RV *Investigator* Scientific Highlights

Voyage #:	**IN2017_V04**		
Voyage title:	The whole enchilada: from production to predation in Tasman Sea ecosystems		
Mobilisation:	0800 Brisbane, Thursday, 31 August 2017		
Depart:	1400 Brisbane, Thursday, 31 August 2017		
Return:	1000 Sydney, Monday, 18 September 2017		
Demobilisation:	1400 Sydney, Monday, 18 September 2017		
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Scientific Highlights

The Chief Scientist

Iain Suthers is a professor at UNSW and at the Sydney Institute of Marine Science (SIMS). He received his PhD in 1989 in Canada, followed by positions in Norway; and Sydney University before a lectureship at UNSW in 1991. This is his 14th voyage on the three vessels which have consecutively served the Marine National Facility. He studies marine ecosystems, from biological oceanography to fisheries ecology. His recent research includes the East Australian Current as it separates from the coast off Port Stephens, forming small 50 km diameter eddies which nurture zooplankton and larval fish. Recently he led the installation of a long-range ocean observing system to provide hourly picture of surface ocean currents off Port Stephens. His most recent project concerns the biological oceanography surrounding the 42 tonne Offshore Artificial Reef, 1.5 km off Sydney Harbour.

Title

From production to predation in the western Tasman Sea.

Purpose

The dynamic ocean habitats are plain to see by satellite and some fisheries are managed by Sea Surface Temperature (SST). Our goal was to convert this physical view to an ecosystem one, by sampling four characteristic oceanographic habitats off the New South Wales coast, and converting the biological samples into a size-based ecosystem. The scientists were divided into three teams:

1. The Blue Team provided the physical context of four classic habitats of the western Tasman Sea, using satellite imagery; over 38 deployments of the Conductivity-Depth-Temperature (CTD); 9 deployments of the Triaxus-Optical Plankton Counter; and deployed over 15 satellite tracked drifters;

2. The Green Team obtained water samples from the CTD at dawn to obtain estimates of phytoplankton biomass, size structure, and primary production. At noon they determined the light levels which drive photosynthesis, and for calibrating with satellite measurements;

3. The two Red Teams deployed plankton nets (for zooplankton and larval fish) and a midwater Danish trawl – a component of the MIDOC system (for small fish, squid and octopus, larval lobster and micronekton), down to 500 m deep (and on two occasions to 1,000 m deep). These samples were sorted, identified, into placed into size categories and some were analysed for trophic level status (carnivore, herbivore etc).

Contribution to the nation

Fisheries productivity is related to seasonal and environmental conditions including climate regimes. At present we have only satellite derived environmental variables of the sea surface for real-time management of fisheries such as lobster and tuna permits. With further analysis, this voyage will deliver a pragmatic, size-based ecological basis to managing our marine estate.

This was a voyage of discovery, sampling 4 eddies off eastern Australia for the first time, with 5 gear types, in day and night, and using the full bioacoustics capability of the vessel. A voyage highlight was the discovery of many larval lobster in an old warm core eddy of eastern Australia. We developed data assimilation techniques and observation directly applicable to the national ocean modelling effort. Analyses are continuing but several new range extensions for fish and squid were made.

Our findings support policymakers and the marine industry through the Integrated Marine Observing System (IMOS) and integrating disparate marine scientists. For genuine integration, in an ecosystem sense, we can now develop more realistic, ecological models that incorporate the IMOS data streams from this voyage's size-structured approach.

For quantitative and cross-disciplinary research training, the Principle Investigators brought on board 6 PhD students, 2 MSc and 1 Honours students, as well as 2 undergraduate students.

As a result of this voyage

1. We have a better understanding of the fisheries ecosystem off eastern Australia, with the potential to forecast the ecosystem across seasons and latitudes underpinning the east coast fisheries. With further analysis, we will link the electronic (acoustic) measurements with actual fish and zooplankton captures.

2. We have found that the large warm eddies which are characteristic of eastern Australia may have similar fish and plankton biomass as the cold eddies, but the size structures are quite different. For example, the cold eddies have more abundant, smaller fishes; the warm eddies seem to be the nursery areas of commercial lobster.

3. We have mapped the mixing and circulation between two characteristic eddy features off south eastern Australia and identified how an oceanographic jet can direct water and production onto the shelf. The importance of these strong landward flows are recognised by some in the commercial fishery, but scientifically remain a mystery, for future voyages to investigate.

4. We have commenced a program to assign these size-sorted samples of plankton and fish to trophic levels with support from ANSTO (Australian Nuclear Science and Technology Organisation) and UBC (University of British Columbia, Canada), to produce the size-based ecosystem for managing fisheries off eastern Australia.