

DIVISION OF FISHERIES

1995 RESEARCH VESSEL PROGRAM

CRUISE PLAN

**FRV SOUTHERN SURVEYOR
CRUISE SS4/95**

9 MAY - 3 JUNE 1995

CSIRO DIVISION OF FISHERIES
MARINE LABORATORIES
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ITINERARY

DEPART: CAIRNS 17:00 HRS TUESDAY, 9 MAY 1995

RETURN: WEIPA 12:00 HRS TUESDAY, 3 JUNE 1995

AREA OF OPERATION

North-western Coral Sea, between 9°S - 17°S and 144°E - 154°E

RESEARCH BACKGROUND

The overall aim of the cruise is to document the distribution and abundance of lobster phyllosoma larvae in the north-western Coral Sea. The need to determine the distribution and abundance of the phyllosoma larvae of *Panulirus ornatus* in the north-western Coral Sea was identified by the Torres Strait Fisheries Scientific Advisory Committee in 1986 when a proposal to undertake such a study was supported. This need arises because of the unusual life history of *P. ornatus* in Torres Strait (see below) and relates to determining potential larval trajectories and sources of recruitment to the Torres Strait stock in addition to gaining a scientific understanding of the ecology of the larval stages.

The Torres Strait lobster undergoes what is probably the longest migration known for lobsters, some 500-600 km from Torres Strait into the Gulf of Papua (GoP), to breed on coastal reefs west of Port Moresby. Although this migration has been well documented, it is not clear why lobsters migrate so far to breed. Some breeding has also been recorded on reefs off the far north-eastern Queensland coast, but to date the observed larval production in this area is small relative to the GoP. A lucrative trawl fishery for lobsters migrating into and across the GoP existed until 1984, when it was banned in order to protect what was believed to be a vital and vulnerable source of recruitment to Torres Strait.

Recent studies have hinted that the north-eastern Queensland coast breeding population may be more significant than previously thought, but questions remain regarding larval trajectories and which, if any, of the known breeding populations may be a source of recruitment to Torres Strait. Studies of current patterns by CSIRO and AIMS indicate the presence of a clockwise gyre in the far north-western Coral Sea that has the potential to mix larvae from both the far north-eastern Queensland coast and GoP breeding grounds and retain them adjacent to Torres Strait until the SE trade

winds could potentially return them to Torres Strait between June and September each year. The westward South-Equatorial Current borders the southern edge of the gyre and becomes the southward East-Australia Current when it impinges on the Australian coastline near Cooktown — this current is likely to be a major sink for the phyllosoma larval pool of the gyre. At present, these explanations are merely hypotheses because there is no information on the distribution and abundance of the phyllosoma larvae relative to these major current patterns of the area or relative to major physico-chemical phenomena. For these reasons we propose to sample the distribution and abundance of the phyllosoma larvae of *Panulirus ornatus* with respect to these major current patterns of the north-western Coral Sea between Cairns and Papua New Guinea and gain some understanding of the response of larvae to factors such as depth, lunar phase, diurnal cycle, and physical chemistry of the water column.

This research would enhance our understanding of the larval phase (about which we know almost nothing) in terms of distribution in the ocean, behaviour, larval retention areas, sinks, growth, recruitment mechanisms etc. This knowledge would have an impact on perceptions of the stock (resilience etc) and our ability to model and assess the impact of fishing, management actions, and environmental impacts.

CRUISE OBJECTIVES

The overall objective is to determine the distribution and abundance of the phyllosoma larvae of *Panulirus ornatus* in the north-western Coral Sea with respect to the major current patterns, depth, lunar phase, diurnal cycle, and physical chemistry of the water column. The specific objectives are:

1. to determine the spatial distribution of phyllosomas relative to a clockwise current gyre in the north-western Coral Sea by sampling phyllosoma abundance at up to 84 plankton-trawl-stations, in groups of 6 stations, distributed across the region.
2. to determine the depth distribution of phyllosomas relative to the physical chemistry of the water column, diurnal cycle, and lunar phase by stratifying plankton-trawl-sampling at 6 depths at each station.
3. to determine the spatial structure of the water surface across the north-western Coral Sea by continuously recording surface temperature, salinity, and chlorophyll with ship-borne instruments.
4. to determine the day and night-time structure of the water column, at each group of 6 stations, by profiling temperature, salinity, light and chlorophyll with a CTD.
5. to observe and document the behaviour of captured phyllosomas (and puerulus, if any); eg. swimming speed, orientation, photo-responses, feeding responses if any.
6. to determine the gut-contents (if any) of captured phyllosomas (and puerulus) and preserve specimens for subsequent analysis.

