

Abstracts in alphabetical order of presenter

Oral presentations

Seabird bycatch in New Zealand fisheries

Edward Abraham, Finlay Thompson, Yvan Richard
Dragonfly Limited
edward@dragonfly.co.nz

In recent years there has been an increased focus by government and by the fishing industry on reducing seabird bycatch in New Zealand fisheries. This has included the use of a range of mitigation devices; an increase in observer coverage in poorly observed fisheries; and work aimed at understanding the impact of fisheries bycatch on seabird populations. In this talk, we will give an overview of the current status of knowledge of seabird bycatch in New Zealand fisheries. We will assess the efficacy of measures aimed at reducing bycatch, and will discuss directions for future research. These include improving our understanding of cryptic fatalities (seabird fatalities that are not seen by fisheries observers); improving information on seabird distributions and demography; understanding the extent of capture of seabirds in recreational fisheries; improving observer coverage in poorly observed fisheries; and ongoing research on how to manage fisheries operations to reduce the associated seabird fatalities.

Pragmatic investigation of seasonal variation in cadmium to phosphate ratio in the subantarctic section of the Munida Transect

Toyin Adu, Russell D. Frew, Keith Hunter
University of Otago
tadu@chemistry.otago.ac.nz

Proper understanding of Cd oceanic cycling and the actual relationship between Cd and PO_4 in the surface seawater is vital in the recalibration of the Cd paleo nutrient proxy. Recent investigations of the study area have shown seasonal variation in dissolved cadmium concentration as well as Cd/ PO_4 ratio and also low primary productivity as a result of low levels of the essential micro nutrient Fe, as there has been evidence of Fe-stressed algal populations. Thus this region forms a natural laboratory for studying Cd and PO_4 dynamics in the ocean. This talk considers the field measurement of dissolved and particulate Cd and phosphate as well as other bioactive trace metals (Fe, Zn, Co) and nutrients (NO_3 , $Si(OH)_4$) in the Subantarctic section of the Munida Transect, South East, New Zealand. The result shows a seasonal trend in Cd/ PO_4 ratio and a relatively low dissolved Zinc concentration. The shelf input of dissolved iron into this iron-depleted water stimulated phytoplankton growth in summer where microplankton (especially diatoms) dominated the phytoplankton distribution as shown by the drawdown in dissolved silicate concentration. Microplankton may have adapted to the use of Cd for their biochemical functions in this Zinc depleted water. It was evident that the seasonal variation in the Cd/ PO_4 ratio is productivity driven as revealed in the characteristic trends in Cd/ PO_4 ratio, particulate cadmium and chlorophyll-a measurement.

Verification of satellite and space-based remote sensing observations in the coastally oriented Subtropical Frontal Zone (STFZ), Eastern New Zealand

Katherine Baer Jones¹, Nicholas Tufillaro², Kim Currie¹, Christina McGraw³, Keith Hunter¹
University of Otago¹, Oregon State University², USA, Clark University, USA³
kbaer@chemistry.otago.ac.nz

Data acquired from satellite remote sensing instruments allow scientists to monitor and evaluate oceanic processes encompassing a wide variety of spatial and temporal scales beyond the bounds of shipboard measurements. Optical data recorded from these space-borne sensors can be related to common oceanographic parameters such as sea surface temperature, chlorophyll-a pigments and photosynthetic active radiation. In May 2011, I embarked on a trip to the United States to collaborate

with researchers from Oregon State University, Clark University, and the Naval Research Lab (NRL) as part of the 2010 New Zealand Marine Society Student Research Award. At Oregon State University, new algal and coloured dissolved organic matter (CDOM) detection algorithms for the MODIS and MERIS satellite sensors were compared to shipboard data collected from the Munida Time Series transect. At NRL, the shipboard measurements were compared to data derived from the newly released Hyperspectral Imager for the Coastal Ocean (HICO), a space-borne spectrometer launched on the International Space Station. These validations with shipboard measurements in the optically complex coastal Subtropical Frontal Zone off the Eastern Coast of New Zealand provide a comprehensive historical dataset and monitoring system for regional scale processes.

On wastewater discharges, blooming seaweeds and earthquakes: Changes in *Ulva* and *Gracilaria* biochemistry reflect changes in nutrient inputs to the Avon-Heathcote Estuary.

Neill Barr¹, John Zeldis¹, David Schiel²
NIWA¹, University of Canterbury²
n.barr@niwa.co.nz

Historically, massive blooms of *Ulva* and *Gracilaria* in the eutrophic Avon-Heathcote Estuary of Christchurch, have significantly affected both the estuary's aesthetic value and its ecosystem function. With the diversion of Christchurch city's wastewater discharge away from the estuary in March 2010 it was expected there would be close to a 10-fold reduction in nitrogen(N)-loading, which in turn promised a reduction in algal biomass. A three-year Ministry of Science and Innovation funded partnership study between NIWA and University of Canterbury is examining, amongst other ecosystem components, macroalgal biochemical indicators of N-loading. Over the 8 months that followed the initial diversion of the sewage from the estuary there was a 30% reduction in *Ulva* tissue-N and a 60% reduction in *Ulva* tissue-chlorophyll. However, the recent Christchurch earthquakes have caused substantial leakage of untreated effluent back into the estuary via broken sewerage pipes. As a result there has been a return to high levels of N-loading and corresponding qualitative shifts in *Ulva* tissue N-isotopes ($\delta^{15}\text{N}$) which reflect changes in the nitrogen sources that affect the estuary. In conclusion these results endorse the use of *Ulva* as a powerful indicator of both the amount and the source of nitrogen that can affect estuaries such as the Avon-Heathcote.

International effort to minimise ships biofouling - working toward greater global biosecurity

Andrew Bell, Naomi Parker
Ministry of Agriculture and Forestry
andrew.bell@maf.govt.nz

Biofouling on ships' hulls has been identified as the most probable vector for the majority of identified translocations of non-indigenous marine species globally. To address this risk a global approach is required. Shipping has become an essential component of the global economy with the increasing volumes of cargo being transferred at greater speed allowing unprecedented global trade. However, such connectedness poses biosecurity risks that need to be carefully balanced against the benefits of trade. Global efforts have been made to address the risks associated with specific commodities through agencies such as the World Organisation for Animal Health and International Plant Protection Convention. Efforts to address the risks associated with trade pathways but not specific commodities, for example sea containers, have only been made more recently. In the marine environment, the International Maritime Organisation as the responsible United Nations body is addressing the biosecurity risks posed by ships. To date the IMO has addressed the risks associated with ballast water through the ballast water management convention and more recently has begun to address the risks associated with biofouling by drafting guidelines on how ships can reduce their biofouling load. These guidelines are proposed for adoption by resolution in July 2011. This talk will discuss these guidelines and trans-Tasman efforts to support their implementation by international shipping.

Patterns of genetic connectivity among benthic fauna on the Chatham Rise and the Challenger Plateau

Eleanor Bors¹, Ashley Rowden¹, Timothy Shank², Malcolm Clark¹, Els Maas¹
NIWA¹, Woods Hole Oceanographic Institution, USA²
ekbors@mit.edu

Genetic connectivity is a critical scientific component of sound Marine Protected Area (MPA) design. Patterns of genetic connectivity among faunal populations can be used to approximate dispersal distances and migratory pathways, understand the import and export of propagules from marine reserves, and determine the geographic extent of a MPA. Deep-sea communities are vulnerable to anthropogenic disturbance from valuable industries in the New Zealand Exclusive Economic Zone (NZ EEZ), including fishing and mining operations. Currently, levels of genetic connectivity among deep-sea populations throughout the NZ EEZ are not well understood. In order to assess potential management actions and ecosystem resilience, it is important to elucidate the connectivity among populations across a range of taxa and deep-sea benthic habitats. Using multiple mitochondrial markers, this study aims to reveal patterns of genetic connectivity among populations of the galatheid *Munida isos*, the gastropod *Fusitriton magellanicus laudandus*, the polychaete *Hyalinoecia longibranchiata*, and the pagurid *Sympagurus dimorphus* inhabiting the Chatham Rise and the Challenger Plateau. Preliminary results of these connectivity analyses will be presented and discussed with regard to ocean currents in the study area. The results will also be considered in the wider context of seafloor management within the NZ EEZ.

Estimating carbonate saturation and pH from hydrographic data

Helen Bostock, Mike Williams, Sara Mikaloff-Fletcher, Kim Currie, Scott Nodder
NIWA
h.bostock@niwa.co.nz

We have used a multi-linear regression (MLR) technique with hydrographic parameters (temperature, salinity, oxygen) from the world ocean circulation experiment (WOCE) transect line P15S2001, to estimate alkalinity and dissolved inorganic carbon (DIC) in the waters east of New Zealand. Carbonate saturation and pH can then be calculated from the alkalinity and DIC. The data and algorithms show that there are two different regimes in the water column; a shallow regime (<1400 m) and a deep regime (>1400 m). In the shallow regime the alkalinity has a strong correlation with salinity and temperature, while in the deep regime alkalinity is affected by carbonate dissolution and departs from its relationship with salinity and temperature. These MLR algorithms developed on the P15S2001 data have been validated with independent alkalinity and DIC data from two mooring sites either side of the Chatham Rise. We currently have few deep water stations with alkalinity and DIC measurements to determine the pH and saturation horizons within the New Zealand EEZ. Thus if we can approximate the alkalinity and DIC from traditional hydrographic parameters it will be possible to use archived CTD and oxygen data from the last 20 years to provide a better estimate of the spatial and temporal (seasonal and interannual) variations in pH and carbonate saturation states in the New Zealand region. Understanding the natural variability of carbonate saturation in the oceans around New Zealand is critical to provide a context for laboratory manipulations and can also be used in predictive habitat models to understand and estimate the distribution of carbonate organisms. It will also allow us to monitor and predict future changes in the pH and carbonate saturation caused by ocean acidification.

Ice, time, and lost worlds: the distribution of benthic fauna in the Ross Sea

David Bowden¹, Malcolm Clark¹, Stefano Schiaparelli², Judi Hewitt¹
NIWA¹, University of Genoa, Italy²
d.bowden@niwa.co.nz

The benthic fauna of the Ross Sea have been studied since the earliest expeditions, and since at least the 1950's, scientists have attempted to map the distribution of faunal assemblages. In 2008, as part of New Zealand's International Polar Year voyage, we sampled sites on the Ross Sea continental

shelf and northern slope, together with previously unsurveyed seamounts further to the north. By integrating our data with earlier studies, we develop a general map of benthic faunal distributions across the Ross Sea shelf, which we then relate to present and past environmental gradients. Beyond shelf depths, we then describe how the fauna change across the transition from high Antarctic to Southern Ocean environments, and discuss how these present distributions have been influenced by historical events and might respond to future change.

A storm surge prediction system for the New York Metropolitan area

Hamish Bowman¹, Malcolm Bowman², Charles Flagg², Brian Colle²
University of Otago¹, School of Marine and Atmospheric Sciences, State University of New York at Stony Brook²
hamish.bowman@otago.ac.nz

Many, if not most, of the world's great cities are built at the heads of historically productive estuaries or alongside river mouths, areas particularly at risk to coastal flooding due to topographically amplified storm surges. In continental mid-latitudes post-glacial isostatic rebound can exacerbate the problem of recent and future sea level rise by lowering shorelines (in the case of NYC ~30 cm/century). Infrastructure built long ago, trillions of dollars of real estate, and many lives are at risk from the damaging flood waters of major storms. Over the last ten years the Stony Brook Storm Surge Research Group has coupled tidal, atmospheric, and oceanographic models to create an integrated storm surge prediction model and warning system for the waters around the New York Bight. Here we present what goes into designing and deploying such a system, as well as observations and analysis of ensemble performance during several historical events.

The activity of carbonic anhydrase (CA) enzyme in marine diatoms

Afroza Bulbul, Russell Frew, Robert Strzepak, Keith Hunter
University of Otago
bafroza@chemistry.otago.ac.nz

Carbonic anhydrase is a zinc-containing enzyme that catalyses the reversible reaction between carbon dioxide hydration and bicarbonate dehydration and is used for inorganic carbon acquisition by phytoplankton. In the oceans, where zinc (Zn) is nearly depleted, diatoms can use cadmium (Cd) as a catalytic metal atom in cadmium carbonic anhydrase (CdCA). Measurements from the Munida transect have shown that during summer Cd is depleted in subantarctic water because of enhanced biological uptake. Zn concentrations in this water are also extremely low. Cd levels decline significantly during summer probably as a result of iron-induced biological growth. The most likely mechanism for uptake of Cd under Zn-limiting conditions is the formation of cadmium containing carbonic anhydrase (CdCA) enzyme. We collected water samples along the Otago transect bimonthly over one year. Carbonic anhydrase enzymes in the field samples were assayed using spectrophotometric method and the total CA ($\mu\text{g/L}$) of all samples was calculated. The measured enzyme content ranged from (1-6 $\mu\text{g/L}$). Laboratory experiments with manipulated concentrations of Zn and Cd were undertaken to understand the factors influencing the production of CdCA. Results from Zn depleted cultured samples showed a positive correlation between CA enzyme production and Cd repletion.

