and will be positively identified in Hobart. In a very general sense, the majority of the zooplankton consisted of small crustaceans, with the amphipods making up the greatest proportion of most tows. As with many zooplankton samples, the plankton was patchy. For example, a few shelf tows were dominated by salps and/or jellyfish, two tows by euphausiids (one ten minute tow had 5 litres of euphausiids), and one station consisted almost entirely of copepods.

Seabird observations — Denis Abbott

George Cresswell, the cruise leader, offered a berth to Denis Abbott as a representative of RAOU (now known as Birds Australia) to conduct seabird observations during the cruise. RAOU has previously placed observers on CSIRO vessels, during the time when it was collecting data for the seabird atlas which will be published soon. Additional observations can be added to that database even though the atlas data is closed off. Conducting observations during the cruise adds to the information on distribution and the number of species of seabirds at this time of year and the relationship between distribution and oceanographic features. The cruise gave me my first opportunity in thirteen years at CSIRO to see the division's work at sea. For someone providing information to scientists and replying to many external enquiries, extending my understanding and familiarity with the organization's work is of critical importance. My berth on the cruise was enthusiastically endorsed by the Chief of Marine Research.

Observations were conducted through most daylight hours on the cruise and they were done in accordance with the BIOMASS protocol for seabird observations (BIOMASS, 1992). The formatted recording sheets used were supplied by Eric Woehler of the Australian Antarctic Division. Under the protocol all birds seen in a 300m arc from the bow to the port, or starboard, beam of the ship are recorded for 10 minutes in the hour. For the rest of the hour spot observations are made as well as recording birds which follow the ship after the 10 minute observation period.

The first transect, southeast from Bruny Island, was done at night. If it had been during daylight hours it is likely that additional species would have been seen, since this was the southern-most transect. No *Pterodroma*, or gadfly petrels, were seen on the trip whereas on a private seabird trip, southeast from Eaglehawk Neck, a month before, numerous gadfly petrels were seen. At this time of year, many of the southern ocean species are moving further south for the Austral summer and that further limited chances of seeing some of these birds.

During the second day the ship was steaming close to the shore, first sheltering from rough weather, partly to re-connect the cable to the CTD, then heading to the deepwater station on the Port Davey transect. Large flocks of Short-tailed shearwaters, *Puffinus tenuirostris* were seen as well as small numbers of Australian gannets, *Sula serrat* and Shy albatross, *Diomedea cauta*. At 43.40S, 146.44E there was a large flock of 100s of Fairy prions, *Pachyptila turtur*. Large numbers of Fairy prions on this part of the coast could be expected since Isle de Golfe and Tasman Island are the two largest nesting areas for the species in Australia, with an estimated 25000 breeding pairs each. Isle de Golfe is at the mouth of Prion Bay!

Fairy prions were again seen early on the Friday, 5 Dec, with over 100 in the 10min observation period 21.00 GMT (08.00 EST). Small numbers of Wandering *Diomedea exulans*, Black-browed, *Diomedea melanophris*, and Shy albatross were seen along with Common diving petrels, *Pelacanoides urinatrix*, White-chinned petrels, *Procellaria aequinoctialis* and Australian gannets. At one station 70+ albatross, mainly Shy, were sitting on the water. This became a feature of observations on Saturday and Sunday on the Strahan and Marrawah transects. Few birds were seen in the 10min observation periods but at the deepwater stations where the ship was stationary for long periods, >80 albatross settled on the water within a 500m radius of the ship. The majority were Shy, possibly >20 Black-browed and >6 Wandering albatross. Shy albatross are the most common albatross in Tasmanian waters and the only albatross to breed in Australian waters: on Albatross Island, Mewstone and Pedra Blanca. At these stations White-chinned petrels (the largest number seen at one time was 22) and >5 Northern giant petrels, *Macronectes halli*, were also on the water. Dynamic soaring is the usual mode of flight for albatross, where they use the wind deflected upwards by the face of the waves. Except for short periods, flapping flight requires too much energy for such large birds, so in still or light airs albatross tend not to fly much. On the Strahan and Marrawah transects wind was below 13 knots for most of the time. The birds also showed little interest in feeding. A mixture of kitchen waste, including some putrid

smoked cod, all dowsed in tuna oil which I had brought to attract seabirds, only drew a few birds when it was ladled over the stern. Strong, gale-force southwesterlies on 3-4 Dec would probably have provided ideal feeding conditions for the albatross.

After the Marrawah transect was finished and the ship was steaming towards King Island, just west of Black Ridge Rock there was a large raft (estimated at 1000+) Short-tailed shearwaters feeding on the surface, a flock of 30+ Australian gannets plunge-diving and a pod 5 or 6 Common dolphins, *Delphinus delphis*, feeding and breaking the surface. One of the ship's crew said he also saw tuna feeding. Given the amount of krill, *Nyctiphanes australis*, in Russel Bradford's zooplankton net tows, all these species were probably feeding on a large swarm of krill. Discussions with Dick Martin, after returning to Hobart, confirmed that this area of Bass Strait is very productive. Nutrient rich water washes in over the shelf with the flood tides at both ends of Bass Strait but central areas of the Strait are relatively unproductive.

On the last day, starting with the inshore stations on the southwest coast of King Island, few birds were sighted. During some observation periods no birds were seen and very few were seen for the rest of the hour. In the hours approaching sunset large numbers of Short-tailed shearwaters crossed the bow of the ship, heading north (276 and 378 for two, 10min periods). In calm, still conditions Little penguins, *Eudyptula minor* could be seen surfacing as well as dolphins in the distance. Three Wilson's storm petrels, *Oceanites oceanicus*, were seen close to the ship where before, on the west coast, they had been at a distance and difficult to identify. Surprisingly few storm petrels were seen on the cruise.

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