CRUISE PLAN

The timing of the cruise was chosen to maximise the chances of sampling lobster phyllosoma larvae in the Coral Sea and was restricted to a very narrow time window because breeding finishes at the end of March and settlement into Torres Strait begins in June/July. Thus, in late May, the greatest number of large phyllosoma are likely to be in the Coral Sea and they are likely to be distributed adjacent to areas to which they may be carried by surface currents driven by the SE trade-winds. To document the response of phyllosoma larvae to the lunar cycle, both the new and full moon cycles in May 1995 will be sampled.

FRV *Southern Surveyor* will depart Cairns for deep water just outside the Great Barrier Reef to conduct the first group of stations. If all gear and equipment is functioning, the *Southern Surveyor* will transect across to south of the far eastern end of Papua New Guinea (Lousiade Archipelago) sampling groups of stations on the way (see Fig.1 & Table 1). The ship will then head back west along the southern coast of PNG before carrying out DSTO research in the centre of the Coral Sea. After DSTO, the ship will resume sampling off the PNG coast, then refuel in Port Moresby and then sample stations southward off the far northern Great Barrier Reef. The ship will return to port at Weipa, via Raine Island Entrance (to collect DSTO equipment) and Torres Strait.

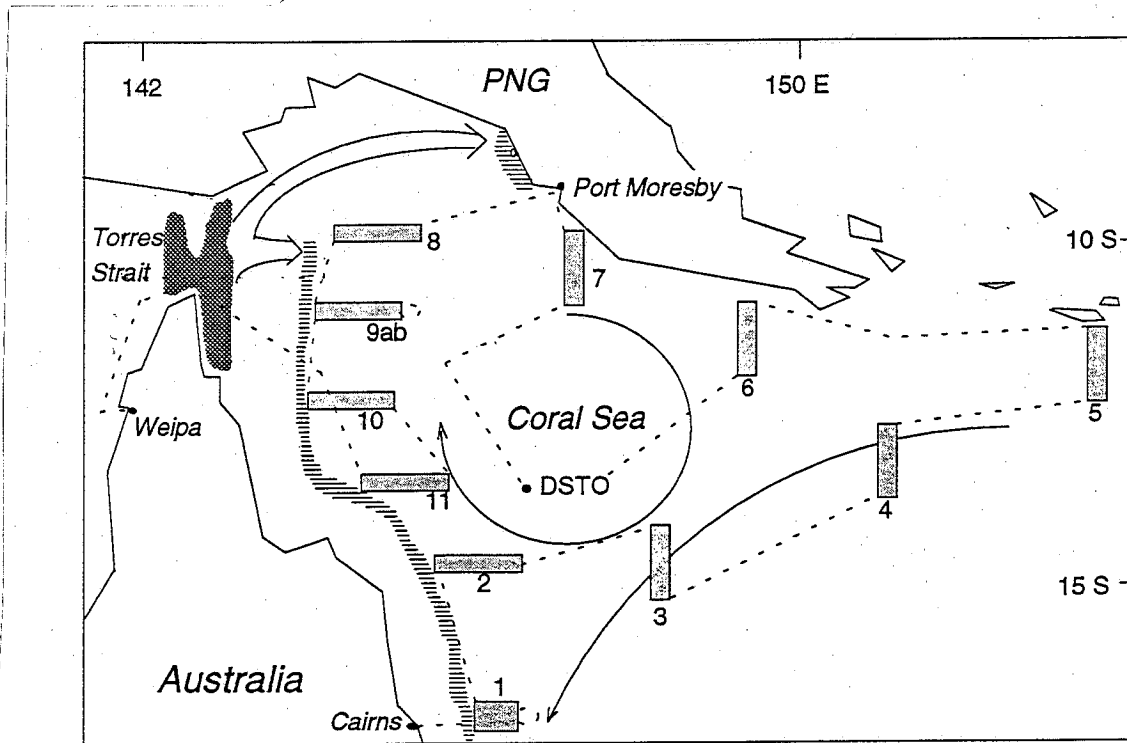


FIG. 1. MAP OF TORRES STRAIT AND GULF OF PAPUA SHOWING THE MAIN LOBSTER FISHING GROUNDS AROUND THE CENTRAL AND WESTERN REEFS AND ISLANDS (▨), THE MIGRATION PATHWAYS (⇒), BREEDING GROUNDS (▨), CURRENT PATTERNS (→) IN THE CORAL SEA, PROPOSED TRACK (---) AND NUMBERED SAMPLING LOCATIONS OF SS4/95.