Ross Sea Antarctic toothfish (*Dissostichus mawsoni*) trophic studies: the lipid extraction dilemma and how to get the best out of stable isotope analysis

Sarah Bury¹, Pinkerton, M¹, Thompson, D.¹, Pakhomov², E., Johnson³, J., Nelson¹, M., Brown, J¹.
NIWA¹, University of British Columbia, Canada², University of Auckland³
s.bury@niwa.co.nz

Ross Sea fish are dominated by a single family, the notothenioids, which comprise half of Antarctic marine fish species and 95% of all fish biomass in the region.

Notothenioids characteristically lack swim bladders and the majority of species are benthic or demersal. However, a depth-related diversification has given rise to some species attaining increased buoyancy by concentrating lipid deposits in tissues and reducing skeletal mineralisation: examples being Antarctic toothfish (*Dissostichus mawsoni*), Patagonian toothfish (*Dissostichus eleginoides*), Antarctic silverfish (*Pleuragramma antarcticum*), and icefish (*Chionobathyscus dewitti*). Antarctic toothfish are particularly lipid-rich with about 10% of their body mass derived from lipids. These lipid-rich species can pose problems to trophic studies when trying to obtain reliable $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ values through stable isotope analysis. In order to establish complete lipid removal from samples analysed during a trophic study of the Ross Sea ecosystem without producing artefacts in the $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ values we carried out extensive experimental analyses on a series of internal laboratory fish standards. We used a combination of fish that we knew to be lipid-rich (Antarctic toothfish) and two Ross Sea fish that had lower lipid content: Whitson's Grenadier (*Macrourus whitsoni*) and icefish (*Chionobathyscus dewitti*). We present $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ data from these standards which underwent three types of sample preparation: no lipid extraction, single lipid-extraction and double lipid-extraction and discuss the implications of these results for other studies analysing high lipid-content materials.

Ontogenetic change and the effects of aquaculture noise on hearing ability of juvenile snapper (*Pagrus auratus*)

Paul Caiger

University of Auckland

pcai007@aucklanduni.ac.nz

The majority of reef fishes have a biphasic life cycle, including a pelagic or dispersal phase where they undergo feeding, ontogenetic development and growth in the open ocean. There is a growing body of evidence that larvae are active in their subsequent orientation and progression back to the reef, with acoustic cues from reefs being potentially important in locating suitable settlement habitats. Auditory evoked potentials (AEP) were used to measure hearing in aquaculture reared snapper (*Pagrus auratus*), with complete audiograms measured for fish ranging in size from 33 to 81mm. Thresholds increased (hearing sensitivity decreased) with size of fish between the frequencies 100-800 Hz. In consideration of acoustic cues playing a role in habitat selection, hearing at these lower frequencies may be of less importance as juvenile fish development continues post-settlement. Wild caught juvenile snapper were also exposed to air 'bubblers' in an aquarium for 2 weeks, and their hearing thresholds were compared to juveniles without this exposure. Bubbler exposed fish were significantly less sensitive to 100 Hz than those without exposure. The audiograms for the bubbler exposed snapper closely resemble those for the aquaculture reared fish of comparable size; therefore hearing thresholds of aquacultured fish or fish held in aquariums may underestimate the true hearing thresholds in fish.

Ocean Threats - Public Perceptions and Actions

Sally Carson, Tessa Mills, Victoria Rosin

University of Otago

sally.carson@otago.ac.nz

The NZ Marine Studies Centre (University of Otago) has been fostering understanding and appreciation of New Zealand's unique marine environment and responsibility towards its conservation. Through community engagement and education, we are raising awareness but are we changing attitudes and behaviours? When interpreting the health of the ocean, research suggests it is better to show people how they can be part of a solution, rather than discussing how they might have been part of the problem. To help in the development of exhibits and programmes on environmental issues we surveyed past visitors to find out what threats to the marine environment they think they have some influence over. Data will be presented on what New Zealanders think they could do as individuals to make a difference. Discussion will focus on how current research findings can be presented to initiate, guide and support public initiatives to improve the health of our ocean.

Imaging the Subtropical Front using seismic oceanography

Joanna K Cooper, Andrew R Gorman, M Hamish Bowman
University of Otago
coojo202@student.otago.ac.nz

Seismic oceanography involves the use of conventional marine seismic reflection methods to identify density and sound speed contrasts within the ocean. These contrasts are caused by temperature and salinity variations; as a result, seismic images can provide insight into the nature of the features associated with those variations, such as thermohaline intrusions, fronts, and eddies. Recent major exploration seismic surveys conducted over the Great South Basin and Canterbury Basin off the east coast of the South Island provide an excellent opportunity to use seismic oceanography to study the Subtropical Front (STF). The STF is the boundary separating warm, saline subtropical waters of the Pacific Ocean from the cool, fresh subantarctic waters of the Southern Ocean. We present images of water column reflectivity in the vicinity of the STF off the coast of Otago, produced by reprocessing seismic data collected over the last 30 years, representing cross-sectional views of temperature structure. These images demonstrate the ability for seismic techniques to complement conventional oceanographic methods such as conductivity-temperature-depth profiling and satellite-derived sea surface temperature data by providing detailed (high vertical and horizontal resolution) images of the position of water column features as well as information about the property contrasts associated with them.

Evidence from the field and laboratory show calcifying macroalgae may be more tolerant to the effects of ocean acidification than previous research suggests

Christopher Cornwall¹, Christopher Hepburn¹, Christina McGraw², Catriona Hurd¹
University of Otago¹, Clark University²
chris.cornwall@botany.otago.ac.nz

Macroalgae are a crucial component of near-shore rocky reef communities, providing food and habitat for a variety of organisms, but are at risk from anthropogenic stressors such as ocean acidification (OA). Oceanic pH is predicted to decrease by 0.3 units due to OA by the end of the century. However, data collected within macroalgal beds indicates that pH fluctuates by 0.5-1.2 units over 24 hours in coastal communities. We grew coralline macroalgae for 40 days under conditions simulating pH conditions at the end of the century due to OA (pH 7.65) and today (pH 8). Each mean pH had two levels of variation: simulating fluctuations within a kelp bed environment (± 0.8 units over a day) and no variation (± 0.0 over a day). Coralline growth decreased in conditions simulating OA. Growth also decreased in fluctuating pH treatments at both mean pH levels. There was no effect of OA on coralline algal health, survival, or recruitment, contrary to previous studies, nor was there any effect of fluctuating pH. This suggests that by the end of the century, the growth of coralline algae could decrease, though their ability to survive and reproduce is unlikely to be affected.

You are adrift on the ocean in a boat with a---. Student participation in bioethics

Steve Cutler
University of Otago
steve.cutler@otago.ac.nz

At the New Zealand Marine Studies Centre, Portobello we continue to meet increasing demand for educational services involving dissections and manipulation of live animals. In doing this we act as the go-between for students and schools to meet Bioethics requirements. The University of Otago Animal Ethics Committee requires all teaching sessions involving the use of animals or animal tissues to be assessed using three questions detailed in the instructions for applications to use animals and to report the assessment results. Recent changes resulting from a National Animal Ethics Advisory Committee directive means that the actual impact on animals used is judged according to a grade system. As educators involved in the life sciences we have a responsibility to engage students in the thinking, practicalities and reflection that help guide personal and communal bioethics. Such

engagement maps a moral landscape that has consequences for protecting New Zealand's marine environment. In the process of our programme assessment we have found that the form the student evaluations take affects the information received. One particular feedback method provided greater detail and depth relevant to the Animal Ethics committee questions and provided clearer waypoints in a developing moral landscape.

Spatial and temporal variation in Fiordland intertidal communities

Robyn Dunmore, Chris Cornelisen
Cawthron Institute
robyn.dunmore@cawthron.org.nz

Unlike their subtidal counterparts, Fiordland intertidal communities have been the topic of very limited research. The intertidal zone experiences the largest variation in physical environment; communities are exposed to a range of salinities, temperatures, light and wave exposures, which vary both vertically within the tidal range and horizontally along the fiords. A low salinity layer is present throughout much of the sounds due to high rainfall and run-off, but Doubtful Sound has been subjected to an additional input of freshwater since 1969 when the Manapouri Power Station became operational, and this has changed the intertidal and shallow subtidal communities significantly. Many species described as relatively widespread pre-tailrace now occur further seaward, and others are restricted to the subtidal. We examined changes in intertidal communities across a variety of spatial and temporal scales, and found that while there were significant changes in horizontal and vertical distributions and abundances of intertidal organisms during the initial operation of the tailrace, the composition and horizontal distribution of intertidal communities in Doubtful Sound have been consistent among separate surveys conducted over the past 26 years. They have remained similar over that time period despite large fluctuations in both rainfall (e.g. wet and dry years) and annual tailrace discharge, and with the addition of a second tailrace tunnel in 2002.

What do New Zealanders Think About Marine Reserves in New Zealand and Where Should They Go?

Tyler Eddy, Bob Zuur, Rebecca Bird
WWF-New Zealand
tyler.eddy@vuw.ac.nz

Recent research commissioned by WWF-New Zealand and undertaken by Colmar Brunton has found that 96% of New Zealanders think that more of New Zealand's oceans should be protected in marine reserves. The average New Zealander thinks that 31% of New Zealand's Exclusive Economic Zone (EEZ) is protected by marine reserves and 36% should be protected. Currently just 0.3% of New Zealand's EEZ is protected in marine reserves, while 20% of the terrestrial environment has equivalent protection. As public desire becomes reality, there is a need to quantify New Zealand's marine biodiversity to ensure decisions to protect marine biodiversity are at the forefront of marine spatial planning decision making. WWF-NZ's past research projects: "Shining a Spotlight on the Biodiversity of New Zealand's Marine Ecoregion", "Treasures of the Sea" and "Future Seas" attempted to quantify what is known about our marine biodiversity, using expert knowledge to produce semi-quantitative resources to inform marine planning. Our next proposed project involves facilitating communication between stakeholders including government, research agencies, industry and non-government organisations to identify information sources and knowledge gaps. We hope that facilitating and contributing to this process will result in the best possible resource to inform marine spatial planning that also meets the needs and objectives of stakeholders.

Great white sharks: wide ranging ocean travellers, but is Stewart Island their home base?

Malcolm Francis¹, Clinton Duffy², Warrick Lyon¹, Kina Scollay
NIWA¹, Department of Conservation²
m.francis@niwa.co.nz

Great white sharks (*Carcharodon carcharias*) are protected in New Zealand waters, but they are still caught in set nets and other fishing gear. The effect of this incidental mortality on their population size is unknown. The Titi (Muttonbird) Islands off north-eastern Stewart Island are an important hotspot for white sharks. A tagging programme has been underway there since 2007 in order to determine their residency patterns, seasonality, migratory behaviour, and ultimately their temporal and spatial overlap with New Zealand coastal fisheries. Most white sharks migrate to tropical regions north of New Zealand from late winter to early summer, and then return to Stewart Island in late summer to early winter. Although long-distance migrations are now reasonably well documented, we know little about their small-scale movements. Our focus has now shifted to the use of acoustic tags, which will be detected by data loggers deployed around north-eastern Stewart Island and Foveaux Strait. This should provide detailed information on spatial and temporal habitat use patterns, and improve our understanding of the extent to which white sharks return to the same place every year.

A Survey of yellow-eyed penguins on Stewart Island / Rakiura 1999 - 2009

Lala Frazer¹, Sandy King¹, Brent Beaven², Sue Murray¹
Yellow-eyed Penguin Trust¹, Department of Conservation²
yeptrust@gmail.com

The Yellow-eyed Penguin Trust and the Department of Conservation carried out a comprehensive census of yellow-eyed penguin numbers on Stewart Island / Rakiura and some of its outliers in 1999-2001. The results showed a much lower than expected number of breeding pairs (79) on Stewart Island / Rakiura compared to a relatively high number (99) on the outliers. Prior to 1999 the estimate for Stewart Island / Rakiura was 470-600 breeding pairs, based on extrapolation from partial surveys carried out in the 1980s and early 1990s but was viewed with some skepticism. These results of the census led to the suggestion that predation of chicks by feral cats on mainland Stewart Island might be affecting breeding success there. A joint project (2003-2008) was conducted to study the factors affecting yellow-eyed penguin breeding success by monitoring breeding success at north-east coast where cats are present, compared to outlying islands where cats are absent. In 2008-2009 an island-wide survey was repeated to determine whether there had been a serious decline in the number of breeding pairs over the whole of Stewart Island / Rakiura or whether it was confined to the north-east coast.

The spoils of dredging - engagement with Port Otago consent applications.

