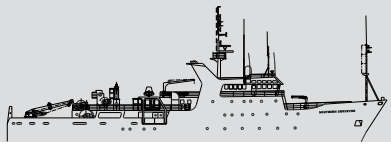


MARINE
NATIONAL FACILITY

2010 program

RV *Southern Surveyor*

CSIRO

voyage summary SS2010_V05

SS2010_V05

The Biological Oceanography of Western Rock Lobster Larvae

Voyage period

Start: 06/07/2010

End: 27/07/2010

Port of departure: Fremantle, Australia

Port of return: Fremantle, Australia

Responsible laboratory

The Oceans Institute, M047, The University of Western Australia

Chief Scientist(s)

A. M. Waite, University of Western Australia

Scientific Objectives

Lack of knowledge of Western Australia's fisheries oceanography fundamentally limits understanding of the recruitment of Western Rock Lobster, *Panulirus cygnus*, in a fishery worth $200-300 million/year to Australia. The life cycle of *P. cygnus* includes a planktonic "*phyllosoma*" larval stage that is transported up to 1500 km offshore via ocean currents. Development then continues for approximately 9 - 11 months at sea, before juveniles ("puerulus") return over the shelf to recruit to coastal reef areas. Critical to improving the management of this fishery, which is under intensive review, is appropriate process information about the oceanographic mechanisms driving coastal recruitment. The last three years of puerulus settlement have been low, with the latest (2008/09) settlement the lowest in 40 years of monitoring and not explained by the environmental factors previously identified as affecting settlement. The cause of the low settlement represents a key unknown for managers assessing the sustainability of WA's coastal fisheries, and is likely to be driven by variation in food availability during the open-ocean stage of the *phyllosoma* larvae.. Our study will test the hypothesis that the ocean productivity, particularly the nitrate-driven classic food chain supporting diatoms and copepods, limits *phyllosoma* growth rate and survival in their oceanic phase. We will execute this study at or after the peak of the autumn/winter plankton bloom in the Leeuwin Current, with the aim of quantifying oceanographic parameters crucial to modelling rock lobster larval dynamics.

Voyage Objectives

1. Onshore-offshore transect survey of *phyllosoma* densities and sizes at four latitudes (Rottnest, Jurien, Abrolhos, Shark Bay; horizontal and vertical distributions), with associated genetic analyses
2. Analysis of offshore food web structures supporting *phyllosoma* growth at sea, particularly the nitrate-diatom-copepod food chain
3. Experimental determination of the rate of lipid accumulated when feeding on copepods.
4. Overall assessment of the potential for the Leeuwin Current autumn bloom to support *phyllosoma* growth leading to successful metamorphosis to puerulus and coastal recruitment of juveniles

Results

1. Successful –Our survey covered the entire of interest with the extra transect included north of the Abrolhos. One unexpected observation was the strength and persistence of a major front between the Leeuwin Current and STSW as they met just S. of the Abrolhos. We called this the "Abrolhos Front".

2. Partially Successful – Major challenges in operating the EZ Net slowed accomplishment of a number of stations and limited the collection of samples for the food web/patch. In addition, problems with the freezer meant that some of the foodweb samples underwent freezing and thawing, such that their integrity may be questionable.

3. Successful – The experiments with *phyllosoma* included identification of their preferred prey and analyses for fatty acid and lipid content are currently underway.

4. Successful – Primary production, nutrient uptake and zooplankton concentrations were measured at all primary productions stations along the 5 transects.

Voyage Narrative

Immediately upon departure from Fremantle, we targeted an eddy-like water mass SW of the Abrolhos to trawl for *phyllosoma* to populate our ship-board feeding experiments. This area had been identified at the end of our previous research voyage as an area for potentially significant *phyllosoma* concentrations because 1) the eddy had formed just north of the Abrolhos, thought to be a major nursery area for *phyllosoma*, and 2) the *phyllosoma* modelling by Ming Feng et al. had identified this same area as a region of possible high *phyllosoma* densities.

A new moon with low winds favoured surface concentration of the *phyllosoma*, and we were lucky in being able to collect enough *phyllosoma* in the Neuston Net samples to populate most of our experiments (~40 or more organisms) in the first few hauls. In fact this *phyllosoma* patch was in the STSW water mass just a few kilometres to the S of the originally targeted eddy, which had moved significantly to the south in the previous month. Unfortunately a fuel leak meant that we had to return quickly to Fremantle for repairs, so we were not able to continue sampling. However, the initial experiments were set up immediately and continued through our period of inaction while in port.

Once repairs were complete 2 days later, we returned immediately to the original location to sample for *phyllosoma*; however, by this time winds had reached 50 knots and the EZ Net was not functioning reliably electronically. This meant that sampling was slowed significantly even once the seas abated. Eventually we ascertained that this was due to a leak in the casing, and the electronics needed constant attention and repairs throughout the rest of the regional survey, slowing and limiting sampling repeatedly throughout the voyage.

