New Zealand Marine Sciences Society & Oceania Chondrichthyan Society 2015 Conference Abstracts

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Te Papa Atawhai

New Zealand Marine Sciences Society & Oceania Chondrichthyan Society 2015 Presentations

Tuesday | 915 | Rm. 260-098

|| Big Oceans, Big Thinking: a broad scale view of current pressures and future challenges for the Pacific Ocean and the opportunities for marine research

Keynote: Andrew Chin

Centre for Sustainable Tropical Fisheries and Aquaculture, James Cook University

The Pacific is the largest and deepest of the world's oceans. It holds immense biodiversity and is crucial to the survival and livelihoods of millions of Pacific peoples who rely on it for trade, income, resources and services, and food security. Ocean seascapes and biodiversity are also integral to the cultural identify, health and well-being of many Pacific peoples. Unfortunately this vital resource is threatened by multiple and increasing pressures. This talk will provide a primer on the scale and diversity of the Pacific and outline the Big Challenges the Ocean faces. Case studies will illustrate issues and opportunities in tuna fisheries, the conservation of Pacific sharks, the shark fin trade, and the impacts of climate change. In spite of the challenges, the Pacific provides Big Opportunities for discovery, collaboration and conservation that offer exciting opportunities for marine research. However, the problems facing the Pacific and its peoples are complex and will require Big System Thinking. Case studies will be described that show how Big System Thinking can bring about effective and long-lasting change, and illustrate a Big System Thinking approach for marine scientists working in the Pacific to consider.

|| Tracking individual space-use in an apex marine predator – The Chatham Island Brown skua (*Catharacta lonnbergi*)

Hendrik Schultz, Todd E. Dennis, Anne C. Gaskett & Craig D. Millar

The University of Auckland

Top predators are crucial for ecosystem function, but are particularly vulnerable to environmental change. The Brown skua is the dominant avian predator throughout the Chatham Archipelago, an important and pristine habitat for rare and endemic seabirds. Alarmingly, skua numbers are declining at this major breeding site in New Zealand. Brown skua space-use is suspected to overlap with farming and fishing operations, but it is unknown to what extent such interactions are driving the decline of the Chatham population. This study combines high-resolution GPS telemetry (minute intervals over multiple weeks) and coarse-scale geolocation (daily position fixes over years) to record perennial skua movements. Precisely, we investigate whether space-use patterns overlap with potential threat areas and if such dynamics differ among individuals. We hypothesise that space-use decisions will vary according to sex, breeding stage and social status. During the 2014 season 27 Brown skua were GPS-tracked at five-minute intervals for 14 to 33 days. With a mean fix-success-rate of 92.1 Â± 3.8% and more than 120.000 location fixes in total, we present first-ever high-resolution movement data revealing so far unknown foraging strategies of this marine apex predator.

Tuesday | 945 | Rm. 260-073 OGGB4

|| Developing New Indicators of Environmental Health for Estuaries

Islay Marsden

School of Biological Sciences, University of Canterbury

Estuaries are one of the most threatened of all marine ecosystems, being impacted by numerous anthropogenic and natural stressors. The Environmental Indicators Programme has been designed to assess the effects of environmental pressure on complex ecosystems. When assessing healthy ecosystems several components are usually considered including water and sediment quality and biodiversity. In this talk I consider other potential indicators of ecosystem health using recent research on the ecology, behaviour and physiology of estuarine molluscs. Estuarine molluscs are integral to the sustainability of estuarine function. Shellfish provide habitat structure, increase species diversity, transfer and recycle resources, improve water quality and provide food for predators and people. Bivalves are effective metal bioindicators for contaminants and microbial pathogens, and show biomarker responses to stress. Recent research also shows that mollusc growth and population parameters are effective bioindicators of estuarine health. When quantified these responses provide resources for coastal management. They allow comparisons of ecosystem health between estuaries and can be used to detect natural and other disturbances. Currently in the Canterbury Region they are being used to assess the effectiveness of estuarine restoration programmes.

|| Seasonal, diel and tidal differences in the distribution of larval fish in Tauranga Harbour

Nathania Brooke[1], Phil Ross[1], Chris Battershill[1], Tom Trnski[2] & Keith Gregor[3]

[1]University of Waikato, [2]Auckland Museum & [3]Bay of Plenty Polytechnic

Estuaries are important nursery habitats for many fish species on account of their high primary production and shallow warm waters. While the value of estuaries as a nursery habitat for juvenile fish is well demonstrated in New Zealand and worldwide, the importance of estuaries for larval life stages is less certain. Here we conducted a series of investigations to better understand the significance of estuaries as nursery habitats, migrational routes and feeding grounds for larval fish.

Larval fish community composition, and tidal and diel distribution patterns were assessed in Tauranga Harbour. Intensive sampling was conducted over the summer period and a reduced level of sampling conducted over a 12 month period. Nineteen species were recorded, with the anchovy *Engraulis australis*, triplefins and gobies as the taxa most frequently recorded. The diel phase was the most important variable, followed by the tidal phase. Very low recruitment was recorded in the second summer of sampling, possibly explained by differences in ocean temperatures. A choice chamber experiment was also conducted to assess whether fish larvae could distinguish between water of oceanic and estuarine origins and whether this might influence species found in estuaries.

|| Inferring movement behaviour in fluid environments: a case study of grey-faced petrel (*Pterodroma macroptera gouldi*)

Jingjing Zhang[1], George L.W. Perry[1], Ashleigh J. Robins[1], Graeme A. Taylor[2], Claire M. Postlethwaite[3] & Todd E. Dennis[1]

[1]The University of Auckland, [2]Department of Conservation & [3]Department of Mathematics, The University of Auckland

Movement of self-powered animals is the net-effect of individuals and the interactions with their environment. With the rapid development of movement ecology, inferential models, as one means of understanding movement behaviour, have become popular analytical tools. Seabirds are unique central-place foragers, and unlike most terrestrial and marine species they travel and forage within fluid media (i.e., atmosphere and ocean). This provides challenges when interpreting their behaviours from individual foraging trajectories. This study aims to identify the types of at-sea behaviours of the grey-faced petrel, a pelagic seabird species, and to explore the factors that shape their behavioural patterns. We collected movement trajectories of grey-faced petrels using high-resolution (every 30s) GPS devices. The analysis includes using a Hidden Markov model to categorize at-sea activities of the birds, and a vector analysis to explain their behavioural strategies in a temporally heterogeneous environment. Our results show three principal types of behaviours along the foraging trips of this species. We conclude that interactions between grey-faced petrels and sea-surface winds are primary drivers of their space-use and behavioural patterns.

|| Assessing ecological community health in coastal estuarine systems impacted by multiple stressors

Joanne Ellis[1], Dana Clark[1], Jim Sinner[1], Caine Taiapa[2], Judi Hewit[t3] & Simon Thrush[4]

[1]Cawthron Institute, [2]Manaaki Te Awanui, [3]NIWA & [4]The University of Auckland