Jim Fyfe
Department of Conservation
jfyfe@doc.govt.nz

In 2008 Port Otago began consultation with the community over plans to deepen Otago Harbour channels to accommodate larger ships. Seven million cubic metres of spoil were to be dredged from Otago Harbour and dumped on the adjacent coast. The Department of Conservation's interest was in the biodiversity and natural values of both the Harbour and dumping site. Public conservation reserves were also adjacent to the proposed dredging channels. A raft of technical and environmental studies and documents were commissioned by Port Otago. Assessing these, and determining whether sufficient assessments and evidence had been provided on the broad range of potential effects, was a major undertaking. Cumulative and specific effects of sediment removal and movement (especially the long term fate of fine silt and clay particles) was a significant concern. Lack of information made assessing effects on birds and some threatened species difficult. DOC chose to negotiate a role in a technical group that will review monitoring and recommend appropriate management responses to Port Otago within an adaptive management framework. How this will operate remains to be seen. However, adaptive management or technical committees that guide

future decisions, and are supported by the company, may provide a model for managing complex consents by major agencies in future. This course of action will need ongoing engagement, but avoids leaving the outcome completely to a consent hearing and appeals through the environmental court that hold uncertainty and high costs.

Seismic evidence of the gas hydrate system in the Pegasus Basin, Southern Hikurangi Margin

Andrew Gorman¹, Douglas¹, R. A. Fraser¹, Ingo A. Pecher², Stuart A. Henrys²
University of Otago, GNS Science²
andrew.gorman@otago.ac.nz

The Hikurangi Margin, east of the North Island of New Zealand, contains a significant gas hydrate province. However, the distribution, concentration and dynamics of hydrate accumulations in the southern portion of the margin (the Pegasus Sub-Basin) off the northeastern coast of the South Island are poorly constrained. In late 2009 and early 2010, a seismic dataset consisting of approximately 3000 km of 2D seismic data was collected in the Pegasus Sub-Basin. The Pegasus Sub-basin is located in the zone of transition between the tectonic regimes of North Island subduction and South Island transpression. The seismic data were acquired using a 12-km-long streamer, providing a grid of data over an area of ~35,000 km², and providing acquisition geometries that facilitate studies based on amplitude variations with offset. Bottom-Simulating Reflections (BSRs) are abundant in the data, and they are supplemented by other features that may indicate the presence of free gas and gas hydrates in zones of high concentration. We present initial results from the study, including high-resolution velocity analysis, providing insight into the nature of interesting seismic features such as bright spots (high-amplitude anomalies) and flat spots (indicating potential fluid contacts).

The intensity, frequency and timing of predation structures reef fish communities

Adrian Stier², Shane Geange¹, Kate Hanson³
Victoria University of Wellington¹, University of Florida², USA, Scripps Institution of Oceanography, USA³
shane.geange@vuw.ac.nz

Studies examining the role of predation in structuring communities often focus on presence or absence of predators, thus emphasizing fixed rather than variable predator densities. In marine systems, spatiotemporal variation in recruitment strength results in considerable variation in abundance of both prey and predators. Yet, few studies have compared variable vs. non-variable predator densities in marine systems. We conducted a 4-month field experiment to assess how the mean and variance of predator density, and the timing of predator arrival affect prey fish abundance and community composition. Experimental treatments included: 1) predator absent, 2) early - two predators for the first two months and no predators for the second two months, 3) late - no predators for the first two months and two predators for the second two months, 4) low density - one predator for the entire four months, and 5) high density - two predators for the entire four months. Relative to the control treatments, the presence of predators reduced average prey density; however, predators increased species richness. For both abundance and diversity, reefs with mean predator densities of 1, and a variance of 2 (early and late treatments) were not statistically different from the low-density treatment (mean predator density of 1 and a variance of 0) suggesting differences in abundance and diversity among reefs were driven by order of predator arrival rather than variation itself. Our results demonstrate that the magnitude of predator effects in structuring reef fish communities is dependent upon both density and timing of predator arrival.

Demersal fish distribution in the Ross Sea

Stuart Hanchet¹, Malcolm Clark¹, Matt Dunn¹, Peter McMillan¹, Matt Pinkerton¹, Andrew Stewart²
NIWA¹, Te Papa²
s.hanchet@niwa.co.nz

Demersal fishes were sampled using a large fish trawl during the BioRoss and IPY surveys carried out in February and March 2004 and 2008 respectively in the Ross Sea region. The distribution and abundance of 65 species collected in these surveys were examined to determine if demersal fish communities varied throughout the area, and if so what environmental factors might influence this. Species accumulation with sample frequency did not reach an asymptote, but the rate of new species caught was low suggesting data were adequate for describing the main components of the communities. Three broad assemblages were identified along a latitudinal gradient from the southern Ross Sea (south of 74°S), central-northern Ross Sea (between latitudes 71°–74°S), and the seamounts further north (65°–68°S). Although this study showed clearly that fish species composition varies latitudinally within the Ross Sea, the environmental drivers of community composition were not straightforward to interpret. Multivariate analyses indicated that environmental factors of seafloor rugosity (roughness), temperature, depth, and current speed were important variables determining the patterns in demersal fish communities.

The life cycle of Antarctic toothfish in the Ross Sea

Stuart Hanchet, Alistair Dunn, Graham Rickard
NIWA
s.hanchet@niwa.co.nz

There have been a number of articles in newspapers, magazines, and science journals over the last 12 months lamenting the lack of knowledge about Antarctic toothfish. Indeed a recent opinion article in *Nature* stated that virtually nothing is known about this fish: no eggs or larvae have ever been collected. So what is known about Antarctic toothfish? In this talk we summarise our knowledge of reproduction, size distribution, and movements of Antarctic toothfish *Dissostichus mawsoni* in the Ross Sea region and develop a plausible life history. Based on the presumed location and timing of spawning, we investigated models that mimic the drift of eggs and larvae over a 6–24 month period using an oceanic circulation model linked to the high resolution global environmental model (HiGEM). The location of toothfish larvae after an 18–24 month period from the models were consistent with the distribution of the smallest toothfish taken in the toothfish fishery. As the juveniles grow in size they move west towards the Ross Sea shelf and then deeper out on to the continental slope as they mature, before undergoing a northwards spawning migration to the Pacific-Antarctic ridge to start the cycle again.

Pathways to fisheries restoration through customary fisheries tools

Christopher Hepburn
Otago University
chris.hepburn@otago.ac.nz

Customary fisheries areas (e.g. mātaītai and taiāpure) can help achieve better management of fisheries by empowering local communities to manage fisheries at finer scales. This approach may be particularly useful in the management of species that exhibit high spatial variability in growth and limited larval dispersal distances such as the black-foot abalone or paua (*Haliotis iris*). An alarming collapse of readily available paua in the intertidal and shallow subtidal zones has been observed in customary fisheries throughout New Zealand. Management of paua fisheries at reef-by-reef scales more appropriate to paua life history and stock size is possible through customary tools and may help restore these depleted fisheries. Paua reseeding programmes will be required in some areas where local stocks have become depleted to levels where recovery will be slow. Perhaps the final hurdle preventing effective management of mātaītai and taiāpure is provided through the fact that the legislation allows management of the fish stock but not the habitat that the fishery relies on. Effective local management alongside reseeding plans as well as a means for the protection and restoration of

important habitats has the potential to play a major role in restoring fisheries in New Zealand for all stakeholders.

Recruitment failure of Western Baltic Spring Spawning Herring - is it caused by food availability for the larvae?

Jan Hesse¹, PD Cornelius Hammer¹, Prof. Gesche Winkler², Dr. Christopher Zimmermann¹, Dr. Daniel Stepputtis¹ and Dr. Christian von Dorrien¹
vTI-OSF, Germany¹, Institut de Sciences de la Mer de Rimouski²
jan@adoris.net

The recruitment of the spawning stock biomass of the Western Baltic Spring Spawning Herring (WBSS) declined between 2004 and 2008 annually by 15-35% and reached a historical low in 2008. In 2009 however, the number of 20mm larvae (n20) reached again the average of the time series. Approximately 80% of the WBSS migrates into the Greifswalder Bodden (GWB), an estuary at the German coast for spawning in a typical retention area from early March into June. It was hypothesized that the zooplankton density and compositions in the years 2008 and 2009 were different causing the recruitment failure in 2008. The density and composition of the zooplankton and the stomach contents of the herring larvae were analysed and it was found that in 2008 the density of nominal prey items was 70,000-80,000 ind.*m⁻³ and about half of what was available in 2009. An extensive literature comparison shows that there are great differences in the field prey concentrations for herring larvae of different stocks and regions. Apparently herring larvae of different stocks survive at far lower prey densities as found in the GWB in 2008. For the WBSS a density of about 200,000 ind.*m⁻³ seems to be optimal. The nominal zooplankton consisted predominantly of *Acartia* developmental stages and adults, and in addition to a small extent of *Eurytemora* and cyclopoid copepod developmental stages and adults. It was found that cyclopoid copepods were positively selected. It is concluded that the high *Acartia*-nauplii density during two weeks in 2009 might have caused the recruitment success in 2009 but that the lower densities in 2008 are not necessarily the cause of the failure in 2008.

When rare species are not

Judi Hewitt, Simon Thrush
NIWA
j.hewitt@niwa.co.nz

Rare species are theoretically important in maintaining the stability of ecosystem functioning, especially in changing environments. However, restricted occurrence or low local abundance is likely to make rare species vulnerable to disturbance and habitat degradation. Moreover, rare species are often habitat-specific and, while this relationship can drive the positive relationship between habitat diversity and species richness, it implies rare species tend to have narrow niches. Temporal dynamics in community composition are also likely to influence the ability of rare species to represent functional insurance against changes. Here we analyse benthic macrofauna data to determine whether species that are spatially rare at the site scale generally (a) demonstrate increases in abundance and occurrence along 2 environmental gradients and (b) are transients (i.e. temporally rare). We find that number of rare species decreases with stormwater contaminants and mud, but few of the rare species exhibit increases along the gradients. We also find that rare species are generally not transients; rather they are consistently present, with many even becoming common at times. These two findings suggest that rare species are an expression of their communities and, thus, are unlikely to generally represent insurance against change.

The feasibility of an electric bycatch reduction device for spiny dogfish

Sunkita Howard

University of Auckland

show056@aucklanduni.ac.nz

Spiny dogfish, *Squalus acanthias*, are a major bycatch species in New Zealand fisheries and the temperate oceans of the world. Bycatch of this low-value shark is a cost to the commercial fishing industry and may not be sustainable, due to life history characteristics that make spiny dogfish populations slow to recover from stock extraction. This study investigated the use of weak electric stimuli to deter electrosensitive dogfish from taking bait, and manipulation of the electric field parameters of frequency and dipole distance to increase deterrent efficacy. Spotted dogfish, *Mustelus lentikulatus*, were used as a model for spiny dogfish in behavioural experiments. All electric treatments significantly reduced a range of dogfish feeding indicators, including bait removal, feeding latency and foraging effort. There was a significant effect of frequency but not dipole distance. These results indicate that development of an elasmobranch-specific electric bycatch reduction device may be possible.

Regional Marine Biosecurity Partnerships - working together to stop the spread of pests

Lou Hunt

Ministry of Fisheries

Lou.Hunt@maf.govt.nz

MAF has set up several partnerships with the aim of preventing or reducing the spread of marine pests and supporting active participation in marine biosecurity. Together with iwi, regional councils, industry, science providers and central government agencies, some significant achievements have been made through these regional partnerships. Work is now underway to support councils in their newly mandated regional leadership role, to roll the regional partnerships out nationally, and to establish a national strategy as an umbrella framework for the regional partnerships to operate within.

Kelp bed habitat drives individual variability in trophic position and resource use of a marine omnivore.

Lucy Jack, Stephen Wing

University of Otago

lucy.jack@otago.ac.nz

Omnivores play an important role in the routing and distribution of organic matter across food webs. We demonstrate a novel approach to quantify the effects of nutritional landscape on niche breadth in terms of basal organic matter sources and provide an example of the influences of habitat on individual variability in trophic position and resource use in a broad-spectrum omnivore, the red rock lobster (*Jasus edwardsii*). Information on the co-occurrence of *J. edwardsii* with kelp bed habitats (*Ecklonia radiata*) and with their preferred prey *Mytilus edulis galloprovincialis* were collected at 60 sites across the Fiordland region. Akaike's Information Criterion (AICc) applied to a series of distance-based linear models (DISTLM) indicated that the presence of mussels was the best predictor of lobster occurrence in the model set. At a subset of sites, we collected lobster muscle samples for stable isotopic analysis and measured demographic parameters: relative abundance, sex and carapace lengths. We characterised habitats with surveys of abundance of the common kelp *E. radiata*, and mussels. Using $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ we calculated individual-based estimates of trophic level and the mixture of organic matter sources: phytoplankton and macroalgae. Using DISTLM, density of rock lobsters and mussel density best explained the variability in lobster diet, while distinct patterns were apparent inside and outside of kelp bed habitat. In kelp bed habitat lobsters fed at a higher average trophic level, with low variability among individuals in trophic level and use of organic matter sources. Outside kelp bed habitat, individual specialisation resulted in broad trophic diversification. The observed patterns indicate a strong bottom-up influence of the nutritional landscape at the scale of the metapopulation which has important implications for understanding nutritional influences on population structure.