In the mean time the original experiments were going extremely well and were completed within 2 weeks. However a freezer failure put all frozen samples at risk, especially those stored to complete the food web analyses.

We sampled and set up another set of experiments so that we would be more likely support the voyage outcomes regardless of the loss of freezer samples. However this was necessarily more rushed than the setup of the first set of samples, such that the overall quality of *phyllosoma* used in the experiments was not quite so high.

Summary

While we made every effort to execute all of our objectives successfully, we lost significant ship time due to ship repairs, the malfunctioning of the EZ Net and the freezer failure. We also had significant interference from bad weather.

Project name

Biological Oceanography of the Western Rock Lobster Larvae

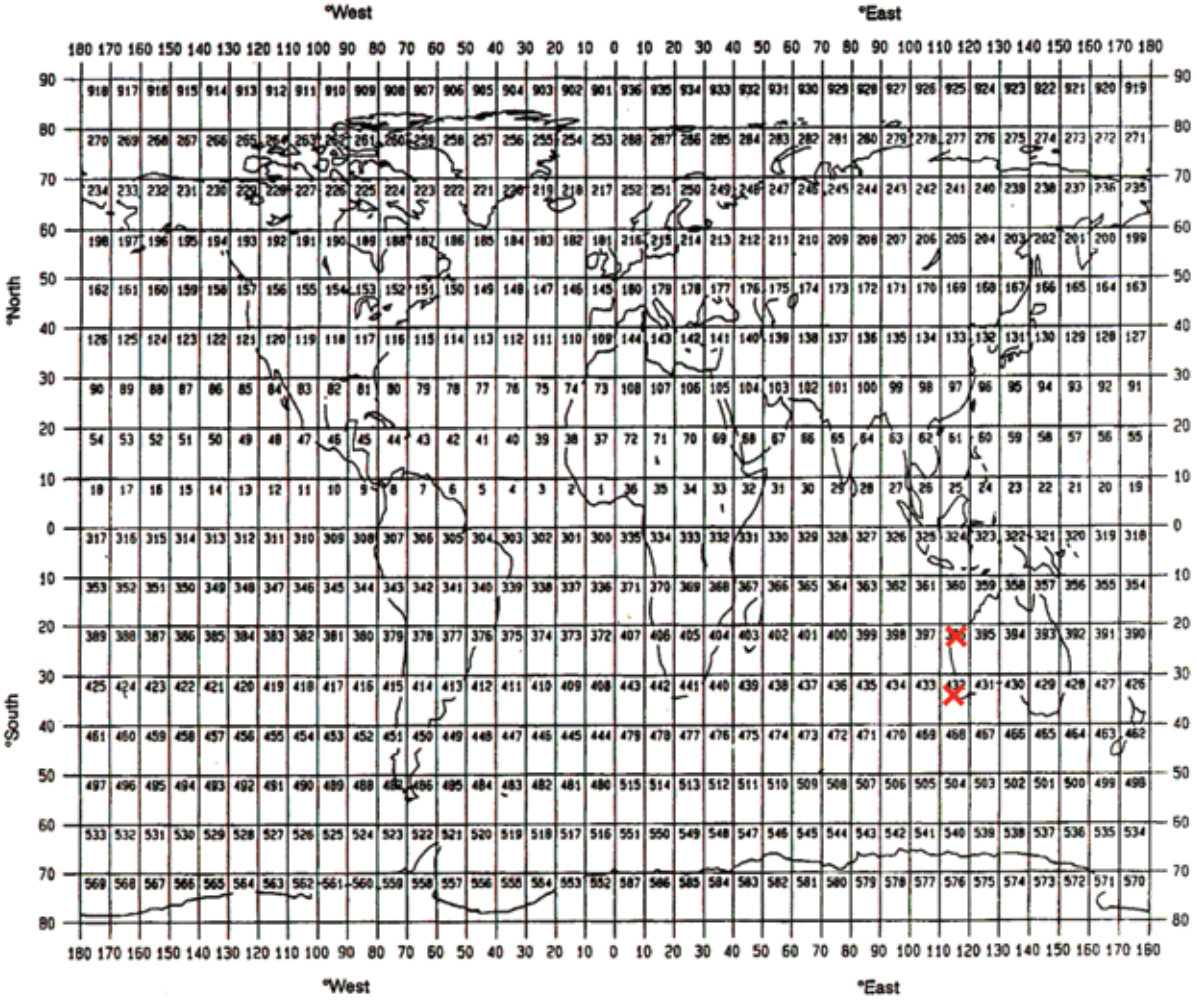
Coordinating body

Waite et al.