Urbanization of the coastal zone and increasing run-off from agriculture and forestry has increased the number of large-scale and chronic impacts affecting coastal ecosystems. The need to assess cumulative impacts is a major motivation for the current desire of managers and ecologists to define ecosystem “health” and “stress”. A number of univariate metrics have been proposed to monitor health, including indicator species and ratios and diversity metrics. Alternatively, multivariate methods can be used to test for changes in community structure due to stress. We developed Multivariate Models using statistical ordination techniques to identify key stressors (mud, nutrients and heavy metals) affecting the ‘health’ of Tauranga macrofaunal communities. The multivariate models were found to be more sensitive to changing health than simple univariate measures. Density responses of functionally important species were also analysed, by regression models, to identify interactions between stressors. All taxa modelled were constrained by a combination of sediments, contaminants and nutrients with both synergistic and antagonistic interactions. The use of regression analysis and ordination models can therefore play a critical role in understanding the likely effects of multiple stressors. “

Tuesday | 1000 | Rm. 260-092 OGGB3

|| Using light trap arrays to characterise the distribution and on-shore movement of larval reef fish in the lead-up to settlement

Daniel McNaughtan & Jeff Shima

Victoria University of Wellington

Many marine species have a pelagic larval stage, which can facilitate long-distance dispersal and highly variable settlement to shape patterns of recruitment to adult populations. Unfortunately, the small size of larvae challenges empirical studies of their distribution and patterns of movement in the lead-up to settlement. We deployed an array of light traps to evaluate the distribution and putative on-shore movement late-stage larvae (i.e., ~2 weeks younger than settlement-stage fish) of the common triplefin (*Forsterygion lapillum*). Our results indicate that late-stage larvae are found surprisingly close to reef systems, and vary in their depth preferences with distance from shore. We also evaluated variation in morphologies, ages, and growth histories (estimated from daily growth increments of otoliths) of sampled fish. Our results suggest behavioural patterns and preferences of larval reef fishes that challenge conventional thinking, and we discuss the potential implications for larval dispersal and recruitment variability.

|| Hutton's shearwater foraging behaviour ascertained by time-depth loggers

Della Bennet, Dr. Sharyn Goldstien, Dr. Travis Horton & Prof. Jim Briskie

University of Canterbury

Every August, the Hutton's shearwater (*Puffinus huttoni*) returns from their Australian winter foraging grounds to breed in the Seaward Kaikoura mountains and at a predator-proof enclosure on the Kaikoura Peninsula. Monitoring this species is challenging as they spend their life predominantly at sea, making it difficult to observe their migration and moulting patterns, and to quantify their diet. Although adults return to breeding colonies at night when parents swap incubation duties and feed chicks, Hutton's shearwaters can spend numerous days at sea without returning to land. While at sea, large flocks of birds are observed rafting and flying, but foraging is rarely seen. To learn more about their foraging behaviours, we deployed time-depth loggers on eight adult birds from 24 November 2014 to 25 January 2015. Individual birds were observed for 12 to 36 days, with birds recaptured to download data and to retrieve loggers. Diving depth varied between incubation and post chick hatching. Diving behaviour changed over the time of day and length of each foraging episode. These results indicate that the foraging by Hutton's shearwater in the breeding season is varied and their conservation requires protection of both the land-based colonies as well as their at sea foraging areas.

Tuesday | 1015 | Rm. 260-073 OGGB4

|| Distribution of Sedimentary and Biological Trace Elements in Estuaries: Gaps, environmental monitoring and further concerns

Julien Huteau

Environmental Research Institute, University of Waikato

Estuaries, the interface between the land and the ocean, are an irreplaceable natural resource providing ecosystem services supporting high diversity and high productivity. However, human populations have increased rapidly around estuaries discharging domestic and industrial waste carrying organic and inorganic contaminants. Due to their location and varied morphological characteristics, estuaries are a sink for pollutants such as heavy metals. Anthropogenically derived chemical cocktails can have irreversible consequences on the ecological state of estuaries. Furthermore, shellfish can bio-accumulate metals to levels that may be considered as a threat when consumed by humans.

We examined urban and connected rural environments, and report on the distribution of 13 trace elements (B, Al, V, As, Cr, Ni, Cu, Zn, As, Cd, Pb, U, K) in surface and subsurface (core) sediment samples; together with trace element profiles of four co-located estuarine species (*Ulva lactuca*, *Zostera marina*, *Amphibolla crenata*, *Autrovenus stuchburyi*). A chemical index from species' analyses is correlated with their physiologies and compared to national and international standards. The work permits localisation of source(s) of contaminants and supports a new approach to current "NZ" environmental monitoring programmes.

Tuesday | 1015 | Rm. 260-092 OGGB3

|| Otolith microchemistry reveals evidence and population consequences of shared larval dispersal histories in a marine fish

Jeff Shima & Steve Swearer

Victoria University of Wellington & University of Melbourne

Larval dispersal is disproportionately important for marine population ecology and evolution, yet our inability to track individuals severely constrains our understanding of this key process. We implement a novel analysis of otoliths of a small reef fish, the common triplefin (*Forsterygion lapillum*), to reconstruct individual dispersal histories and address the following questions: (1) How many discrete sets of dispersal histories ('dispersal cohorts') contribute to replenishment of focal populations; (2) When do dispersal cohorts converge (a metric of shared dispersal histories among cohorts); and (3) Do these patterns predict spatio-temporal variation in larval supply? We used light traps to quantify larval supply, and otolith microstructure and microchemistry (using LA-ICPMS) to reconstruct daily environmental histories of individuals in their 30-day lead-up to settlement. Our results indicate a variable number of dispersal cohorts replenish focal populations (range: 2-8, mean=4.3, SD=2.8). Convergence times varied (from <0d to >30d prior to settlement), and larval supply was negatively correlated with cohort evenness but not with the number of cohorts, or when they converged indicating disproportionately large contributions from some cohorts (i.e., sweepstakes events). Collectively, our results suggest that larval reef fishes may variably disperse in shoals, to drive local replenishment and connectivity within a metapopulation.

Tuesday | 1030 | Rm. 260-098

|| Marine sensory ecology: examining chemical ecology in seabirds and the use of sensory-based conservation

Megan Friesen, Anne Gaskett & Jacqueline Beggs

The University of Auckland

Marine animals, active in the extreme conditions of the ocean, often exhibit specialized sensory adaptations to communicate, navigate, and forage. Procellariiform seabirds (including petrels and albatrosses) live entirely on pelagic oceans, are highly philopatric, and many return to dense breeding colonies at night where they often nest in underground burrows. These behaviors likely indicate a multi-modal use of specialized senses. For example, nocturnal breeding behavior has emphasized the importance of auditory cues in many petrel species. Additionally, Procellariiformes (tube-nosed seabirds) are noted as having one of the largest avian olfactory bulb to brain size ratios, and are thought to use chemical cues for foraging, and burrow and mate location. The use of odor for communication and recognition indicates distinct chemical profiles. We hypothesized that within the order of tube-nosed seabirds, species-specific chemical profiles would be evident and likely used as inter-specific distinguishable traits. We also have evaluated the use of senses in conservation of seabirds and the applicability of these techniques to other taxa that share key behavioral traits (e.g. pelagic, colonial, philopatric).

|| Macrofauna community composition drives denitrifier response to nutrient loading

Emily Douglas[1], Conrad Pilditch[1], Casper Kraan[2], Louis Schipper[1], Andrew Lohrer[2] & Simon Thrush[3]