Strategies Employed by Communities to Manage Taiāpure

Anne-Marie Jackson, Catriona Hurd, Christopher Hepburn
University of Otago
anne-marie.jackson@otago.ac.nz

Taiāpure is a customary fisheries area management tool that aims to make better provision for the recognition of rangatiratanga and the rights secured in relation to Article II of the Treaty of Waitangi. The legislative provisions for taiāpure are provided in Part IX of the Fisheries Act 1996. This paper will examine how the taiāpure concept is utilised by the East Otago Taiāpure Management Committee (EOTMC). The East Otago Taiāpure was formally gazetted in 1999 and is managed 50% by the hapū of Ngāi Tahu, Kāti Huirapa ki Puketeraki and 50% by community members. Through the taiāpure concept, the EOTMC is able to draw on multiple identities as strategies to successfully manage the East Otago Taiāpure. Four of these identities will be discussed: the community management identity; the Māori identity; the scientific identity and; the environment identity. Each of these identities is utilised to operationalise rangatiratanga for Kāti Huirapa ki Puketeraki as a means to sustainably manage their fishery now and for future generations.

Carbon limitation in macroalgal communities and their response to ocean acidification

Rebecca James, Catriona Hurd, Christopher Hepburn
University of Otago
jamre398@student.otago.ac.nz

Ocean acidification will influence the speciation of inorganic carbon. More CO₂ will be available; this is an energetically cheap carbon source for photosynthesis compared with HCO₃⁻. Increased CO₂ availability could influence macroalgal growth and lead to changes in macroalgal community structure. However, before we can predict how macroalgae will respond to this change in their carbon supply, we require a better understanding of the extent of carbon limitation in macroalgal communities. Community surveys and stable isotope measurements showed more CO₂-only using species were present at wave exposed sites, where CO₂ availability is predicted to be higher due to thinner diffusion boundary layers compared with wave sheltered sites. The carbon uptake kinetics were examined for two common species under two water motion (high and low) and pH (8.1 and 7.6) treatments, showing saturation of photosynthesis at a lower total inorganic carbon concentration at pH 7.6. A 6-week growth experiment with young macroalgal communities at two pH treatments (8.1 and 7.6) revealed that although all communities grew, there was reduced growth for all algae at pH 7.6. This project has shown that greater CO₂ concentrations could positively influence photosynthesis in some species of macroalgae by reducing carbon limitation, however water motion strongly influences this effect.

Update on border management of the biofouling pathway for marine invasive species

Liz Jones
MAF Biosecurity
liz.jones@maf.govt.nz

Biofouling on arriving ships, yachts and other vessels has been the subject of considerable research and analysis with the objective of developing preventative measures to reduce the number of new marine pests arriving and becoming established through this pathway. This presentation gives an update on the resulting import health standard that is about to be released by MAF under the Biosecurity Act and how it will be used to direct border management for all arriving vessels in respect of hull biofouling management. This standard and the preventative measures it establishes represent an example of the way marine science is fundamental in providing a basis for legal instruments used to protect against risks to our marine resources. The presentation will include a picture of how various commissioned research contributed to the final biofouling border system.

A bioeconomic model for Hooker's sea lion bycatch in New Zealand

Viktoria Kahui

University of Otago

Viktoria.kahui@otago.ac.nz

The New Zealand Ministry of Fisheries constrains the incidental capture of Hooker's sea lions in trawl nets of the southern squid fishery by closing the season once an upper limit on sea lion deaths is reached. The regulatory measure is in fact a limit on effort since the number of sea lion deaths is calculated from an estimated mortality rate per standard unit of effort measured in tows. During recent years vessels have been observed to increase the median time per tow suggesting the industry is expanding the capacity of an unregulated input in response. This paper formalises the current situation analytically by constructing a bioeconomic model that captures the idiosyncrasies of the squid fishery and the imposed regulation. Reducing the regulatory constraint to an isoperimetric problem can show how the current management regime may skew incentives leading to the observed increase in tow time. An extension to the current regulatory framework by introducing a spatial dimension to the estimated sea lion mortality rate may lead to more efficient behaviour. Despite retaining an upper limit on sea lion deaths, the profit maximising squid industry is given the incentive to increase effort in areas of high squid density relative to sea lion density.

Near-future CO₂-driven hypercapnia depresses echinoderm larval metabolism by approximately one-third

Miles Lamare¹, Maria Byrne², Sven Uthicke³, Mike Barker¹

University of Otago¹, University of Sydney², Australian Institute of Marine Science³

miles.lamare@otago.ac.nz

Metabolic depression, a reduction in metabolic activities, is an adaptive strategy to minimise the adverse effects of abiotic stressors and hypercapnia. We examined the metabolic response of larvae from eight echinoderm species ranging from Antarctic to tropical habitats in projected near future (year 2100) ocean conditions (0.4 pH lower than present day, pCO₂ (aq) = 1091 to 1450.8 μatm) at their ambient sea temperatures. Metabolic activity was quantified from larval respiration rates, measured in ambient and reduced pH seawater using a microrespirometer. All species exhibited a reduction in metabolic rate (12.3 to 50.9%) when exposed to hypercapnic conditions and this was significant in six species. Across all species metabolism was reduced by ca. 30% when exposed to seawater pCO₂ levels predicted for the year 2100. The data indicated that the level of metabolic depression was not closely linked with basal metabolic rate, despite the broad latitudinal range of the species and between a lecithotrophic larvae and planktotrophic developmental modes. Modelling of data suggest that sea temperature increases (due to global warming) may not be sufficient to compensate for hypercapnia-induced metabolic depression. This is the first study to show that metabolic depression, and its potential for reducing the fitness and viability of small invertebrate larvae, is an important consideration in understanding the effects of ocean acidification on marine organisms.

New Zealand's International Polar Year - "Census of Antarctic Marine Life" project in the Ross Sea region 2008-2011: An overview

Mary Livingston, Stu Hanchet

Ministry of Fisheries

mary.livingston@fish.govt.nz

In February 2008, New Zealand scientists embarked on a highly ambitious, epic voyage to the Southern Ocean, to survey marine biodiversity in the Ross Sea region as a major contribution to New Zealand's collective International Polar Year research effort. In spite of some of the worst summer ice conditions for 30 years, the IPY-CAML voyage successfully sampled 39 sites with 282 gear deployments from the sea surface down to 3500 m, and from the continental shelf and slope of the Ross Sea to unexplored seamounts and abyssal plains immediately to the north. Three years of post-voyage analysis has now been completed. Extensive sample processing and the characterisation of assemblages in these areas identified many new species and new records and a comprehensive

assessment of the link between environment and biodiversity distribution in the region. The results from this project have already been used as inputs to CCAMLR and the management of the toothfish fishery. They have also contributed to bioregionalisation of the area and the development of a science based approach towards MPA proposals that are now under discussion in the political arena. With a strong outreach component, the project also generated a popular science documentary film, over 20 scientific papers and reports and over 50 presentations to scientists, managers, and the general public. Our presentation provides an overview of the project and the voyage, and is a prelude to other papers presented about IPY-CAML results in this session.

Contributions of shallow sedimentary habitats to overall estuarine primary production and nutrient dynamics

Andrew Lohrer, Niall Broekhuizen, Iain MacDonald, Rod Budd
NIWA
d.lohrer@niwa.co.nz

Intertidal flats and estuarine waters <5 m deep are the most productive parts of our coastal ecosystems due to the relatively warm, nutrient-laden, well-lit waters. Annual production by benthic microalgae (microphytobenthos) far outweighs that of phytoplankton in these shallow areas and forms the base of the marine benthic food web. The high productivity in these shallow estuarine habitats is critical to the delivery of goods and services in adjacent coastal systems, even though the contribution of the shallow estuarine habitats may not be immediately recognised by the public. Here, we report on the contributions of benthic microphytes and benthic nutrient dynamics relative to phytoplankton and water column processes in Mahurangi Harbour, north of Auckland. Benthic chamber incubations were performed at three depths during night and day, with dark and light bottle incubations conducted simultaneously at the same three depths. These results were accompanied by data on sediment and water column chlorophyll concentrations. Finally, we collected water samples at three depths every 1.5 hr for an entire day in order to calculate the export of Chla, TOC and nutrients from the estuary to the adjacent coast. Come to the talk to find out what we found out.

Plastic brains and phenotypic sex - possible mechanisms of sex reversal in the kyusen wrasse, *Halichoeres poecilopterus*

Mark Lokman¹, Kiyoshi Soyano²
University of Otago¹, Nagasaki University, Japan²
mark.lokman@otago.ac.nz

Functional sex reversal is a strategy that is geared towards maximizing reproductive fitness. It is commonly employed by wrasses, groupers and marine gobies, whose members are often protogynous - starting life as female and changing to the male phenotype later in life. The hormonal signals and sequential architectural changes that lead to reconstruction of the gonad from an ovary into a testis have been well-documented; however, little is known about the changes that occur in the brain, i.e., the control centre that initiates sex change. We therefore aimed to compare gene expression profiles between brains and pituitary glands of females, transitional males and terminal-phase males of a common Japanese wrasse, *Halichoeres poecilopterus*. We focused our attention on genes that are known to be, or likely to be, expressed in a sexually dimorphic pattern and/or genes that are implicated in regulating reproduction. We also evaluate the effects of prolonged treatment with the neuropeptide kisspeptin on gonadal sex and the expression of these genes in the brain.

Dusky Dolphin Behaviour and Movement Patterns: Effects of Tourism off Kaikoura, New Zealand

Dave Lundquist¹, Neil Gemmell¹, Bernd Würsig²
University of Otago¹, Texas A&M University, USA²
lundquistdave@hotmail.com

Public perception is often that cetacean-watching is low-impact and sustainable. However, questions remain regarding widespread and high-intensity tourism, and effects on health and well-being of wild cetacean populations. Studies >10 years ago of dusky dolphin tourism off Kaikoura led to a voluntary midday rest period and 10-year moratorium (1999-2009) on expansion. The present study used a theodolite connected to a laptop running Pythagoras software to collect group behavioural state and calculate position information for dolphins and vessels in order to assess current effects of tourism. Dolphins swam slower, milled more, rested and socialised less, and changed behavioural state more often when vessels were present than at other times. The greatest effects on dolphin behaviour and movement patterns occurred when >3 vessels were present. Reorientation rate did not significantly change with either the number or type of vessels present. Individual dusky dolphins may be resilient to these changes because they exist in a large and open population that feeds at night in this area. But because resting and socialising are critical daytime activities that are reduced in the presence of vessels, management steps must be taken to protect dolphins and to ensure that negative effects due to tourism activity are minimised.

Modelling the impacts of disturbance on functional diversity of marine benthic communities

Carolyn Lundquist¹, Simon Thrush¹, Giovanni Coco², Mark Pritchard¹, Judi Hewitt¹, Ngaire Phillips¹, David Bowden¹
NIWA Hamilton¹, Universidad de Cantabria²
c.lundquist@niwa.co.nz

Marine soft sediment habitats are modified by disturbances from fishing, mining and other human and natural disturbances. However, the difficulty and expense of sampling in these habitats make it challenging to evaluate the success of different strategies to manage disturbance impacts. Here, we present a seascape model of disturbance/recovery dynamics in benthic communities dominated by both infaunal and epifaunal taxa. We define eight functional species groups, each with different parameters for dispersal, age of maturity, age of mortality and interactions with other species, resulting in varying timelines of recovery from disturbance for each functional group. We use data from field surveys of benthic communities to validate the model using a fuzzy logic approach to translate functional traits of organisms into the eight model functional groups, using inshore surveys from Tasman and Golden Bays, and offshore surveys from the Chatham Rise and Challenger Plateau. We further calibrate the functional interaction matrix and other model parameters based on field data and expert knowledge. Our long term goals are to use the model to correlate spatial and temporal rates of disturbance with the persistence of functional groups in soft sediment ecosystems, thus informing management scenarios to minimise disturbance impacts on seafloor communities.

Rig nursery areas: what makes a good one and what's wrong with the South Island?

