

## RV *Investigator* Scientific Highlight

<b>Voyage:</b>	IN2015_V03
<b>Chief Scientist:</b>	Iain Suthers
<b>Voyage title:</b>	Submesoscale processes – billows and eddies - along the productive shelf by the East Australian Current
<b>Mobilisation:</b>	Brisbane, Tuesday, 2 June 2015
<b>Depart:</b>	Brisbane, Wednesday, 3 June 2015
<b>Return:</b>	Sydney, Thursday, 18 June 2015
<b>Demobilisation:</b>	Sydney, Thursday, 18 June 2015



## Title

Billows and other small eddies along the productive shelf by the East Australian Current

## Introduction

The East Australian Current is our strongest ocean current that affects the livelihoods of most Australians, from climate and weather, to fisheries and tourism. It is our closest current, sometimes only 15 km offshore, and it has strengthened in recent decades. The ecological effects of this current are unknown, but one process (which is well recognised off eastern Japan) is the drawing of coastal water offshore, including plankton and larval fish. Is this natural process a loss to the ecosystem or an unappreciated nursery ground for coastal fish stocks?

The voyage consisted of three main projects with the following objectives:

- 1) To discover the oceanographic behaviour of small, frequent eddies that characterise the coastal side of all ocean boundary currents;
- 2) To determine the effect of this entrainment on the planktonic food web including phytoplankton and zooplankton; and
- 3) To examine the effect of East Australian Current in drawing coastal water into an offshore nursery ground for larval fish, and for commercial lobster.

## Contribution to the nation

We have discovered a possible mechanism for fisheries production world-wide, Frontal eddies of ocean currents have the capacity to maintain our fisheries by the 3 stages: entrain, sustain and retain coastal larval fish into an offshore nursery. We found evidence of greater zooplankton production in these offshore nursery grounds compared to the surrounding ocean, and compared to the source waters or spawning grounds.

We were surprised by the host of common estuarine and coastal species as larvae in the offshore eddies (bream, yellowtail kingfish, tailor).

A possible outcome of a strengthening East Australian Current with climate change is the formation of more eddies, and hence a possible benefit for fisheries – at least for the early life history of fish. Also, these offshore eddies may be suitable locations for sea ranching, or even re-stocking the ocean where the larvae may have better chance of survival than the usual 99% mortality.

## As a result of this voyage

1. We have a better understanding of Australia's largest ocean current, which is directly adjacent to over half the nation's population. With this information we can inform the biological effects of a strengthening East Australian Current.
2. We have found that small clockwise eddies are common, especially off the continental shelf, and have the potential to be offshore nursery grounds for larval fish. We also established the positive response by coastal plankton to this new offshore environment;

and we have revealed the physical oceanographic mechanism how small eddies can enrich plankton.

3. We have mapped the largest submarine canyons along the continental slope off eastern Australia; not only may this support tremendous biodiversity, they are clearly very important for local fisheries, because they act as conduits for deep nutrient rich water.
4. We have commenced a program of collaboration and analysis involving 6 post-graduate students and 5 research fellows, from 4 countries and 6 universities.

## CSR/ROSCOP Parameter Codes

	METEOROLOGY
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

	MARINE BIOLOGY/FISHERIES
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

D09	Sea level (incl. Bottom pressure & inverted echosounder)
D72	Instrumented wave measurements
D90	Other physical oceanographic measurements

B37	Taggings
B64	Gear research
B65	Exploratory fishing
B90	Other biological/fisheries 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 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

	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