[1]University of Waikato, [2]NIWA & [3]The University of Auckland

Denitrification is one of few ways to remove nitrogen from coastal ecosystems. This microbial process is mediated by environmental conditions and by the activities of resident macrofauna. We do not know to what extent variation in macrofauna community composition influences denitrification, yet this is important as anthropogenic stressors are altering benthic biodiversity. To test this, a nutrient enrichment experiment was set up across a 300,000 m2 area of inter-tidal sandflat. Four treatment combinations of macrofaunal functional diversity (high/low) and functional abundance (high/low) were replicated 7 times within the study area. At each site, 1 m2 plots consisting of a control (no addition), medium (150 g N/m2) and high (600 g N/m2) nitrogen enrichment treatments were established. Treatments significantly increased pore water ammonium concentrations after 5 weeks of enrichment. We hypothesised that higher functional diversity and functional abundance would provide resilience to nutrient stress through facilitating denitrification. Results showed that denitrification enzyme activity (DEA) was highest (470 % of control rates) at sites with fine sediments, and high abundance and diversity of macrofauna. Conversely, DEA was supressed by nutrient enrichment (1 % of control rates) when site abundance and diversity were low. These results support our hypothesis and highlight the importance of community structure for ecosystem function in the face of environmental change.

Tuesday | 1030 | Rm. 260-092 OGGB3

|| Is bigger always better? An experimental evaluation of size-selective predation on young reef fish

Phoebe Caie & Jeffrey S. Shima

Victoria University of Wellington

Size-selective predation at settlement is widely considered to be an important source of mortality for many young reef fish (e.g., the 'Bigger is Better' hypothesis). However, the strength and direction of selection (and how this potentially changes with ontogeny) is still poorly understood. We evaluate patterns of size-selective predation on young stages of the common triplefin (*Forsterygion lapillum*). Previous studies on this species suggest that larval growth histories may affect survival independently of size (e.g., because fast-growing fish may settle sooner, but not necessarily bigger). We established mesocosms (1000L tanks with cobble substrate, a stipe of *Cystophora*, and predators - *Forsterygion varium*) and manipulated densities of common triplefin of two discrete age classes (pre-settlement larvae and post-settlement juveniles). We found predation to be size-selective on larval fish but not on older juveniles. We also extracted otoliths from survivors and from fish consumed by predators (i.e., dissected from the guts of predators) and evaluated vulnerability of young fish to predators as a function of larval age and/or growth histories. Our results clarify the relationship between early life history traits and survival after settlement.

|| Chick provisioning behaviour and foraging ecology of breeding mottled petrels, *Pterodroma inexpectata*

Rachael Sagar, Brendon Dunphy, Margaret Stanley & Matt Rayner

School of Biological Sciences, The University of Auckland & Auckland War Memorial Museum

Gadfly petrels (genus *Pterodroma*) are a group of small to medium sized seabirds with a broad distribution throughout the world's oceans. Despite their former ubiquitous distribution throughout New Zealand, very little in known about the endemic mottled petrel, *Pterodroma inexpectata*, including its breeding biology and foraging ecology. This study seeks to examine the spatial ecology, provisioning regimes and diet of breeding adult mottled petrel during chick-rearing, and to document chick growth from hatching to fledging. Analysis of movements gathered through telemetry and δ13C values from the whole blood of adult mottled petrels provide evidence of a novel high-latitude foraging niche during chick-rearing, atypical of *Pterodroma* species studied to date. These findings were supported by low provisioning frequencies, large meal sizes and an apparent tendency towards a dual-foraging strategy. Preliminary data indicate that in 2013, mottled petrel chick growth was retarded due to the low nutritional value of meals provided to chicks, rather than from meal size and provisioning frequency. These results highlight the need for inter-annual studies of the foraging ecology and breeding success in mottled petrels, and targeted future research.

Tuesday | 1045 | Rm. 260-073 OGGB4

|| Denitrifiers in the coastal gradient

Theresa O'Meara

The University of Auckland

Denitrification in temperate coastal systems has been studied extensively in intertidal and subtidal zones, but is poorly understood in adjacent upland soils. Additionally, past research has generally not distinguished between fungal and bacterial denitrification. Fungi and bacteria require different substrates and oxygen conditions, produce different end products, and interact in coastal systems. Bacteria produce N2 (harmless gas), but fungal denitrification often results in the production of N2O (greenhouse gas). Potential denitrification rates were measured across estuarine marsh elevation/inundation gradients using the acetylene block technique. Inundation time was integrated with anoxic/oxic potentials to model total site nitrogen removal. Results indicate that fungi and bacteria can have similar denitrification potentials in low salinity systems. In fully saline systems, bacterial denitrification dominates in anoxic conditions and fungal denitrification dominates in oxic conditions. As sea level rises, the conversion of intertidal low salinity to saline subtidal systems may result in decreased denitrification rates and an increase in fungal nutrient processing. These results indicate that fungal denitrification in coastal systems has the potential to contribute to the global N2O budget and warrants further study.

|| How many early birds does it take to get the worm? Density-dependence and priority effects in reef fish

Shane Geange[1], Davina E. Poulos[2], Adrian C. Stier[2] & Mark I. McCormick[3]

[1]School of Biological Sciences, Victoria University of Wellington, [2]James Cook University & [3]National Center for Ecological Analysis and Synthesis

Priority effects, whereby individuals that arrive early in a habitat significantly affect the establishment of species arriving later can regulate community structure. Priority effects may be especially intense between reef fish that compete for habitat following larval settlement. Although competition in reef fish has been shown to be density-dependent, particularly following settlement, the extent to which density mitigates or enhances the magnitude of priority effects is largely unknown. We evaluated the prediction that increasing densities of later arriving species overwhelms the competitive effect of early arriving species, thereby alleviating priority effects. To achieve this, we manipulated timing and density of lemon damselfish settlement relative to that of the ambon damselfish. We found that the effect of timing of arrival had a much stronger influence than density did. Relative to when both species arrived simultaneously, survival of the lemon damselfish declined when they arrived 3 h later than ambon damselfish, and a three-fold increase in the density of lemon damselfish failed to alleviate this priority effect. Although density-dependent effects have been shown to influence competitive interactions between reef fish settlers, our results suggest that across settlement densities commonly observed for these species, priority effects are also a strong regulating force.

Tuesday | 1130 | Rm. 260-098

|| What is the strategic landscape for New Zealand's marine biosecurity?

Andrew Bell

Ministry for Primary Industries

"New Zealand's 2003 Biosecurity Strategy is being updated. The update is to ensure we have a biosecurity system that is resilient to emerging risks and the changing environment within which it operates. Once completed the update will provide a touchstone for all stakeholders in the biosecurity system covering the vision, key principles, direction and priorities for action through to 2025.

Marine biosecurity is significant to New Zealand as evidenced by its advanced status relative to the rest of the world. Many of the challenges that face New Zealand's biosecurity in general are common to the marine environment. For example, changing trade volumes and patterns influence the risk profiles of shipping and climate change will see the changes in New Zealand's vulnerability to pests and diseases. However, some aspects are unique to the marine environment and it is essential that those working in the marine environment ensure it is being represented. For example, who is the marine constituency? How would a biosecurity partnership approach work in a commons environment? How are tangible (e.g. economic) and intangible (e.g. existence value) values reconciled in decision making? How do we ensure we have the knowledge and capacity to deliver the biosecurity outcomes New Zealanders expect?