Malcolm Francis, Warrick Lyon, Emma Jones, Peter Notman, Christy Getzlaff
NIWA
m.francis@niwa.co.nz

In spring, female rig (*Mustelus lenticulatus*) move into coastal waters around New Zealand, where they give birth to live young. The new-born sharks, about 25-30 cm total length, remain in estuaries and shallow harbours during summer and then depart in autumn-winter. Estuaries and bays appear to function as nursery areas by providing abundant food (mainly crabs) and perhaps protection from predation by large fishes and sharks. A nationwide set-net survey was carried out in February-March 2011 to identify important rig nursery areas. Juvenile rig abundance varied enormously among estuaries. Greatest abundance occurred in Kaipara and Raglan Harbours, moderate numbers in

Waitemata Harbour, Tamaki Estuary, and Porirua Harbour, and only small numbers in Manukau Harbour, Pelorus Sound, and Otago Harbour. No juvenile rig were caught in Tauranga Harbour, Farewell Spit, Whanganui Inlet or Nelson. Thus moderate to large catches were restricted to some North Island harbours. In harbours that produced large catches, catch rates varied greatly among sites. The zero to low catches in South Island harbours were surprising given that major commercial rig fisheries occur in the region. Future work will assess potential human threats to the important North Island rig nurseries.

Management and use of marine resources

Chris Mace
NIWA
crmace@mace.co.nz

New Zealand's marine environment is nationally important because of its immense economic, social and environmental value. Our oceans and coasts are rich with resources, and they make a significant contribution to our economy through fishing and aquaculture, oil and gas exploration and extraction, tourism and recreation, transport and telecommunications links. Our marine environment is globally important both in terms of its biodiversity and because of the unique role our oceans play in understanding how climate change might impact globally.

Managing our marine environment is not an easy task because of its size and diversity. The ocean is a large, interconnected ecosystem, yet we have no explicit over-arching strategy for how we manage it. Getting greater value from our marine resources has never been more important for New Zealand's long-term prosperity but increasing the use of our marine resources means we face increasing difficulty in how we manage them. We have already seen examples of how conflicting interests between building our economic prosperity and protecting our unique marine environment might play out in the future. These conflicts highlight, more than ever, the need for a strong, well-defined, and integrated National Oceans Strategy to inform policy development and guide how our marine environment is researched, managed, and used. And it is essential that organisations involved in marine sciences work closely with each other, and with those managing and using our marine resources, to build our knowledge and understanding of our marine environment and its various interactions.

Management and restoration of cockle beds in New Zealand?

Islay Marsden, John Pirker, Sue Adkins, Henry Couch
University of Canterbury
islay.marsden@canterbury.ac.nz

The intertidal cockle *Austrovenus stutchburyi*, locally known as tuangi, is endemic to New Zealand where it commonly occurs in sheltered sandflats and estuaries. While it is still abundant in some places, recreational collecting, changed seabed use and habitat change have resulted in losses of shellfish beds. This talk reviews the current status of cockle resources in New Zealand and describes some of the methods (including closures and experimental transplants) that have been used to try to re-establish them. Cockle populations differ both within and between locations and recent research suggest that this is often site specific and correlated with habitat disturbance, sediment properties and contaminant levels. We discuss the role of Customary Fishing Regulations and the management of Maori Marine Reserves in promoting cockles as a sustainable shellfishery. We also present results from recent small and large scale transplant studies from the South Island of New Zealand.

Genetic Approaches to Reseeding in New Zealand's Blackfoot pāua (*Haliotis iris*)

Tom McCowan¹, Chris Hepburn² Gerard Prendeville³ and Neil Gemmell ¹

¹ Centre for Reproduction and Genomics, Department of Anatomy and Structural Biology, University of Otago, Dunedin, New Zealand

² Department of Marine Science, University of Otago New Zealand.

³ Paua Mac 7, 30 Boons Valley Road, Waikawa Bay, Picton, New Zealand.

New Zealand's Blackfoot Abalone or pāua (*Haliotis iris*) is a fishery of significant commercial, recreational and customary value. Reseeding has been trialed with promising outcomes in pāua. We are currently investigating how genetic approaches can be used to improve pāua reseeded management practices. We have undertaken a reseeded trial in Tory Channel, Marlborough Sounds, where genetic surveys of hatchery broodstock, wild populations and recaptured individuals has allowed for the determination of survival rates, an assessment of genetic changes during the hatchery process and for wild population structure and recruitment analyses. This study has allowed us to apply this methodology to reseeded in a customary fishery, the East Otago Taiāpure. We have undertaken initial genetic surveys of pāua populations suitable for reseeded within the Taiāpure. This has been complimented with broodstock collection from these areas, the offspring of which will be used to reseed targeted populations. Genetic monitoring of wild, broodstock and reseeded populations can ultimately be used to ensure the viability of reseeded programs and to monitor downstream genetic effects on wild populations. In a customary setting, this methodology can also provide a novel means of maintaining certain elements of tikanga inherent in customary fisheries management.

Ocean acidification and algal reproduction: Separate and compensatory effect of DIC over pH on the ontogeny of giant kelp *Macrocystis pyrifera*

Dr. Michael Roleda¹, Jaz Morris, Christina McGraw², Catriona Hurd¹

University of Otago, Clark University, USA²

jaz.morris@botany.otago.ac.nz

The worldwide effects of ocean acidification (OA) on oceanic species are an emerging concern. However, studies on OA and macroalgae have focused primarily on calcareous species. No studies to date have investigated OA's impact on the early life-history stages of kelp. In this study, spores from *Macrocystis pyrifera* (Laminariales) were exposed to a range of pH treatments from pH 7.6-8.5 in the presence and absence of added dissolved inorganic carbon (DIC). Germination rate under each scenario was quantified after 5 days. Gametophyte development was observed over six weeks at pH 8.14, pH 7.86 and 7.61. In both experiments, acid stress caused a significant reduction in germination, while added DIC had the opposite effect. The rates of pH increase in culture vessels suggest that uptake of CO₂ over HCO₃⁻ is higher in low-pH/high-DIC conditions, indicating a compensatory effect of increased photosynthetic efficiency due to OA. No significant changes in sex ratio of gametophytes were detected between treatments. Our data suggests that OA will have multiple effects on the ontogeny of *Macrocystis*, highlighting the need for further research into the development of other kelp species.

Age and growth of habitat-forming *Solenosmilia variabilis* - an assessment of recovery potential

Helen Neil, Di Tracey, Malcolm Clark, Peter Marriot

NIWA

h.neil@niwa.co.nz

Some species of coldwater corals can form large reef-like structures that provide habitat for numerous other species. These corals can be removed or their integrity affected by physical disturbance from the likes of bottom trawling and seabed mining. Our ability to assess the recovery rate of these habitats and their associated communities is at present compromised by our lack of knowledge on the age and growth of the main matrix-forming coral species. Whilst some research on the age and

growth of some corals has been conducted by NIWA, estimates for the key matrix-forming species remain elusive (globally). Such matrices are constructed by only a few coral species in deep waters throughout the South Pacific. A scoping study to determine the feasibility of ageing NZ's deep sea habitat forming corals has been conducted on specimens of *Solenosmilia variabilis*. This proof-of-concept study confirmed the viability of using radiocarbon difference analyses across a single coral colony. Linear growth rates calculated range from 0.3 to 1.3 mm/yr, in keeping with growth rates reported for matrix/reef forming *Lophelia* (e.g. Mortensen & Rapp, 1998; Mortensen, 2000). Using a conservative estimate of matrix height of ~20cm, it could take hundreds of years for a colony to attain this height.

Distribution, abundance and acoustic properties of Antarctic silverfish in the Ross Sea

Richard O'Driscoll¹, Gavin Macaulay², Stephane Gauthier¹, Matt Pinkerton¹, Stuart Hanchet¹
NIWA¹, IMR, Norway²
r.odriscoll@niwa.co.nz

The IPY-CAML voyage provided the first acoustic estimates of the abundance and distribution of Antarctic silverfish (*Pleuragramma antarcticum*) in the Ross Sea. Using multiple acoustic frequencies allowed discrimination of silverfish from krill and other associated species. Mark identification was confirmed using targeted and random trawling. Silverfish were widely distributed over the Ross Sea shelf. Adult silverfish formed layers at 150

X-radiographs reveal stratigraphic variability over monthly timescales on the muddy and energetic Poverty shelf

Alan Orpin¹, JP Walsh², Reide Corbett², Andrea Ogston³, Richard Hale³
NIWA¹, East Carolina University, USA², University of Washington, USA³
a.orpin@niwa.co.nz

The Poverty Bay continental margin contains a remarkable sedimentary archive of environmental change. Sediment yields in the muddy Waipaoa River catchment today are among the highest on earth; the product of tectonics, easily erodible lithologies, a vigorous maritime climate, and deforestation. Accordingly, terrigenous inputs dominate the marine sediment record on the adjacent continental margin. Significant advances in the understanding of sedimentation throughout the Waipaoa Sedimentary System have been afforded through the MARGINS Waipaoa Source-to-Sink initiative, but the balance of processes that drive sediment dispersal, deposition, and erosion on the energetic continental shelf remains largely unknown. A current project has the goal of determining how the shelf sedimentary record is produced by diverse processes. Around 230 precision multicores were slabbed for X-ray analysis using a portable digital imaging system and subsampled for radiochemical tracers (Pb-210, Be-7). X-radiography was an excellent diagnostic tool for identifying strata and the architecture of sedimentary structures preserved in cores. Provisional comparison of X-radiographs at reoccupied core sites over thirteen months suggests that changes occur over monthly timescales. This approach raises significant philosophical questions about the fidelity and completeness of the geological record, and emphasises the transient nature of many deposits affected by strong oceanographic drivers.

Feasibility of using longline fishery bycatch data to map the distribution of sessile benthic invertebrates on the slope and shelf of the Ross Sea.

Steven Parker, Russell Cole, Stuart Hanchet
NIWA
s.parker@niwa.co.nz

Protecting long-lived, low productivity, and fragile benthic invertebrates such as corals and sponges, first requires some knowledge of their distribution. Most of the area fished in the Ross Sea has never been scientifically surveyed, and the only access to the area is via commercial fishing vessels. High resolution bycatch data (per 1200-m of longline) have now been collected for two fishing seasons,

with 4 728 observations. Several regions with consistent presence of sessile invertebrate taxa bycatch are identifiable, as are several areas of dense fishing effort with no evidence of these taxa. Spatial analysis indicates that the probability of detection for several of these taxa is high enough to assess presence or absence in an adequately sampled area. Video transects on the Ross Sea slope from New Zealand's 2008 IPY voyage were used to characterise the fine scale distributions (i.e. < 600 m) for several taxa. Together, the data show that these invertebrate taxa occur in complex mosaic patterns of small patches dispersed within larger habitats. These results are beginning to show fishery-scale patterns in distribution, which can then inform predictive models of distribution for use by fishery managers.

The nursery effect for juvenile snapper

Darren Parsons

NIWA

d.parsons@niwa.co.nz

The role that structured habitats play as nurseries for juvenile fishes is often stated but rarely tested. For any habitat to function as a nursery it must provide a greater than average per unit area contribution to the adult population than other habitats. Increased abundance, however, does not necessarily infer that a habitat is a nursery. The most practical method of gathering additional evidence of a nursery effect is by establishing increased productivity of that habitat through increased survival and or growth. Therefore, we set out to compare growth and survival rates of juvenile snapper (*Pagrus auratus*) using Artificial Seagrass Units (ASU's) with varying blade density. We tagged juvenile fish (including snapper) that recruited to these ASU's with individually numbered coded microwire tags. This presentation provides some insight from this experiment into the dynamics of snapper recruitment and the importance of structured habitats such as seagrass beds to adult populations.

Possible chronic impacts of potential climate change on the distribution of estuarine mysids (*Tenagomysis* spp.) of South Island, New Zealand.

Sourav Paul, Dr. Gerry Closs, Dr. Keith Probert, Matthew Downes

University of Otago

souravpaul4@gmail.com

In estuaries mysid shrimps are a critical link between benthic and pelagic food webs, and form a large proportion of faunal biomass. *Tenagomysis* spp. are abundant in estuaries of New Zealand, but surprisingly, are poorly studied. The study investigated combined effects of change in salinity (0-33) and temperature (5-20°C) on the survival and osmoregulatory capacities of *Tenagomysis chiltoni* and *Tenagomysis novaezealandiae*. Salinities of 15-25 and temperature of 20°C were most favourable for survival except in extremes of fresh and seawater. Both species maintain body fluid concentrations at species-specific levels over a range (0-33) of environmental salinities, and the iso-osmotic points are within 15-20, which corresponds with their lowest mortality. Statistical analysis showed their survival and osmoregulation are closely related to the changes in temperature rather than salinity. Experimental results were compared with field observations that suggest an interaction between salinity and temperature may drive the spatial distribution of *Tenagomysis* in estuaries. The results highlight the potential sensitivity of estuarine systems to climate-mediated changes in temperature and sea level.

A Pre-history of fishing in New Zealand

Chris Paulin

Museum of New Zealand Te Papa

chrisp@tepapa.govt.nz

The relatively low densities of Māori populations in New Zealand prior to European contact had little or no impact on the vast stocks of fish around the coasts except in very small, localised areas.