PRINCIPAL INVESTIGATORS

A. Anya Waite
B. Lynnath Beckley
C. Peter Thompson
D. Megan Saunders
E. Christin Sawstrom
F. Andrew Jeffs

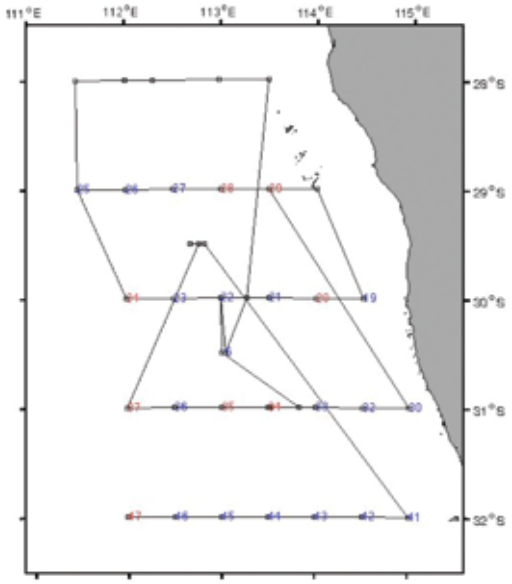
GEOGRAPHIC COVERAGE - INSERT 'X' IN EACH SQUARE IN WHICH DATA WERE COLLECTED



SUMMARY OF MEASUREMENTS AND SAMPLES TAKEN					
Item No.	**PI** see page above	**NO** see above	**UNITS** see above	**DATA TYPE** Enter code(s) from list on last page	**DESCRIPTION**
1 – CTD Casts	A, D E -all C (Isus Sensor H90)		CTD drops to 1000 m	H17 H11 H21 BO2 H16 D71 H90 –ISUS	Continuous recording of : T, S, oxygen, Chlorophyll fluorescence, transmission, ADCP, and ISUS nitrate sensor (H90)
	A, D, E Hydrochem – H21, nutrients	@ 3 – 10 depths		H21 H24 H25 H76 H26 H10 B02	Bottle samples taken from CTD for on-board analysis of : Salinity / Oxygen (3/ cast) Nutrients : Nitrate + nitrite, Ammonium, Silicate,Phosphate (10/ cast) Chlorophyll a (2 size fractions) (5 / Cast)
	A,(w/D,E) – B07, B01, B06 C-B02-HPLC	20 CTD stations	Stations	B01 B71 B06 B72 B09 B13 B14 B08 B07	Production Station Bottle Sampling : Subset of above also including : Nutrient uptake measurements, Particulate and dissolved organic matter, Phytoplankton and bacterioplankton (4-5 depths per cast)
2- UW	A&B - TBC H71 B02 G- H27 & H90		Voyage track	H71 B02 H27 H90 – Oxygen / Ar ratio	Underway Measurements
3 - Nacelle	A? C? &B-TBC	21	Files	H71 B02 + H90 (Ecopuck)	Nacelle Tow-Yo Deployments – deployment of towed body containing T, S, and pressure sensors plus an Ecopuck with transmission at several wavelengths
4-Bongo Nets	B,D,E- B14/ B14/B09 F – B90	19 deployments	Net Hauls	B14/B14/B09 B90 – Feeding Genetics	Bongo Net Deployments
EZ Net	B,D,E- B14/ B14/B09 F – B90	42 deployments;		B14/B14/B09 B90 – Feeding Genetics	EZ Net Deployments
Neuston	B, D, E – B, D,E - B90 F – B90	49 Deployments		B90 - phyllosoma Feeding Experiments B90 – Feeding Genetics	Neuston Net Deployments

CURATION REPORT	
Item No.	**Description**
1	A / B (UWA :
2	A (UWA) C (CSIRO) – Bacterial / picoplankton/ and Particulate samples other than HPLC to be returned to UWA for analysis. HPLC samples to be analyzed at CMAR Hobart, CSIRO. Dissolved isotope samples to ber un by UCal Davis.
3	A (UWA) B(UNSW) C (CSIRO)
4	D- Murdoch University – The majority of the zooplankton samples to be stored in the Beckley laboratory at Murdoch University. A small portion of the plankton samples (for genetic analyses) have been sent to Dr. Andrew Jeffs (U. Auckland). Plankton samples from the feeding experiments are located at CSIRO Hobart for analysis of fatty acids/lipids.

Voyage track



General ocean area:
eastern indian ocean

Specific areas: Shelf and ocean areas adjacent from coast to 111 30' E and between 32 and 28 S.