The strategic considerations for New Zealand's marine biosecurity will be discussed as an introduction for New Zealand's marine science community into the conversation on New Zealand's Biosecurity Strategy to 2025.

|| The multiple dimensions to connectivity

Jenny Hillman[1], Simon F. Thrush[1] & Carolyn J. Lundquist[1,2]

[1]The University of Auckland & [2]NIWA

Connectivity is well recognised in population dynamics and especially in marine systems where populations are often considered open. But connectivity in ecosystem processes, i.e. the flux of energy and matter, has been neglected, despite its importance in the functioning of ecosystems at different spatial scales. There is a growing demand to both conceptualise and quantify connectivity in ecosystem processes because humans continue to heavily modify the natural world around them while the demand for benefits to society from ecosystems increases. I will assess the connectivity framework provided by the concepts applied in connectivity studies of populations to provide an understanding of the links that exist between the supply and flow of ecosystem services and the ecosystems themselves.

Tuesday | 1130 | Rm. 260-092 OGGB3

|| Intraspecific growth differences in two species of triplefin

Paul Caiger & Kendall Clements

The University of Auckland

Triplefins are the most abundant and diverse family of reef fishes in coastal New Zealand, and have undergone an ecological radiation over a short period of time. This system offers the opportunity to improve our understanding of ecological speciation, a phenomenon that is poorly understood in marine species.

One approach in triplefins is to evaluate measures of fitness performance in different habitats. Growth rates are a common tool for fisheries biologists, and here we use growth as a proxy for post-settlement performance. We found differences in growth rates between populations of two species of triplefin (*Forsterygion lapillum* and *F. varium*) sampled across an environmental gradient in the Hauraki Gulf, using a three-fold approach.

First, we estimated juvenile growth rates by comparing otolith increment widths across populations. Second, we used the relationship between otolith weight and fish length as a proxy for growth rates. Third, we examined patterns in abundance, settlement and mortality using underwater visual censuses. Over the course of three years, using length-frequency analysis, we were able to determine size-class structure, how this shifts seasonally, and how it relates to habitat type. Using a length-based approach, we fitted growth curves to population age modes, again permitting comparisons between habitats.

|| Challenges of managing two concurrent marine pest incursions in the vector hubs of Marlborough

Jono Underwood[1], Jeannine Fischer[2] & Kathy Walls[2]

[1]Marlborough District Council & [2]Ministry for Primary Industries

After an early scare in 2005, where a single specimen of *Styela clava* was discovered on a vessel with no subsequent finds, there has been a lift in awareness of incoming threats to Marlborough. However, both *Styela clava* and *Sabella spallanzanii* have now turned up on our doorstep. In June 2013 *Steyla clava* was discovered during MPI's Marina High Risk Surveillance programme in Picton Marina. This prompted a biosecurity response. The following February 2014, a vessel with *S. spallanzanii* was discovered in Waikawa Bay. Another response was initiated with the vessel hauled and de-fouled. No further *S. spallanzanii* were discovered both in Waikawa Bay or at selected locations where the vessel had frequented the previous winter. The S. clava response moved into Long Term Management. Come November 2014, three *S. spallanzanii* where discovered in Picton Marina. This detection was almost certainly unrelated to the previous detection. Over the last two hyears there have been dive surveys, clearances of *S. clava* and new finds of both species. There has also been innovation, relationships forged and a growing realisation of the task at ahead to prevent the vector hubs of Marlborough becoming new sources of infection for marine pests.

|| Do bioturbating crabs facilitate detrital processing and breakdown in marine soft-sediments?

Rebecca V. Gladstone-Gallagher[1], Conrad A. Pilditch[1], Hazel R. Needham[1], Carolyn J. Lundquist[2] & Andrew M. Lohrer[2]

[1]University of Waikato & [2]NIWA

Marine ecosystems are often linked by the transport of allochthonous plant detritus across habitat boundaries; however it is unclear whether resident macrofauna affect detrital retention and breakdown. We conducted a field experiment to assess whether bioturbation by a common grapsid crab, *Austrohelice crassa* (Dana, 1851), would facilitate the decomposition of seagrass detritus at both a sandy and muddy estuarine site. At each site 16 cages (0.4 m^{-2}) were established, and crabs (0 or 35 individuals per cage) and seagrass detritus (0 or 130 g DW per cage) were randomly added in an orthogonal experimental design. Crabs were given two weeks to acclimatise before seagrass was added to the cages. Ten days after seagrass addition we deployed benthic chambers to measure benthic metabolism, primary production and the regeneration of inorganic nutrients (i.e. measures of ecosystem function). Preliminary results indicate that treatment effects on gross primary production (GPP) and benthic metabolism, approximated by sediment O2 consumption (SOC), were site-specific. SOC and GPP at the sandy site were influenced by the presence of both crabs and seagrass detritus, however interactions between crabs and detritus did not occur. At the muddy site, the presence of seagrass detritus increased SOC, but there was no crab effect. Our findings highlight how detrital subsidies influence soft-sediment ecosystem function, and that the role of large bioturbating macrofauna in regulating sedimentary processes is context specific.

|| Effects of recent growth history on social dominance and resource acquisition by temperate reef fish

Ben Moginie & Jeffery S. Shima

Victoria University of Wellington

Theoretical studies suggest that “successful” individuals may share common traits that maximize their chances of survival and reproduction. However, previous studies have struggled to identify particular life history traits that consistently predict reproductively successful individuals. This may occur because traits such as ‘recent growth’ may convey a fitness advantage in some circumstances (e.g., when ‘bigger is better’), but may result in an energetic deficit that is costly in other circumstances. Recent growth history is one of several traits that appears to predict the success (as measured by subsequent growth, body condition and survival) of a small reef fish, the common triplefin (*Forsterygion lapillum*). Here, we manipulate the growth histories of recently settled common triplefin in a laboratory experiment, and evaluate the consequences for social dominance and the ability to acquire resources. Our results suggest that recent growth history can influence subsequent performance (as measured by behavioural interactions), but also that a substantial component of variation in behavioural traits may be intrinsic i.e., due to inherent ‘personality’ differences among individuals (e.g., boldness, etc). We discuss the implications of our work for competitive interactions and population dynamics of reef fish.

|| Plant-animal interactions in Kaipara Harbour: do cockles enhance the primary productivity of seagrass patches?

Drew Lohrer, Michael Townsend, Sarah Hailes, Ivan Rodil, Katie Cartner, Daniel Pratt & Judi Hewitt

NIWA

Little neck clams, or cockles (Austrovenus stutchburyi), are ecologically important intertidal bivalves that have been shown to influence nutrient cycles and the productivity of microphytobenthos on sandflats. Here, we investigated the potential for Austrovenus to impact the productivity of macrophytes (seagrass, Zostera muelleri) and to examine the contributions of these two habitat-defining species in patches where they co-occur. We sampled cockle densities, sediment properties, and Zostera shoot densities across the boundaries of two seagrass patches on Tapora Bank in Kaipara Harbour, and measured dissolved oxygen and nutrient fluxes in light and dark benthic incubation chambers in conjunction with a 0 to 70% gradient in live Zostera coverage. Mud and organic matter content increased with increasing Zostera coverage, whilst cockles were most abundant at intermediate shoot densities (peaking at roughly 45% cover). Ammonium efflux measured in dark chambers was highest at the highest Zostera shoot densities, and was likely linked to the remineralisation of organic material in the muddier sediments inside seagrass patches. Interestingly, both Austrovenus and Zostera contributed positively to rates of gross primary production measured in the chambers (multiple regression models, $p<0.01$, $r2adj >0.58$), indicating the potential importance of healthy cockle populations to seagrass patch productivity.

|| Marine Biosecurity in the Bay of Plenty

Hamish Lass

Bay of Plenty Regional Council

The marine environment in the Bay of Plenty is highly valued for numerous reasons including economic values, cultural values, biodiversity, tourism, recreation, harvesting of seafood, aquaculture, natural character and amenity.