Although the archaeological record of fish bones in middens, the historical record of Māori fishing activities and Māori fish names in early New Zealand literature, or the oral histories submitted to the Waitangi Tribunal cannot provide full and exact details of Māori fishing activities, we can conclude that Māori had a good knowledge of, and used extensively, all of those fish species that were available in coastal and inshore waters that could be captured with the available technology. Distance from shore, rather than depth was the main limiting factor however, an estimated depth limit of Māori fishing of between 50 and 100 metres can be inferred. Increasing population, and the introduction of new preservation techniques by Europeans soon led to commercial harvesting exceeding the productivity of many fisheries. Commercial mullet fishing in the northern harbours collapsed before the end of the nineteenth century, and although some people began expressing concerns it was considered that overfishing was restricted to localised areas close to fishing ports. Expansion of European interests into commercial fishing in the late 1800s led to increasing government regulation and conflict with Māori rights which had been guaranteed under the 1840 Treaty of Waitangi.

Maui's anchor

Neville Peat
npeat@clear.net.nz

Stewart Island/Rakiura has a place in New Zealand maritime history out of all proportion to its size and population, beginning with its status as the southernmost permanently settled corner of Polynesia. No part of the island's human history avoids contact with the sea, from centuries of muttonbirding to pioneer Pakeha shipbuilding, fishing, tourism, even farming. The island was the anchor of Maui's fabled fishing canoe and with Cook's *Endeavour* expedition of 1770, it blew away two thousand years of European mythology about the existence of a Great Southern Land. In the vicinity of Stewart Island, the ocean circulation has some interesting twists and turns to it. Neville Peat has written several books about the island, most recently *Rakiura Heritage* (Department of Conservation 2010).

Growth of a newly arrived range-extender in New Zealand: a comparison with the case of Tasmania

Danilo Pecorino, Miles Lamare
University of Otago
pecda015@student.otago.ac.nz

The sea urchin *Centrostephanus rodgersii* (Agassiz 1863) has recently undergone an expansion of its range southward, towards Tasmania, and eastward, to northern New Zealand and its offshore islands. This expansion is likely to be due to the change in strength of the East Australian Current and, consequently, to the increase in the annual average seawater temperature and potential to transport larval stages further from their place of origin. We are presently undertaking a study on the growth, reproduction and larval biology of the species in Northern New Zealand, as little is known of the biology and ecology at this site. By means of tag-recapture techniques and subsequent non-linear regressions on growth after 1-year, we built growth models for the species in north New Zealand to compare with the Tasmanian population. Age estimates were performed and validated and morphological data were compared, as well. The maximum size of the two populations proved to be similar, while growth rate appears to be higher in New Zealand, despite a much larger Lantern Index (usually interpreted as a clue for poorer nutritional status).

Science requirements for identification and protection of vulnerable marine ecosystems

Andrew Penney¹, John Guinotte²
Ministry of Fisheries¹, Marine Conservation Institute, USA²
andrew.penney@fish.govt.nz

The adoption in 2007 of UNGA Resolution 61/105 on Responsible Fisheries, and the 2009 FAO Guidelines for Management of Deep Sea Fisheries, established obligations for participants in bottom

fisheries in the high seas to prevent significant adverse impacts on vulnerable marine ecosystems. What does this mean? What are VMEs? What are significant adverse impacts? How should the risk of significant impacts be assessed? What would qualify as adequate protection measures to prevent significant impacts? Given the scarcity of data on high seas benthic biodiversity patterns, what other information might be useful in predicting occurrence of VMEs? With current research funding constraints, how might such information be collected, generated or improved? These questions have created substantial challenges for the recently negotiated South Pacific Fishery Management Organization (SPRFMO). As the main bottom fishing nation in the SPRFMO Area, an overview of the initiatives taken by New Zealand to answer these questions will be presented, management actions implemented in response to the bottom fishery impact assessment for this fishery will be evaluated, and options for collecting information needed to improve management will be suggested. Lessons learned and approaches developed on the high-seas are useful to management of vulnerable ecosystems within New Zealand waters.

Ecosystem modelling of the Ross Sea: validation and insight from the International Polar Year Census of Antarctic Marine Life (IPY-CAML) voyage

Matt Pinkerton, Janet Bradford-Grieve
NIWA
m.pinkerton@niwa.co.nz

We present an end-to-end food web model of the Ross Sea and validation data derived from the recent New Zealand International Polar Year Census of Antarctic Marine Life (IPY-CAML) voyage to the Ross Sea region. Information required to develop trophic models is typically incomplete and a novel method is presented to adjust the initial parameter set to give a balanced model taking into account the estimates of parameter uncertainty and the large range of magnitude (>6 orders of magnitude) in trophic flows between groups. Data for the validation of the trophic model of the Ross Sea were collected during the New Zealand IPY-CAML survey of the Ross Sea region in February/March 2008. Diet and trophic linkages of species were measured by two approaches: (1) gut contents analysis, especially of the fish community; (2) stable isotope analysis.

Habitat complexity and biodiversity: bryozoan patch-reef size, and polychaete biodiversity on the New Zealand continental shelf

Anna Wood¹, Keith Probert^{1,2}, Ashley Rowden²
¹University Of Otago, ²NIWA
woan929@student.otago.ac.nz

Large, heavily-calcified bryozoans dominate an area of continental shelf of south-eastern New Zealand (Otago shelf, 46°S), about 500 km², in water depths of 80–150 m. The cyclostome *Cinctipora elegans* dominates small patch reefs which grow to about 15 cm tall and <1 m² in area. Reefs are interspersed with heterogeneous muddy gravels in which biogenic material (molluscan and bryozoan) is an important constituent. Diverse in- and epifauna are associated with these biogenic habitats. We examine the relationship between habitat complexity generated by bryozoans as live colonies and as constituents of sediment, and the biodiversity of associated polychaetes, using the naturally varying quantities of bryozoan material in each sample. Thirty large grab samples were collected from 80 m water depth, and each was divided into a small sediment sample, epifauna including bryozoans, and infauna. Faunal samples were washed on 5 mm, 1 mm and 0.5 mm sieves and sediment samples analysed using standard procedures. Polychaetes were identified to the lowest possible taxonomic unit, and multivariate analyses were used to examine the relationship between polychaete species and trophic diversity, and the habitat generated by bryozoans as epifauna and as sediment. Here we present data on habitat and associated fauna from the 5 mm sample fractions. Our findings may have important implications for management of these fragile shelf habitats, which are threatened by commercial fishing.

The Conservation Services Programme - Research into fishing interactions with protected species

Kris Ramm
Department of Conservation
kramm@doc.govt.nz

The Conservation Service Programme (CSP), administered by the Department of Conservation, is a legislated programme which was set in place with two explicit aims. To firstly understand the nature and extent of adverse effects from commercial fishing on protected species in NZ fisheries waters and secondly to develop effective solutions to mitigate against, these adverse effects. The work of the Conservation Services Programme is funded largely through levies charged to the commercial fishing industry and has operated for the past 16 years. Over this time CSP has funded a large number of research projects ranging from ongoing observer coverage onboard commercial fishing vessels, trialling of methods for mitigating against captures of protected species and population studies on certain species such as New Zealand sea lions and black petrels. This talk takes some case studies from the work which has been conducted by CSP over its history, discussing some of its successes as well as areas of further development and outlooks into the future.

Photo-ID estimates of southern right whale abundance in the Auckland Islands calving grounds

Will Rayment¹, Simon Childerhouse²
University of Otago¹, Australian Antarctic Division²
will.rayment@otago.ac.nz

Southern right whales were hunted to the brink of extinction in New Zealand by commercial whaling, but populations are presumed to be increasing since protection in 1935. We aimed to quantify this recovery and investigate population parameters in the sub-Antarctic Auckland Islands, the primary known calving area. Photo-ID surveys were conducted in Port Ross during annual 3-week long expeditions from 2006-2010. All whales except calves were recognisable owing to the unique pattern of callosities on the head, resulting in a catalogue of 378 individuals. Mark-recapture models allowing temporary emigration from the study area were implemented using the robust design in program MARK, with competing models ranked by AIC. The best model had capture probabilities varying by primary sampling period, with Markovian temporary emigration by mature females and random temporary emigration by other whales. Estimates of abundance on the calving ground varied from 183 (95% CI: 41-807) in 2007 to 328 (259-414) in 2010. The model averaged estimate of non-calf survival rate was 0.964 (95% CI: 0.725-0.996). Using the estimates from the best model incorporating random temporary emigration, the size of the super-population (i.e. whales associated with the survey area during the course of the study) was estimated to be 1184 (1032-1358) in 2010. This study provides up to date population parameters for southern right whales in New Zealand and establishes a baseline with which to assess population recovery.

Risk of commercial fisheries to seabird populations within the NZ EEZ

Yvan Richard¹, Edward R. Abraham¹, Dominique Fillippi²
Dragonfly Limited¹, Sextant Technology Ltd²
yvan@dragonfly.co.nz

New Zealand is a global centre of seabird diversity, and some studies estimate a high number of seabird captures in commercial fisheries within the Exclusive Economic Zone (EEZ). The impact of these captures on species viability depends on demographic parameters such as population size, survival, and productivity. For 64 New Zealand seabird species, we examined the risk from bycatch in commercial trawl and longline fisheries. For each species, the risk was assessed by comparing the number of birds killed annually in fisheries, to the Potential Biological Removal (PBR) index, which represents the number of human-induced fatalities a species can sustain. Among the studied species, the black petrel (*Procellaria parkinsoni*) clearly stood out as the species the most at risk from

commercial fishing activities within the EEZ, with fatalities in fisheries estimated to be around 10 times higher than the PBR. The risk was high for 19 other species, although the risk was sometimes driven by our cautionary approach for dealing with the lack of observations in inshore fisheries. The benefits of the approach in guiding fisheries management and seabird research, as well as its limitations, will be discussed.

Photosynthetic response of monospecific macroalgal stands to density

Derek Richards, Catriona L Hurd, Daniel W. Pritchard, Stephen R. Wing, Christopher D. Hepburn
University of Otago
derek.richards@otago.ac.nz

Photosynthesis by benthic marine macroalgae makes an important contribution to the productivity of coastal seas. Current estimates of macroalgal productivity are often based on photosynthetic characteristics of thallus pieces or whole thalli, not from groups of individual as is typical in situ. These methods have the potential to overestimate rates of productivity, as they do not account for neighbourhood shading effects that may reduce photosynthetic rates in dense macroalgal stands. In order to determine if productivity estimates based on individuals differ from those based on communities, a controlled laboratory experiment was conducted with three dominant sub-canopy macroalgal species (*Cystophora scalaris*, *Xiphophora gladiata* and *Undaria pinnatifida*) from Southern New Zealand. Photosynthetic parameters (initial slope of the P-E curve, saturation irradiance E_k , maximum rate of photosynthesis P_{max} and dark-respiration R_d) were obtained via photosynthesis vs. irradiance (P-E) experiments using a custom-built respirometry chamber for a range of densities that corresponded to the minimum, average and maximum densities of these species in the field. A five to seven-times decrease in P_{max} was observed when the density of the algal stand was above 1 individual m^{-2} and R_d were also lower in communities than for individuals. Our results illustrate that single-specimen estimates of productivity based on O_2 evolution could substantially overestimate community productivity.

Ocean Warming: an experimental articulation

Jennifer Rock
University of Otago
jennyrock@otago.ac.nz

A shortcoming of science communication about climate change is the lack of public engagement. Effective engagement requires an emotive component and yet it is difficult from our mammalian perspective to conceptualise the effects of a 2-4 °C change in environmental temperature. Consequently we are incapable of empathy with change confronting the vast majority of organisms on this planet that are not homeotherms. Visual narratives formed by the organisms themselves, and sensory representation through a creative sci-art approach may be a key to better conceptualisation and engagement. Here I present preliminary results from a project seeking to creatively communicate the far-reaching effects of ocean warming by representation of ectotherms' responses to increased temperature. 2 °C Different: ARTiculation of warming, was initiated as a pilot study in 2011, with creative contributions from masters students in the Centre for Science Communication, University of Otago.

Interactive effects of two key species on soft-sediment ecosystem state and variability

Ivan Rodil, Drew Lohrer, Mike Townsend, Luca Chiaroni, Simon Thrush
NIWA
irodil@niwa.co.nz

The objective of this study was to understand the combined effects of two key species that occur in subtidal soft-sediment systems throughout New Zealand. This aim was achieved using a preliminary survey of three sites in the Mahurangi Harbour where the densities of the two species naturally varied, followed by a long-term manipulation of their densities in controlled experimental treatments across

sites. Horse mussels *Atrina zelandica*, and heart urchins *Echinocardium cordatum* are individually known to have a strong influence on sediment traits including microphyte productivity and macrofaunal community. The experimental treatments established at each site reflected the natural densities of the species across sites (*Atrina* alone, *Atrina* and *Echinocardium* together, *Echinocardium* alone), and there was a treatment lacking both species. After a six month period, macrofaunal abundance and richness was highest in the *Atrina* only treatments. However, the facilitation of macrofauna by *Atrina* was entirely negated in the presence of high densities of *Echinocardium*, as *Echinocardium* had a strong negative effect on macrofaunal abundance and richness. Ten to fifteen *Echinocardium* per m² was identified as a threshold density beyond which macrofaunal abundance and richness was limited.