PERSONNEL LIST

Scientific Participants

Name	Affiliation	Role
Anya Waite	UWA	Chief Scientist
Lynnath Beckley	Murdoch University	Deputy Chief Scientist
Peter Thompson	CSIRO	Biological Oceanographer – Larval Nutrition
Megan Saunders	UWA	Lobster Feeding Experiments
Nick Sachlikidis	Department of Primary Industries,	
Queensland	Lobster Feeding Experiments	
Judith Meyer	Uni Kiel / UWA	Research Volunteer
Nutrient Uptake Experiments		
Josh Dornan	Department of Fisheries, WA	Net and Zooplankton Assistance
Alicia Sutton	Murdoch University	Net and Zooplankton Assistance
Nick Breheny	Murdoch University	Research Technician
Zooplankton, Fish Larvae		
Don Mckenzie	CMAR	MNF Voyage Manager
Bob Beattie	CMAR	MNF Computing support
Lindsay Macdonald	CMAR	MNF Electronics Support
Alicia Navidad	CMAR	MNF Hydrochemistry Support

UWA = University of Western Australia; UNSW = University of New South Wales
CSIRO = Commonwealth Scientific and Research

Organisation; MNF = Marine National Facility

Marine Crew

Name	Role
Mike Watson	Master
John Barr	1st Mate
Rob Ferries	2nd Mate
Nick Fleming	Chief Engineer
Rob Cave	1st Engineer
Graeme Perkins	2nd Engineer
Tony Hearne	Chief IR
Chris Softley	IR
Matt Barrett	IR
Jonathan Lumb	IR
Peter Coleman	IR
Jason Wall	Chief Cook
Lynette McLaren	2nd Cook
Charmayne Aylett	Chief Steward

Acknowledgements

We acknowledge funding from the Fisheries Research and Development Council to A. M. Waite and co-workers, contributions and equipment including Bongo Nets from the CSIRO. We thank Don McKenzie for scientific assistance at sea far beyond his official role of Voyage Manager.

Anya Waite
Chief Scientist

CSR/ROSCOP PARAMETER CODES

M01 Upper air observations
M02 Incident radiation
M05 Occasional standard measurements
M06 Routine standard measurements
M71 Atmospheric chemistry
M90 Other meteorological measurements

PHYSICAL OCEANOGRAPHY

H71 Surface measurements underway (T,S)
H13 Bathythermograph
H09 Water bottle stations
H10 CTD stations
H11 Subsurface measurements underway (T,S)
H72 Thermistor chain
H16 Transparency (eg transmissometer)
H17 Optics (eg underwater light levels)
H73 Geochemical tracers (eg freons)
D01 Current meters
D71 Current profiler (eg ADCP)
D03 Currents measured from ship drift
D04 GEK
D05 Surface drifters/drifting buoys
D06 Neutrally buoyant floats
D09 Sea level (incl. Bottom pressure & inverted echosounder)
D72 Instrumented wave measurements
D90 Other physical oceanographic measurements

CHEMICAL OCEANOGRAPHY

H21 Oxygen
H74 Carbon dioxide
H33 Other dissolved gases
H22 Phosphate
H23 Total - P
H24 Nitrate
H25 Nitrite
H75 Total - N
H76 Ammonia
H26 Silicate
H27 Alkalinity
H28 PH
H30 Trace elements
H31 Radioactivity
H32 Isotopes
H90 Other chemical oceanographic measurements

MARINE CONTAMINANTS/POLLUTION

P01 Suspended matter
P02 Trace metals
P03 Petroleum residues
P04 Chlorinated hydrocarbons
P05 Other dissolved substances
P12 Bottom deposits
P13 Contaminants in organisms
P90 Other contaminant measurements
B01 Primary productivity
B02 Phytoplankton pigments (eg chlorophyll, fluorescence)
B71 Particulate organic matter (inc POC, PON)
B06 Dissolved organic matter (inc DOC)
B72 Biochemical measurements (eg lipids, amino acids)
B73 Sediment traps
B08 Phytoplankton
B09 Zooplankton
B03 Seston
B10 Neuston
B11 Nekton
B13 Eggs & larvae
B07 Pelagic bacteria/micro-organisms
B16 Benthic bacteria/micro-organisms
B17 Phytobenthos
B18 Zoobenthos
B25 Birds
B26 Mammals & reptiles
B14 Pelagic fish
B19 Demersal fish
B20 Molluscs
B21 Crustaceans
B28 Acoustic reflection on marine organisms
B37 Taggings
B64 Gear research
B65 Exploratory fishing
B90 Other biological/fisheries measurements

MARINE GEOLOGY/GEOPHYSICS

G01 Dredge
G02 Grab
G03 Core - rock
G04 Core - soft bottom
G08 Bottom photography
G71 In-situ seafloor measurement/sampling
G72 Geophysical measurements made at depth
G73 Single-beam echosounding
G74 Multi-beam echosounding
G24 Long/short range side scan sonar
G75 Single channel seismic reflection
G76 Multichannel seismic reflection
G26 Seismic refraction
G27 Gravity measurements
G28 Magnetic measurements
G90 Other geological/geophysical measurements