In 2013, a single Mediterranean fan worm (*Sabella spallanzanii*) was detected in Tauranga Harbour Following that detection, a systematic surveillance operation was developed in collaboration with key stakeholders. So far 3427 boats, 36 km's of marina walkway pontoons , 246 swing moorings , 381 wharf piles, 4.6 km's of marina rock walls and 2.3 km's of beach have been searched. This has resulted in the discovery of infestations at Bridge marina (17), Sulphur point marina (11) and moored boats (5). *Styela clava* was also discovered on some vessels

This surveillance, and the management of marine pests in the region, has been based on a collaborative and strategic approach and the development of the Marine Biosecurity Management Plan for the Bay of Plenty. BOPRC, iwi, industry, MPI and other stakeholders work together towards common environmental, cultural, social and economic goals.

To support the management plan, BOPRC has developed a Small Scale Management Plan (SSMP) under section 100v of the Biosecurity Act. This was required to give BOPRC powers to manage any new incursions as no marine pests are listed in the current Regional Pest Management Plan. This is the first time a SSMP has been developed in New Zealand.

|| Go with the flow: nursery habitat association in juvenile snapper

Darren Parsons, Crispin Middleton, Keren Spong, Graeme Mackay, Matt Smith & Dane Buckthought

NIWA

Nursery habitats are a crucial lifecycle component for many fishes, with elevated survival and growth often attributed to shelter from predators or increased provision of food.

We assessed potential explanations of the nursery function of structurally complex habitats for post-settlement snapper, *Chrysophrys auratus*. Specifically, we deployed Artificial Seagrass Units (ASUs) and used a combination of video observation, netting and diet analysis of associated snapper as well describing potential prey around the ASUs. We did not observe any predation and few potential predators, suggesting that snapper are not using nursery habitats as a predation refuge. The diet of post-settlement snapper mostly consisted of calanoid copepods that were found within the water column where nearly all feeding events were observed. Plankton sampling revealed a greater availability of copepods at ASU sites with greater current strength, while netting and video observation demonstrated that the abundance of snapper was highest at sites with intermediate water velocity. The interaction between water flow and food availability may represent an important trade-off where structurally complex habitats may allow snapper to access sites with a greater supply of planktonic food while reducing swimming costs. This mechanism may have broader relevance for other species utilising estuarine nursery habitats.

|| Operational tools to mitigate biosecurity risks from fouled vessels and marine infrastructure

Lauren Fletcher, Javier Atalah & Grant Hopkins

Cawthron Institute

The proliferation of non-indigenous species has led to demand for treatment tools to reduce initial incursions and subsequent domestic spread. Two techniques that have been considered for mitigation of biosecurity risks from fouled vessels and other structures are encapsulation and desiccation. Encapsulation involves wrapping surfaces with plastic to 'smother' enclosed organisms, with mortality accelerated through addition of chemicals. Desiccation exploits physiological stress associated with air exposure. Recent laboratory and field based studies investigated the efficacy of both tools. The tolerances of a range of fouling taxa are presented, including early life-stages and adults in relation to environmental factors. Total mortality took up to 10 days for communities encapsulated without chemicals, compared to only 48 hours for those encapsulated with acetic acid. Desiccation tolerance varied considerably between taxa. The ascidian *Ciona* spp. died within 24 hours under both controlled and 'realistic' settings. However, hard bodied organisms, such as the bivalves *Mytilus galloprovincialis* and *Crassostrea gigas*, were more tolerant to desiccation stress; total mortality was recorded after 7 and 16 days under realistic settings for each species, respectively. These findings provide insights into the factors driving encapsulation and desiccation success that will be useful in developing standardised protocols for use by biosecurity response personnel.

Tuesday | 1215 | Rm. 260-073 OGGB4

|| Monitoring localised mangrove expansion for resource management

Melanie Vaughan, Megan Carbines & Jarrod Walker

Auckland Council

Mangrove expansion and removals are a contentious, emotive and persistent issue. Expansion has been documented in Auckland by a number of studies, mainly at regional or estuary scale and in relation to historical densities. Managing mangroves is largely occurring in localised areas, responding to more recent perceived expansions. There is a need to monitor mangrove expansion at a finer temporal and spatial scale to inform local mangrove management.

Using aerial photography, a 1996 and 2010-11 mangrove extent was mapped for Auckland. Where overlapping aerials were available through time, finer temporal changes in extent was measured. We were able to measure change between years but it is much smaller than the historical expansions of the mid 1900's.

Mangrove expansion is likely to continue and we need to be able to cost effectively monitor changes in mangrove extent on a local scale to inform decisions and monitor outcomes of management. While the mangrove boundary may not have changed greatly, the density of mangroves may have increased leading to perception of reduced amenity and access. Therefore it is important to track not just the mangrove area but some measure of density or infilling. The use of automated analysis of satellite imagery for monitoring mangrove extent and infilling has been investigated.

|| Detection and classification of John Dory (*Zeus Faber*) vocalisations

Rosalyn L. Putland[1], Craig A. Radford[1] & Allen F. Mensinger[2]

[1]The University of Auckland & [2]University of Minnesota Duluth

John Dory (*Zeus faber*) is a solitary predatory fish widely distributed around New Zealand, and commonly caught in commercial and recreational fisheries throughout the North Island. John Dory vocalise when caught, it is unknown if they produce these sounds naturally underwater. This research aimed to detect and classify John Dory vocalisations in their natural environment. Combining innovative hydrophone technology and baited underwater video (BUV), a total of 81 sounds were detected from recordings taken at shallow and deep water sites, including a marine reserve. The 'bark' was classified as a sound formed of repetitive pulses, on average 197 ms in length, ranging between 200 and 600 Hz with a peak frequency at 312 Hz. All characteristics correlated (maximum coefficient = 0.9395) to sounds recorded in air.
The video footage also allowed for concurrent behavioural observation. Displacement of all fishes from the camera frame after a vocalisation suggested no association with a feeding strategy, but the subsequent raising of their dorsal and anal fins may relate the sound to territorial display. Theoretically, the detection and classification discussed could be used for research into spatial and temporal distributions of the John Dory in New Zealand and overseas.