Groups of sampling stations (indicated by shaded boxes in Fig.1) will be positioned relative to the major current patterns in the north-western Coral Sea. The East-Australia current will be sampled in the area directly east of Cairns; phyllosoma in this current will have been lost to the main gyre and could not return to Torres Strait — this will indicate the attrition of the larval pool in the gyre. The boundary between the South-Equatorial Current and the Coral Sea gyre will be sampled to examine the distribution of larvae with respect to this convergence. The remaining main sampling areas will provide representative sampling around and across the gyre so that larval distribution relative to the gyre can be documented. The areas in the centre of the gyre will be sampled opportunistically during the DSTO activities. The area directly east of Torres Strait may be a larval accumulation area due to the SE trade winds.

Details of methods will be similar to Rimmer & Phillips (1979 *Marine Biology* 54:109-124). Sampling will be done both day and night and over two lunar phases and at a range of depths at each station to determine the depth distribution of the larvae with respect to the diurnal and lunar cycles.

The sampling net will comprise a large (70 m²) pelagic trawl of 12 mm stretched mesh and 0.5 mm plankton net cod-ends. The larger pelagic net serves to enhance the catch rates of phyllosoma by the plankton net cod end. Depth stratification capabilities will be possible by using a multiple opening/closing net system (MIDOC) in the cod-end instead of a standard plankton net. Each station will be stratified at 5 depths, each for ~30 mins, giving at station time of ~200 minutes. Stations in a group will be separated by ~30 minutes steaming. A surface/neuston net (~2 m², 2.5/1 mm mesh) will be deployed at each station and cleared every 30 minutes to correspond with the depth-stratified samples. Hence, each group of 6 stations will take 24 hrs to sample, which will cover the full diurnal cycle. One or two groups of stations will be replicate sampled, each station during both the day and the night, within a 48 hr period to describe diurnal depth distribution patterns and confirm that depth distribution patterns observed in day only or night only stations within groups are not due simply to spatial confounding.

Physico-chemical parameters of the surface waters, including temperature, salinity, and chlorophyll, will be measured and recorded continuously by ship-borne instruments to determine the spatial structure of the water surface across the north-western Coral Sea.

Physico-chemical parameters of the water column will also be measured, at midday and midnight within each 24 hr grouping of stations, by depth-profiling temperature,

salinity, light and chlorophyll with CTD casts. This will allow the depth stratified sampling to be targeted to provide the best description of the distribution of larvae relative to water column structure.

Any live captured phyllosoma larvae (and post-larvae = puerulus, if any) will be observed and videoed in ship-board aquaria and their behaviour documented; eg. swimming speed, orientation, photo-responses, and feeding responses if any. Further, the gut-contents (if any) of captured phyllosomas (and puerulus) will be documented and specimens will be preserved for subsequent analysis. Plankton sample sorting, phyllosoma identification, and analysis of distribution patterns will be undertaken as far as possible during the cruise.

The proposed cruise track, steaming and station time allocations are as follows:

	Location	Duration (hours)	Start time	Finishtime	Start Lat	-Long	End Lat.	Long.	
transit	Cns	5	Tue 9/5/95 17:00 — Tue 9/5/95 22:00						
location	1	24	Tue 9/5/95 22:00 — Wed 10/5/95 22:00		16 40	146 05	16 15	145 55	
transit		10	Wed 10/5/95 22:00 — Thu 11/5/95 8:00						
location	2	24	Thu 11/5/95 8:00 — Fri 12/5/95 8:00		14 35	145 45	13 30	146 50	
DSTO	Osprey	12	Fri 12/5/95 8:00 — Fri 12/5/95 20:00		13 45	146 45	13 45	146 45	
transit		10	Fri 12/5/95 20:00 — Sat 13/5/95 6:00						
location	3	24	Sat 13/5/95 6:00 — Sun 14/5/95 6:00		13 40	148 35	15 05	148 55	Full Moon 13 May
transit		15	Sun 14/5/95 6:00 — Sun 14/5/95 21:00						
location	4	24	Sun 14/5/95 21:00 — Mon 15/5/95 21:00		14 25	151 25	13 00	151 00	
transit		18	Mon 15/5/95 21:00 — Tue 16/5/95 15:00						
location	5	24	Tue 16/5/95 15:00 — Wed 17/5/95 15:00		13 05	154 05	11 45	153 40	
transit		24	Wed 17/5/95 15:00 — Thu 18/5/95 15:00						
location	6	24	Thu 18/5/95 15:00 — Fri 19/5/95 15:00		10 40	149 50	12 10	149 35	
DSTO Coral Sea		128	Fri 19/5/95 15:00 — Wed 24/5/95 23:00		12 45	146 55	12 45	146 55	Last Quarter 21 May
location	7	24	Wed 24/5/95 23:00 — Thu 25/5/95 23:00		11 35	147 00	10 10	147 40	
transit		5	Thu 25/5/95 23:00 — Fri 26/5/95 4:00						
Pt. Moresby		4	Fri 26/5/95 4:00 — Fri 26/5/95 8:00		9 25	147 15	9 25	147 15	
trans		11	Fri 26/5/95 8:00 — Fri 26/5/95 19:00						
location	8	24	Fri 26/5/95 19:00 — Sat 27/5/95 19:00		10 05	145 35	09 45	144 10	
trans		6	Sat 27/5/95 19:00 — Sun 28/5/95 1:00						
location	9a	24	Sun 28/5/95 1:00 — Mon 29/5/95 1:00		10 50	144 05	11 05	145 35	New Moon 29 May
location	9b	24	Mon 29/5/95 1:00 — Tue 30/5/95 1:00		11 05	145 35	10 50	144 05	replicate location
transit		7	Tue 30/5/95 1:00 — Tue 30/5/95 8:00						
location	10	24	Tue 30/5/95 8:00 — Wed 31/5/95 8:00		12 05	144 05	12 00	145 30	
transit		6	Wed 31/5/95 8:00 — Wed 31/5/95 14:00						
location	11	24	Wed 31/5/95 14:00 — Thu 1/6/95 14:00		13 00	145 35	13 35	144 10	
transit		12	Thu 1/6/95 14:00 — Fri 2/6/95 2:00						
DSTO Raine		4	Fri 2/6/95 2:00 — Fri 2/6/95 6:00		11 35	144 00	11 35	144 00	
transit		30	Fri 2/6/95 6:00 — Sat 3/6/95 12:00						
Weipa		5	Sat 3/6/95 12:00 — Sat 3/6/95 17:00		12 35	141 55	12 35	141 55	
GoC Prawns		192	Sat 3/6/95 17:00 — Sun 11/6/95 17:00		13 00	140 00	12 35	141 55	

In summary, the total cruise time for the Coral Sea leg is 24.8 days, or 595 hrs, of which, ~280 hrs will be towing plankton nets at 2 kn, ~50 hrs will be hove-to for CTD casts (14 hrs) and for DSTO work (36 hrs), and ~265 hrs will be steaming at 10-12 kn. Eight days have been allocated for the second leg, in the Gulf of Carpentaria, giving a total of 33 days.

**PERSONNEL
(CORAL SEA LEG)**

Dr C. Roland Pitcher,	Project/cruise leader (CSIRO Fisheries)
Mr Tim D. Skewes,	Biologist (CSIRO Fisheries)
Mr Darren M. Dennis,	Biologist (CSIRO Fisheries)
Mr Clive Liron	Vessel Manager (CSIRO Fisheries)
Mr Jeff Cordell	Electronics, MIDOC codend (CSIRO Fisheries)
OMS staff x 1	CTD & chemistry (CSIRO Fisheries)
Dr Barry Bruce	Biologist (CSIRO Fisheries)
Dr Chris Evans	Biologist (PNG DFMR)
Mr Philip Polon	Biologist (PNG DFMR)
Mr Barre Kare	Biologist (PNG DFMR)
Dr Andrew Kulesa	Engineer (DSTO)
Mr Brian Jones	Engineer (DSTO)

CONTACTS

For further information about this cruise, contact:

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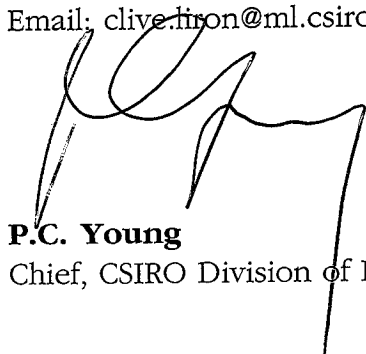
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