Population genetic structure of the New Zealand estuarine clam *Austrovenus stutchburyi* (Bivalvia: Veneridae) reveals population subdivision and partial congruence with biogeographic boundaries

Phil Ross¹, Ian Hogg¹, Conrad Pilditch¹, Carolyn Lundquist², Dick Wilkins¹
University of Waikato¹, NIWA²
pmr16@waikato.ac.nz

We examined the population genetic structure of the New Zealand endemic clam, *Austrovenus stutchburyi*, to determine: 1) whether populations of this estuarine taxon are genetically subdivided; and 2) if the locations of genetic boundaries were congruent with known biogeographic break points. 372 *A. stutchburyi* were collected from 29 New Zealand estuaries and mitochondrial cytochrome c oxidase I sequences and microsatellite markers analysed to identify genetic structure. We detected a pattern of genetic isolation-by-distance and identified six *A. stutchburyi* subpopulations, a greater number of subpopulations than reported for much of New Zealand's open coast benthos. Although these data indicate that long distance dispersal may be less frequent in estuarine than in open coast taxa, partial congruence between genetic and biogeographic boundaries suggests that historical events and natural selection may also contribute to the observed population genetic structure.

Spatial and Temporal Variation of the Iron Speciation in Surface Waters of the Otago Continental Shelf

Sylvia Sander¹, Feng Tian², Enitan Ibisani, Kim Currie³, Russell Frew¹ and Keith A. Hunter¹
University of Otago¹, Temasek Polytechnic, Singapore², NIWA³
sylvia.sander@otago.ac.nz

A time series of a surface transect across the Otago Continental Shelf was undertaken between 2000 and 2008 to measure the dissolved iron concentration (DFe) and organic complexation of iron, as well as macronutrients and general hydrographic data. The study area contains three distinct water masses: 1) neritic water; 2) the Southland Current (SC), derived from the Subtropical Front (STF); 3) Subantarctic Water (SAW). Variations in nutrient concentrations in the study area indicated that SAW is the predominant source of nitrate and phosphate to the shelf. Dissolved iron concentrations dropped seawards from several nanomolar to sub-nanomolar levels. The dissolved iron was fully complexed with strong organic ligands in all three water masses, and the ligand concentrations also showed a slightly seaward decreasing trend. Trends in dissolved iron and the iron-binding ligand concentrations related to season were obvious in neritic waters. Concentration maxima occurred during late spring and summer months, and concentration minima occurred in the middle of each year (winter months). Dissolved iron concentration was low (~0.1 nM) in SAW year round. Data from the present study are in support of SAW being classified as a high nitrate low chlorophyll (HNLC) water body.

Estuarine trophic subsidies to coastal mollusc dominated communities: positive and negative effects on functional diversity

Candida Savage¹, Simon Thrush², Drew Lohrer², Judi Hewitt², Luca Chiaroni²
University of Otago¹, NIWA²
candida.savage@otago.ac.nz

Carbonate sediments enhance habitat heterogeneity and diversity and play an important role in carbon storage and ecosystem function. The functional diversity of these open coast ecosystems can be influenced through positive (food subsidies) and negative (land-derived sediment) inputs from estuaries. We present data on shifts in community structure and diversity in mollusc dominated habitats along estuary-coast gradients in two locations on the Coromandel peninsula. The influence of estuary-derived food sources across these gradients for the key bivalve, *Dosinia subrosea*, was characterised using chemical markers in multiple tissues that reflect relatively recent and integrated diets. We also discuss the influence of food supply and sediment impacts on growth of *Dosinia subrosea* across estuary-coast interfaces. The research highlights the importance of estuarine conservation as a means of maintaining healthy ecosystem structure and function in coastal mollusc dominated communities.

From New Zealand to Antarctica and back: a round-trip ticket for symbiotic polychaetes

Kareen Schnabel¹, Maria Chiara Alvaro², Marco Oliverio³, Andrea Barco³, Geoff Read¹, Stefano Schiaparelli⁴
NIWA¹, Italian National Antarctic Museum, Italy², University of Rome, Italy³, University of Genoa, Italy⁴
k.schnabel@niwa.co.nz

Several recent studies show that, in the Southern Ocean, 'symbiotic' associations are widespread and more common than previously believed. Here we illustrate the ecological, morphological and molecular characterization of one of the best known Antarctic association, the one occurring between the polyxenous polynoid polychaete *Polyeunoa laevis* McIntosh, 1885 and its several cnidarian hosts. Samples were collected in the Ross Sea, from 70 to 1990 m, mainly during the 2008 NZ 'IPY-CAML' Tangaroa cruise and their DNA sequences are integrated with other samples from different Antarctic expeditions. A group of *Polyeunoa*-like polychaetes from New Zealand has also been added to the Antarctic molecular dataset for comparison. On the whole, 118 sequences have been obtained and allowed to reconstruct the phylogeography of this peculiar association. Molecular evidences suggest the existence of at least five different cryptic species of *Polyeunoa* and indicate that the group originated outside Antarctica, in deep water basins off New Zealand. After colonization of Antarctica through 'polar emergence', the group radiated further and colonized seamounts off Antarctica and, secondarily, the deep water basins off New Zealand.

The fate of algal remains in Doubtful Sound, Fiordland

Susanne Schüller, Candida Savage
University of Otago
schsu070@student.otago.ac.nz

Doubtful Sound represents a model estuarine system to study how fluctuating physicochemical gradients alter sediment records of algal productivity. The head of the fjord (Deep Cove) experiences a highly stratified water column with a 3-5m low salinity layer while the outer fjord has a well-mixed water column. These physical gradients strongly influence phytoplankton production, as well as the fate of algal remains in Doubtful Sound. In this study, we investigate how phytoplankton remains are altered, preserved and degraded as they settle out of the water column and get incorporated into the long-term sedimentary record. Degradation and preservation processes in the water column and sediment are evaluated using phytoplankton pigments as biomarkers in sediment traps, surface sediment samples and sediment cores to create a temporal and spatial picture of algal remains across Doubtful Sound. Using a multi-proxy approach by complimenting phytoplankton pigments with diatom analyses (surface sediment, sediment cores) and stable isotopes analyses (surface sediment)

we are able to better understand processes that affect sedimentary records of productivity in estuarine and fjord environments.

Ocean colour, sea ice and in situ biogeochemical data during the IPY R.V. Tangaroa voyage to the western Ross Sea, Feb-Mar 2008

Jill Schwarz, Mike Williams, Marieke van Kooten, Mark Gall, Matthew Pinkerton
NIWA
j.schwarz@niwa.co.nz

At high latitudes, frequent cloud and ice cover affecting ocean colour data lead most remote sensing researchers to rely on monthly chlorophyll composites. Because of the complex biophysical interactions, use of monthly composites risks missing or over-smoothing the strongest chlorophyll signals. We analysed satellite and ship-borne (underway and discrete) data from the IPY voyage (TAN0802) of the R.V. Tangaroa to assess the value of satellite products in the Ross Sea. Monthly ice concentrations were found to be exceptionally high during the voyage season, and persistence of the 80:100% ice class was longer than the 9-year (2003 to 2011) norm. Ocean colour data were strongly affected by cloud and ice. Of 898 MODIS 5-minute granules which included some portion of the Ross Sea, 583 granules contained some useful ocean surface coverage. Significant chlorophyll concentrations were observed in the satellite data in the eastern, western and northwestern Ross Sea. Of these, only the southeastern bloom was sampled by the ship. Nitrate was depleted at the bloom, but NO₃:DRP remained relatively constant at ~11.5 mol:mol). Here, we show the distributions of remotely-sensed parameters, sub-pixel variability in chlorophyll and POC and the appraisal of monthly ocean colour composites.

The impact of Coumaphos on the antioxidant metabolism in *Ulva* sp.

Katja Schweikert, David J. Burritt
University of Otago
katja.schweikert@otago.ac.nz

Coumaphos is one of several organophosphates used in the process of wool scouring. Effluents from this process reach coastal waters without any treatment, carrying organic substances with half-lives of up to 5 years in soils and sediments, and several months in water. Consultation with a Māori elder from Bluff identified an obvious loss of coastal life, from shellfish to seaweeds, along several parts of the coast of the South Island of New Zealand. These observations were made over the past 40 years, along a coastal area fed by the Oreti River catchment. Water eco-toxicity tests are commonly conducted on invertebrates and fish, but not on plants and algae, neglecting the less obvious impacts toxin contamination can have on primary producers. For the people of Ngāi Tahu the seaweeds *Durvillaea antarctica* (Rimurapa), *Porphyra* sp. (Ngāi Tahu Claims Settlement Act) and *Ulva* sp. are of traditional importance, so we are investigating the ability of these seaweeds to cope with organic pollutants. This is the first report of the impact of Coumaphos, on *Ulva* sp. Enzymatic and non-enzymatic antioxidant levels were measured along a time course experiment over a period of seven days. For the assessment of free radical development and oxidative damage hydrogen peroxide and lipid hydroperoxide levels were measured.

The Ngai Tahu Customary Fisheries Protection Areas Project: Restoring Rangatiratanga

Nigel Scott
Te Rananga o Ngai Tahu
Nigel.Scott@ngaitahu.iwi.nz

This presentation will outline the project that is being conducted by [Toitu Te Whenua](#) to facilitate the establishment of a co-ordinated network of customary fisheries protection areas (CPA) spread throughout the [Ngai Tahu Whanui Takiwa](#). This project will ensure [Ngai Tahu](#) maximise the effectiveness of CPA both individually and collectively, whilst minimising the impact on the commercial fishing sector. [Ngai Tahu Whanui](#) are well aware that it is not possible to protect all

traditional fishing grounds of significance using CPA and that each established area management tool will impact on the establishment of any other within a given quota management area. It was therefore essential that [Ngai Tahu Whanui](#) acknowledged this cumulative effect and co-ordinated and planned the establishment of CPA in order to protect the most significant mahinga kai areas and to ensure a good spread of customary protection is achieved around the entire takiwa. Toita Te Whenua has conducted extensive background research through a range of reference material as well as interviews with [Ngai Tahu Tangata Tiaki/Kaitiaki](#) and key [Ngai Tahu](#) individuals in order to identify the customary fisheries of significance that warrant CPA establishment. The outcome of the project so far has been the identification of a number of fishing grounds around the [Takiwa](#) □ that require CPA. Mataitai Reserves are a common tool identified for enacting CPA, alongside special customary fisheries regulations and new taiapure.

The effects of 11-ketotestosterone on migratory behaviour and sea water pre-adaptation in the shortfinned eels,

Alvin Setiawan, Matthew J. Wylie, Erin L. Forbes, P. Mark Lokman
University of Otago
alvin.setiawan@otago.ac.nz

Freshwater eels (*Anguilla* spp.) are famous for their long-distance oceanic spawning migration. Before undertaking this migration, immature non-migrant adults in freshwater must undergo a dramatic transformation (silvering) into their migrant form involving systemic physiological, morphological and behavioural changes. Associated with these changes is a dramatic increase in the serum levels of 11-ketotestosterone (11KT). More importantly, exogenous 11KT induces the physiological changes that are closely associated with silvering in both sexes. In this study, we investigate the possible role of 11KT in modulating downstream migratory behaviour and salinity preference in the New Zealand shortfinned eel (*A. australis*) and its effects on physiological preadaptation to sea water. Migrant, but not non-migrant, eels readily showed preference for downstream locations in a raceway and evidence indicating physiological preadaptation to sea water, but no corresponding effects due to 11KT were found. However, our observations did indicate that 11KT treatment may heighten general activity (restlessness) levels, the first report of a behavioural effect of 11KT on anguillids. These results suggest that while 11KT clearly has an important role in modulating silvering, it alone cannot induce all the necessary changes.

The commercialisation of marine science - what is the price of independence?

Elisabeth Slooten
The University of Otago
liz.slooten@otago.ac.nz

Marine science is becoming increasingly commercialised. As government funding and research budgets shrink, universities and other research agencies increasingly fill the gap with commercial funding. How will this affect research priorities and our ability to provide independent advice on marine management and conservation? Evidence of conflicts of interest include research on the impact of noise on marine mammals, with different results reported depending on whether the work was funded by oil and gas companies or other government and non-government agencies. Journals such as *Nature* and *Science* now require authors to explicitly acknowledge ties with industry, and some research providers state that commercial sponsors will not be able to modify the text of the final report. New Zealand's Chief Science Advisor expressed concern about the low rate of collaboration and ideas flowing from universities and research institutions to business. However, the British Association for Advancement of Science warns that closely linking science with economic growth undermines science and public trust in scientists. Providing truly independent science advice will require major changes to science funding. This talk outlines some of the key arguments in this debate, in order to encourage discussion about the commercialisation of science among the membership of NZMSS.