Tuesday | 1230 | Rm. 260-098

|| The risk of Australians in New Zealand: Biofouling on a fishing vessel

Edwin Ainley & Jeannine Fischer

Ministry for Primary Industries

In May 2014 a large fishing vessel arrived in NZ waters to fish for Orange roughy off the Louisville ridge. No biofouling, or information on the state of the hull, was notified on its pre-arrival forms. In late September the Ministry for Primary Industries (MPI) were notified about concerns around the level of biofouling present on the hull. Closer inspection revealed just how severe it was. An initial response was immediately stood up by MPI to mitigate any potential risks to the New Zealand environment. Tracing of the vessel revealed previous stays in a number of South Australian ports, an area that is host to a range of non-indigenous invasive marine species (NIMS). The vessel was completely encapsulated in plastic wrap to mitigate potential risks to the New Zealand environment. The efficacy of the wrapping was tested, and samples were taken throughout the duration of encapsulation to ensure sufficient mitigation of any risks to New Zealand.

|| Social, cultural, and ecological values of shellfish in Canterbury estuaries

Ani Kainamu

University of Canterbury

New Zealand estuaries are valued ecosystems providing numerous ecosystem services. Bivalves provide ecological services as food for predators, providing habitat for other organisms, by filter feeding and removing contaminants. Cockles/tuaki (*Austrovenus stutchburyi)* were measured for condition index and bacteria levels (E. coli) at 7 selected sites within 4 estuaries in the Canterbury Region. Recreational users, tangata whenua, and local experts were interviewed to gather environmental information and management practices. Cockles were abundant at all sites. Oystercatchers (shellfish-consumers) were more abundant at marine sites where the shellfish condition index was high. The E. coli levels in cockle tissues were usually lower in summer than in winter, when values for an urban and a rural estuary exceeded the recommended food safety guidelines. Over time the cultural value of the urban estuary has declined. The most important environmental indicators for tangata whenua included estuarine ecological function, having an active relationship with place, and cultural assessment for healthy food gathering. People undertaking recreational activities valued landscape features, environment and wildlife, and wanted water levels to be safe for swimming. Integration of social, cultural and ecological knowledge will assist in a more holistic approach to estuarine system management.

Tuesday | 1230 | Rm. 260-092 OGGB3

|| Temporal variation in the vocalisation rates of a New Zealand reef fish, *Pempheris adspersa*

Lucinda van Oosterom

Institute of Marine Science, The University of Auckland

A large number of fishes are known to produce sound, but research into soniferous fishes in New Zealand is surprisingly limited. The New Zealand bigeye, *Pempheris adspersa*, are nocturnal planktivorous reef fish that feed in loose shoals and are soniferous. Captive bigeyes produce low frequency 'pops' both day and night, however, the temporal variation in vocalisation rates of wild bigeyes is unknown. Passive acoustic monitoring was used to determine daily, lunar, and seasonal variation in vocalisation rates of a bigeye shoal outside a known daytime refuge. Vocalisation rates increased at dawn and dusk, and during the full moon and summer. Simultaneous visual and acoustic techniques showed that bigeyes maintain loose shoal structure while travelling to and from their daytime refuge at dusk and dawn, respectively, which is when vocalisation rates are highest, suggesting that bigeye vocalisations are important during daily migrations. Temporal variations in vocalisation rates also correlated with variation in ambient sound levels, suggesting higher levels of ambient sound could cause acoustic masking and affect the active space of bigeye vocalisations. These findings are in support of the hypothesis that bigeye vocalisations are used as contact calls to maintain shoal cohesion.

|| How useful is encapsulation as an incursion response tool for heavily fouled vessels?

Kathy Walls[1], Lauren Fletcher[2] & Grant Hopkins[2]

[1]Ministry for Primary Industries & [2]Cawthron Institute

In September 2014, MPI was notified of a heavily fouled commercial fishing vessel in Port Nelson. The vessel had previously stayed at ports in Australia with marine species of high risk to New Zealand. As the vessel was not scheduled to be slipped for 28 days, it was important to prevent any biosecurity risks by encapsulating the hull with an impermeable wrapping. The Dissolved oxygen (DO) of the seawater within the wrapping was measured periodically and a number of biofouling species were sampled from the hull. After 17 hours' encapsulation, DO levels dropped rapidly to around 50% of ambient levels and were less than 6% by Day 8. Samples of *Mytilus galloprovinicialis* taken from the hull on Day 8 were dead; however, algae and a new to New Zealand species of barnacle were alive. When the vessel was slipped, significant amounts of biofouling had sloughed off the hull and most species still attached were dead, with the exception of some algae and colonies of *Bugula neritina*. The results suggest that encapsulation can mitigate the risks posed by heavily fouled vessels while awaiting haul out. Efficacy is likely to increase when used in combination with a chemical treatment.

Tuesday | 1245 | Rm. 260-073 OGGB4

|| Two sciences? Towards developing a holistic biological assessment for Hawaiian stream mouth estuaries

Kelly Ratana

NIWA

The stream mouth estuaries (SMEs) of O`ahu have been understudied despite their importance as an estuarine nursery habitat, a corridor for native amphidromous species, and their prime location at the confluence of streams and coastlines. Human development has been linked to declines in both abiotic and biotic condition of aquatic ecosystems. Biological community indicators, within a multi-metric index of biological integrity, are commonly used to assess aquatic ecosystems in the US and NZ. While scientific assessments exist for both stream and coral reef ecosystems in Hawai`i, none are currently available for SMEs. Additionally, Native Hawaiian cultural knowledge systems are yet to be utilized to inform and support robust measures of assessment and monitoring. The estuarine space presents BIG challenges with inherent variability and multiple uses. This presentation will describe the application of both scientific and cultural tools to determine the ecological condition of stream mouth estuaries on O`ahu, Hawai`i. Lessons learned that can inform the New Zealand context will also be discussed.

|| Leatherjacket life history: preliminary results of otolith-based ageing study

Valerio Visconti[1], Elizabeth D. Laman Trip[2] & Kendall D. Clements[1]

[1]The University of Auckland & [2]Nelson Marlborough Institute of Technology

The leatherjacket *Meuschenia scaber* is widely distributed in New Zealand and was added to the Quota Management System in 2003, with a TACC of 1431 tonnes per year. Leatherjacket has been identified by MPI as a priority for research because of the lack of information on its demography, and information on life history traits including growth, life span, mortality and reproduction is required to ensure sustainability of this resource. To date, the few studies that have focused on the early life stage of this species indicate that leatherjacket grow rapidly in their first year and live up to seven years. In spite of this information from populations on shallow reefs in northeastern New Zealand, no otolith-based age assessments are available. The main aim of this research is thus to provide MPI with the necessary biological information to inform the management of this species. Here we present the preliminary results of otolith-based ageing study on a sample of 455 individuals from a bottom trawl survey conducted in Pegasus Bay, on the east coast of the South Island (ECSI) between May and June 2014. Overall, we found a maximum age of nine plus years and a male biased sex ratio.

Tuesday | 1345 | Rm. 260-098

|| Clam (*Austrovenus stutchburyi*) parasite loading in an environment modified by commercial harvesting

Sorrel O'Connell-Milne, Robert Poulin & Will Rayment

University of Otago

Parasites can have significant impacts upon their host, interspecific interactions and ecosystem function. However, parasite transmission dynamics are usually strongly dependent on host densities. Commercial fishing often reduces densities and changes age structures of target populations. This research investigates the effects of commercial harvesting on parasite abundance within clams. Clams (*Austrovenus stutchburyi*) have been commercially harvested from Otago since 1982. A subset of shellfish were analysed for parasite load (numbers of trematode metacercariae per clam) within commercially harvested and unharvested areas at 14 sites in Blueskin Bay and the Otago Harbour. In addition, unparasitised juvenile clams were caged at these sites over a winter and summer period to monitor spatial and temporal patterns of parasite loading. Finally, the effect of parasite load on clam growth was monitored both in situ and in a laboratory experiment. Overall, commercial harvesting resulted in a 36% increase in average parasite load compared to unharvested control areas. Also, high parasite loads were found to negatively affect growth and body condition of clams. Therefore, harvesting has the potential to alter both the local transmission of trematode parasites and their impact on individual hosts.

|| Monitoring and management of marine mammals in offshore Taranaki

Simon Childerhouse & Deanna Clement

Blue Planet Marine & Cawthron Institute

The monitoring of environmental effects in offshore Taranaki varies considerably between areas, taxa and activities. A key component of this ecosystem is marine mammals with over 20 different species regularly reported there. There are some major difficulties in monitoring marine mammals which include species being widespread, transient and/or seasonal, often in small numbers, with a lack of base line information on natural and/or 'normal' behaviour. Added to these complexities, are the range and diversity of anthropogenic activities which have the potential to impact upon them. The present approach for approving marine consents under the EEZ Act includes marine mammals as part of the decision making process but often an understanding of any possible impacts are limited by a lack of systematic and dedicated marine mammal data. Furthermore, the piecemeal and individualistic approach to consents means that there is often a lack of incentive for applicants to look outside the boundaries of their application at the whole Taranaki system. Given the highly distributed and mobile nature of marine mammals, it behoves Regulators and both new applicants and existing consent holders to pool resources into larger, comprehensive studies that address Taranaki wide questions of interest with relevance to all parties.

|| Can metal hurt your herring? The effect of shipwrecks on otoliths and other tales from the debris field

Phil Ross[1], Matthew Bennion[2], Ray Tana[1] & Brendan Hicks[1]

[1]Environmental Research Institute, University of Waikato & [2]Galway-Mayo Institute of Technology

The 2011 sinking of the container ship MV Rena provided a novel opportunity to examine the utility of fish otoliths as a tool for monitoring pollution events. Because of the potential for trace metals to be incorporated alongside calcium carbonate during otolith formation, it has been suggested that otoliths may provide a time-stamped trace metal history of the water environment. Following the grounding of the MV Rena, oil and other contaminants were discharged into the waters around Astrolabe Reef. Contaminants included metals and other inorganic and organic materials derived from structural and mechanical components of the ship as well as industrial chemicals and materials and personal belongings being carried as cargo. These materials either fell overboard during the grounding or went down with the ship, resulting in significant but localised contamination of Astrolabe Reef by trace metals, polycyclic aromatic hydrocarbons and organotins. Otoliths from sea perch (*Helicolenus percoides*) were collected from Astrolabe Reef and control locations three years after the grounding of the Rena. Chronological evidence of this event was assessed in otoliths using Laser Ablation Inductively Coupled Plasma Mass Spectrometry to test the hypothesis that a fish's exposure to Rena-derived contaminants will be recorded in its otoliths.

|| Effects of AQUI-S on cardiophysiology of the Australasian red spiny lobster *Jasus edwardsii* during pre-transport procedures

James Robertson, Andrew Jeffs & Tony Hickey

The University of Auckland

The Australasian red spiny lobster, *Jasus edwardsii*, is an important commercial seafood species, with New Zealand exports to global markets exceeding $240 million in value annually. Crustaceans are predominately transported alive and out of water, exposing them to a variety of stressors, including handling, desiccation, temperature fluctuations and hypoxia during shipment, resulting in physical damage and mortalities. Anaesthetics, such as AQUI-S, have shown potential in suppressing the physiological impacts of stress, by improving the health of live transported crustaceans through reductions in metabolism, locomotor function and sensory awareness. Using non-invasive electrophysiological techniques, variations in cardiac rate under standard, chilled and AQUI-S pre-transport commercial procedures were identified for *J. edwardsii*. The greatest depression in cardiac rate occurred under 300 ppm of AQUI-S, followed by chilling and standard commercial procedures. Heart rate during recovery was slower and significantly lower in air after administration of AQUI-S compared to in water. No significant difference between lobster weight and anaesthesia induction of AQUI-S was observed. Mitochondrial spectrometry indicates uncoupling proteins and dissociation of ADP phosphorylation from substrate oxidation during AQUI-S induced anaesthesia as a possible mechanism of action in spiny rock lobsters. The significantly lower heart rate achieved by AQUI-S administration supports its potential use in reducing mortalities in the commercial shipment of live lobsters, with further investigation into determining the relationship between dosage and exposure time on blood chemistry recommended.

Tuesday | 1400 | Rm. 260-073 OGGB4

|| A view from the environmental regulator beyond 12 nautical miles

Simon Coubrough

Environmental Protection Authority

The Environmental Protection Authority (EPA) has been regulating a broad range of activity beyond 12 nautical miles for almost 2 years under the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012 and Permitted Activity Regulations. The legislative framework is under development but there have already been some lessons for the EPA from the processes described in legislation, their interpretation and implementation. The EPA has been monitoring and promoting compliance with these relatively new rules, and in doing so interacted with science providers, seismic surveyors and oil and gas operators located offshore from Taranaki. This presentation describes some of the new rules, how they have been implemented, and some of the challenges encountered by the EPA in relation to activities occurring offshore.

|| Great scampering scampi – odours that make New Zealand scampi search for food

Robert Major & Andrew Jeffs

The University of Auckland

New Zealand scampi (*Metanephrops challengeri*) are a commercially important crustacean that is caught around NZ using bottom trawls. Trawling results in large quantities of by-catch, damages the seafloor and the captured scampi. New potting technology is being developed to improve the sustainability and efficiency of the scampi fishery. An integral part of potting fisheries is using species-specific bait; this research aims to investigate the chemosensory systems and foraging behaviour of New Zealand scampi to identify effective chemoattractant baits for use in a potting fishery.

In order to identify effective baits, scampi were placed in a flow-through tank with a range of natural products (mackerel flesh, squid mantle, green-shell mussel gonad, and crushed crab). The proportion of scampi that reached the bait and the length of the phases of chemically-meditated food search behaviour were quantified and compared. The results found the phases of chemically-mediated food search behaviour to be highly variable and that no single natural product elicited quicker responses for each phase of food search behaviour. Results from initial field trials that were carried out using promising candidate baits from the behavioural assay in European and New Zealand designed pots will also be presented.

Tuesday | 1415 | Rm. 260-073 OGGB4

|| Marine Consenting in the EEZ – a Decisions Maker's perspective

Gillian Wratt

EPA Board and Decision Making Committee member

Five of the six applications for marine consents since the EEZ Act came into effect in 2013 have been for activities in the offshore Taranaki region.

In making decisions on marine consent applications under the EEZ Act, the EPA must take into account any effects on the environment. Taking account of effects on the environment requires scientific evidence on the existing environment and on the likely effects of the proposed activity on the environment.