Argonauta at risk: dissolution and carbonate mineralogy of egg cases

Abigail Smith¹, Kennedy Wolfe², Maria Byrne²
University of Otago¹, University of Sydney, Australia²
abby.smith@otago.ac.nz

Cephalopods are champion mineralisers. Nautilids produce robust external shells and internal mineralised tissues; *Spirula* makes an internal chambered spiral; sepiids produce flat “cuttlebone;” squids and octopi produce beaks and statoliths. Most cephalopod carbonate is aragonite, but one squid is an exception: the female *Argonauta* secretes a fragile calcitic spiral egg-case. Three argonaut cases were collected at Batemans Bay, NSW, Australia. Four replicate pieces from each were immersed in seawater of varying pH: 8.2 (ambient), 7.8, 7.6, 7.4, 7.0 and 6.5. Weight loss was measured after 7 and 14 days. Dissolution rate increased with decreasing pH, with less than 1% loss in 14 days at pH 7.8, 5% loss at pH 7.4, and 20% loss at pH 6.5. Carbonate from all treatments was analysed using x-ray diffractometry, showing no significant changes in mineralogy as shells dissolved. The pelagic life-habit of cephalopods makes them particularly vulnerable to ocean acidification. Unlike an internal skeleton, which can be protected from seawater while still needed, the *Argonauta* egg case is exposed to sea water from inception. These egg cases, unprotected by mucous or epithelium, with high surface-area and low volume are vulnerable to dissolution as ocean pH decreases.

Hagfishes – S’not what you’d expect

Clive Roberts,¹ Andrew Stuart¹, Vincent Zintzen¹, Carl Struthers¹, Peter Smith²
Museum of New Zealand Te Papa Tongarewa¹, NIWA²
andrews@tepapa.govt.nz

Hagfishes (family Myxiniidae), are the subject of numerous evolutionary, physiological and ecological studies, but have not been well researched taxonomically. As recently as 1989 the New Zealand region was believed to contain just three species. Deep-sea sampling by the Te Papa Fishes Team using baited traps and video has caught large numbers of specimens, and, with the use of molecular and morphological techniques has increased the species count to eight.

Common dolphin bycatch in New Zealand mackerel trawl fisheries

Finlay Thompson¹, Edward Abraham¹, Katrin Berkenbusch²
Dragonfly Limited¹, Otago University²
finlay@dragonfly.co.nz

Observer coverage of the mackerel trawl fishery in New Zealand waters between 1995 and 2009 allowed evaluation of common dolphin bycatch (*Delphinus delphis*) on the North Island west coast. Observer data were used to develop a statistical model to estimate total captures, and to explore covariates related to captures. A two-stage Bayesian hurdle model was used, with a logistic generalised linear model predicting whether any common dolphin captures occurred on a tow, and a zero-truncated Poisson distribution estimating the number of dolphins captured. Over the 14-year study period, there were 108 common dolphin captures reported by observers, with capture events frequently involving more than one individual. The model explored several factors that might contribute to dolphin captures. Dolphins were more likely to be caught when the headline depth was less than 30m, than when it was deeper. In the 2008-09 season, an estimated 25 common dolphins (95% c.i.: 13 to 52) were captured in the mackerel trawl fishery.

Changes in nature and the nature of change in our coastal ecosystems

Simon Thrush

NIWA

s.thrush@niwa.co.nz

My talk will discuss how environmental science, and ecology in particular, can inform environmental management and policy making for coastal marine ecosystems. Research has progressed in the last couple of decades from a focus on individual events and local impacts to much broader scales. Shifts to more ecosystem-based approaches to management seek to reframe resource use conflicts by increasing the scope of ecosystem assessments and the depth of knowledge used to assess the consequences of change. The potential for ecology to contribute to these management processes are significant, through raising the profile of important ecosystem goods and services, the recognition of cumulative and multiple stressor effects and habitat fragmentation. Equally important, is the appreciation that ecosystem responses surprise us because feedback processes can result in threshold responses or regime shifts in coastal ecosystems. I will use some examples from our field research to illustrate how these ideas are ground in our understanding of ecosystem function. They have important implications for the resilience of coastal ecosystems and raise some important challenges for future research that will only be fully resolved through integrated research programmes. Progress in these challenges is essential if ecology is to effectively contribute to management and maintenance of biodiversity and ecosystem function in our multi-use coastal ecosystems.

Potential predatory impact of the invasive paddle crab, *Charybdis japonica*, in Waitemata Harbour: implications for functional change

Michael Townsend¹, Drew Lohrer¹, Ivan Rodil²

NIWA¹ University of Vigo, Spain²

m.townsend@niwa.co.nz

The Japanese paddle crab *Charybdis japonica* was first observed in Auckland in 2000 and is now found throughout the Waitemata Harbour and Hauraki Gulf. Despite the predation potential of *Charybdis*, almost nothing is known of its impacts in New Zealand. Accurate ecological information is critically important in non-indigenous species risk management, therefore we need to understand the impacts of *Charybdis* on benthic communities. We present results from a subtidal caging experiment designed to document the predatory impacts of *Charybdis* whilst feeding in the presence and absence of functionally important pinnid bivalves, *Atrina zelandica*. The effects of *Charybdis* on overall macrofaunal abundance or diversity were more subtle, as *Charybdis* appeared to specifically target larger macrofauna (i.e., large macrofauna had reduced abundances in cages with crabs relative to controls). Gut content analysis from 53 *Charybdis* specimens found a range of species consumed, with a significant presence of *Echinocardium cordatum* across both habitats (77% of full guts contained *E. cordatum*). Results will be discussed in relation to the functional roles of both *A. zelandica* and *E. cordatum* for ecosystem process regulation and invasion resistance, and will be used to refine a MAFBNZ conceptual model for species interactions in the Waitemata Harbour (2008).

Identification of iron-siderophore chelates in the offshore waters, East of New Zealand

Imelda Velasquez, Enitan Ibisani¹, Brook Nunn², Keith Hunter¹, Sylvia Sander¹

University of Otago¹, University of Washington, USA²

ivelasquez@chemistry.otago.ac.nz

It is known that iron (Fe) is an essential nutrient for phytoplankton growth in the marine environment. Due the poor solubility of Fe, and low input into large areas of the global ocean, like the Southern Ocean, Fe becomes a limiting factor for primary productivity in these areas. Dissolved Fe generally occurs complexed to organic ligands. The similarities in the stability constants of these ligands with the stability constants of known siderophores, led to the assumption that these ligands may be or include siderophores. In this study, naturally occurring siderophores were detected using high performance liquid chromatography coupled with mass spectrometer (HPLC-MS) in off shore waters

surrounding New Zealand. Hydroxamate-type siderophores (mainly ferrioxamine types) dominated the study areas in neritic, Sub-Antarctic and mesotrophic surface waters off the eastern coast of New Zealand. The results were strongly supported by chemical assays and electrochemical measurements. This is the first time that siderophore-type chelates have been detected in iron limited waters of the Southern Ocean. The information on the presence and distribution on these siderophores coupled with physical properties of the water and Fe speciation could help in understanding Fe biochemical cycling in the area.

Scaling Up Power Output from Tidal Turbine Farms

Ross Vennell
University of Otago
Ross.vennel@otago.ac.nz

To make a significant contribution tidal turbines must to be grouped in large farms generating hundreds of Mega Watts from the high flows along tidal channels. A critical question is how much power can be obtained from a given number of turbines? Ideally installing 100 one MW turbines would produce a 100MWs of power. However extracting power from tidal currents also slows flows along a channel, which limits power production. This makes answering the question complex, particularly when gaps within rows of turbines are required to allow navigation of vessels and marine life along the channel. The power extracted by tidal turbine farms is ultimately a compromise between maximising power production and the maximum fraction of the cross-section turbines can be permitted to occupy and the maximum environmentally acceptable flow reduction. The upper limit for the average power obtainable is around 240MW for Kaipara Harbour and around 15,000MW Cook Strait. However if only 10% of the channels' cross-sections can be filled with turbines, then the largest average output from 10 rows of turbines falls to 46MW and 800MW respectively.

Investigations into the feasibility of managing a non-indigenous marine species at sites with high community values.

Kathy Walls¹, Emily Jones²
Ministry of Agriculture and Forestry¹, Golder Associates (NZ) Ltd²
katherine.walls@maf.govt.nz

The Australian tunicate *Pyura praeputialis* (*Pyura*) was first recorded from the Far North in 2007. This species dominates the mid-low rocky intertidal shore of the Bay of Antofagasta, Chile, where it is thought *Pyura* arrived via shipping over 100 years ago. In New Zealand, *Pyura* could displace native species and impact on economic, environmental and socio-cultural values. A delimiting survey showed that *Pyura* is widespread in the Far North and that eradication is not possible. However, local elimination of relatively small, isolated populations from sites which are important to local communities may be feasible. The feasibility of local elimination of this tunicate was investigated. Two clearance sites and a control site were established in the Far North. Six months after the first clearance, there was very low recruitment evident at both the clearance sites and in monitoring plots that had been cleared at the control site. However, densities at the control site appeared to have increased outside the cleared plots. The results thus far suggest it may be feasible to maintain populations at low densities in semi-isolated localities. Interesting questions are beginning to emerge about the ability of this species to rapidly colonise and occupy space on intertidal hard substrates.

Identifying Nutritional Content of Potential Prey of Spiny Lobster Larvae

Miao Wang, Andrew Jeffs
University of Auckland
mwan108@aucklanduni.ac.nz

Unsuitable diets and feeding regimes are blamed for the consistent occurrence of high mortalities in larval culture of spiny lobsters, one of the world's most valuable seafoods. To identify the natural diet and nutritional requirements of spiny lobster phyllosoma for predicting the composition of an effective

artificial feed, nutritional analyses has been conducted on potential phyllosoma prey species captured off the coast of New Zealand, including two species amphipod, three species of chaetognath, two species of salp, and three species of shrimp. In samples of each of these, we analysed the content of water, ash, protein, carbohydrate and lipid. All of these species have high water content, from 81.5% to 96.7%. Salp and chaetognath have higher ash content (around 70% and 50%), while amphipod and shrimp are less than 20%. Proteins are the dominant proportion of proximate matter in all taxonomic groups, followed by lipids, with carbohydrates making up generally less than 5%. The results of this study show that phyllosoma larvae are probably relying heavily on dietary sources of protein to supply both metabolic energy and biochemical resources for anabolism. This conclusion tends to be confirmed by other related studies on the metabolism of spiny lobster phyllosoma.

Monitoring organic enrichment of coastal sediment with sediment profile imagery

Peter Wilson, Kay Vopel
Auckland University of Technology
peter.wilson@aut.ac.nz

The majority of organic carbon supplied to the coastal seafloor is mineralised by sulfate reduction, a bacterially mediated reaction that releases hydrogen sulfide (H₂S) into the sediment porewater. H₂S readily reacts with sediment iron compounds to form iron sulfides that are responsible for the distinct black colouration of organic-rich sediment. Most of these sulfides convert back to H₂S when treated with acid and are known as the acid volatile sulfides (AVS). AVS analysis has long been used to assess the metal toxicity of sediment but it may also provide a proxy for the organic carbon flux, that is, the rate of organic carbon deposition. This rate is of interest for environmental managers worldwide dealing with the effects of organic enrichment on coastal ecosystem functioning. The measurement of AVS, however, has not been adopted in routine environmental monitoring. One reason for this is its laborious nature. We will show how we can overcome this problem by measuring AVS in situ and at high resolution using sediment profile imagery. To do so, we will explore the relationship between sediment colour and the concentration of AVS, and then demonstrate how this correlation can be used to rapidly map the spatial distribution of AVS.

Lowstand glacial landforms and fluvial systems east of Campbell Island, New Zealand

Gary Wilson, Andrew Gorman, Hamish Fraser, Scott Preskett
University of Otago
gary.wilson@otago.ac.nz

In March 2009, a detailed high-frequency seismic survey was undertaken in Perseverance and Northeast harbours and across the shallow platform on the eastern side of the Campbell Island in order to examine the floors of the fiords and adjacent shelf for evidence of glacial processes and associated sedimentation. Data were collected using the University of Otago Research Vessel *Polaris II* and included single-channel Chirp and electro-acoustic (boomer) sub-bottom imaging, and interferometric side scanning sonar (C3D). A network of ~42 lines was collected over 4 days of surveying. Sediment grab samples were collected from the shelf and short (3m) piston cores were collected from inside the harbours. The combined dataset shows that terminal moraines coincide with the mouths of Perseverance and Northeast harbours and that the harbours give way to a now infilled v-shaped valley network that dissects the shelf. Despite subaerial exposure of the shelf at the last glacial maximum, glaciers apparently did not extend out on to the shelf. Instead the shelf was eroded by river systems presumably sourced from the glaciers which occupied the valleys on-shore. The submarine channels are now infilled with gravelly and shelly drift, which also forms low-angle dune structures on the sea floor.