This presentation will cover lessons learnt to date in terms of the scientific evidence presented to the Decision Making Committees.

|| Effects of turbidity and hypoxia on the metabolism and feeding behaviour of juvenile snapper (*Pagrus auratus*)

Hana Cumming

The University of Auckland

The marine environment has been subject to large changes in recent decades as a result of human population growth and subsequent increasing demands on aquatic ecosystems. Two of these key changes include huge increases in sediment input and hypoxic zones, both of which are serious environmental contaminants and can cause a multitude of effects on species living in affected areas. Previous studies have explored the hypoxic physiology of fish, however despite acknowledging the ecological importance of combined stressors, there is still a lack of understanding regarding the physiological effects of combined stressors on fish. Therefore, this study aims to examine the combined effects of turbidity and hypoxia on juvenile fishes, providing a new perspective into how multiple land-based impacts can affect life in estuaries. Snapper (*Pagrus auratus*) are used as a model species as they are important both recreationally and commercially in New Zealand. This study will utilise respirometry techniques and a swim flume to test the hypothesis that turbidity and hypoxia alters the metabolism and feeding behaviour of juvenile snapper. It is hypothesised that hypoxia and turbidity stressors together will reduce the fitness and performance of *P. auratus* through a limitation of food acquisition and growth potential.

|| A new growth monitoring technique for New Zealand scallops?

Sophie Burgess

The University of Auckland & NIWA

Estimates of parameters such as growth, mortality and recruitment are required for the effective stock assessment of a species. This study aims to further enhance our understanding of the growth parameter in *Pecten novaezelandiae*. Current knowledge of *P.novaezelandiae* growth is limited to analyses of tag recapture studies on individuals released during surveys. However, size selectivity of dredges and the timing of release and recaptures means the data are limited to larger scallops, and don't provide good information on seasonal patterns.

In some species, annual growth rings have been used to estimate age, but this has limitations due to the influence of erosion and other environmental disturbances, often leading to disturbance growth check formation, which can be hard to distinguish from annual growth checks at the macroscopic scale. A solution to such issues is the inspection of internal microstriae, enhanced through the addition of a chemical stain, improving their visibility via microscopy.

The current study investigated the application of a flourochrome dye to monitor juvenile *P.novaezelandiae* growth rates and striae deposition patterns over a known time frame. This method may be applicable to adult growth monitoring investigation in future.

|| Preparing for Oil and Gas Industry Expansion: coastal resource mapping and 3D seismic campaigns

Chris Battershill[1], Andrew Heyward[2], Andrew Heap[3], Scott Nichol[3], Tara Anderson[4], Rachel Prezlawski[3] & Denise McCorry[5]

[1]University of Waikato, [2]Australian Institute of Marine Science, [3]Geoscience Australia,[4] NIWA & [5]Woodside Energy

As an example of preparation for oil and gas industry development, we report on a series of large scale coastal mapping exercises that were carried out to characterise the benthic marine environments of the North West Shelf and Bonaparte Gulf of Australia. Techniques included the use of multi-beam and sub-bottom profiling technology informed by benthic dredge and grab sampling; together with towed underwater video and baited remote underwater video surveys. The exercise developed surrogates for fast, large scale habitat mapping; developing information on the bio-physical character of the coastal shelf. An important component was the assessment of natural marine hazards that may affect pipeline positioning and to provide environmental information relevant to the coastal positioning of oil and gas processing hubs. An important component of the program was examining the environmental safety of 3-D seismic profiling campaigns on the benthos, fish and marine mammals. Examination of the effects of seismic profiling campaigns using airgun arrays was carried out, with the first ever in situ experiments performed, where fishes and corals were examined in real time (with longer term follow-up), as the seismic vessel passed overhead.

|| Hypoxia tolerance in New Zealand triplefin fishes

Tristan McArley[1], Lisa Wallace[1], Andreas Kunzmann[2], Stephanie Brohl[2] & Neill Herbert[1]

[1] The University of Auckland & [2]Leibniz-Center for Tropical Marine Ecology

The ability of an organism to acquire oxygen from its environment is essential to survival and tolerance of low oxygen conditions (hypoxia) can play an important role in determining a species distribution. New Zealand triplefins are a group of marine fishes that include species distributed in intertidal and sub-tidal habitats and are therefore exposed to environments with varying dissolved oxygen profiles. Intermittent stop-flow respirometry was used to resolve hypoxia tolerance in intertidal and sub-tidal triplefin species at 18°C and 21°C. At both temperatures hypoxia tolerance was greatest in species that are found in intertidal habitats (*Bellapiscus medius*, *Forsterygion lapillum* and *Forsterygion nigripenne*) and was lowest in exclusively sub-tidal species (*Forsterygion malcolmi* and *Forsterygion varium*). Increasing acclimation temperature from 18°C to 21°C had the effect of increasing standard metabolic rate (SMR) and reducing hypoxia tolerance. Hypoxia appears to be an important determinant of species distribution in triplefins with intertidal species that experience daily low oxygen exposure showing comparatively higher tolerance than sub-tidal species which occupy relatively normoxic habitats. The reduced hypoxia tolerance and higher SMR associated with higher temperature has potentially important consequences for the ability of intertidal species to withstand hypoxia in a warming climate.

|| Investigating hypotheses for rapidly declining fishery catch rates on deep-sea seamounts

Max Schofield, Matthew Dunn & Nokuthaba Sibanda

Victoria University of Wellington

Fisheries for orange roughy (*Hoplostethus atlanticus*) have occurred worldwide. Orange roughy fisheries in New Zealand commonly target fish aggregations on seamounts, hills, and other distinct features. These fisheries often display a rapid decline in catch rates (assumed to indicate a rapid decline in fish abundance) that cannot be explained by removals from catch. A range of hypotheses about orange roughy populations were developed and tested to investigate this pattern. An abundance index for orange roughy on the Andes Seamount Complex was first estimated using general linear models. A set of hypotheses to explain catch rates was then developed and parameterized in a modified Schaefer surplus production model. Likelihood estimation was used to evaluate unknown parameters. The hypotheses that provided the most credible explanation for the catch rate trend were (1) a Changing Growth Model, which allowed a change in population growth rate, and (2) a Habitat Degradation Model, which reduced the carrying capacity of the region based on the area of habitat impacted. The research supports the assertion that the orange roughy populations on seamounts and other features are not demographically closed, and advises a cautious approach to exploiting seamount ecosystems.

|| Offshore Taranaki environmental monitoring approaches

Olivia Johnston

Cawthron Institute

"The Offshore Taranaki Environmental Monitoring Protocol (OTEMP), developed by the Cawthron offshore team, was a critical first step in developing consistent environmental monitoring plans relating to production and drilling related discharges in offshore Taranaki. The aims of this document were to provide:

- Recommendations for developing discharge monitoring programmes specifically for the Taranaki offshore region.
- Stakeholders with a clear monitoring objective: to protect the environment through adaptive management.
- Consistent monitoring methods allowing regional assessments and comparisons across sites.
- Guidance for linking discharge monitoring hypotheses to initial Environmental Impact Assessments (EIA).

OTEMP is now freely available and has been widely adopted (by industry and regulators alike).

This talk will describe the development of and methods for OTEMP, opportunities for research, and will go on to discuss future directions for environmental monitoring in the region.

|| Shapes and landscapes - a morphological approach to the meta-population dynamics of a galaxiid fish

Eimear Egan[1], M J. Hickford[1], J Quinn[2] & D R. Schiel[1]

[1]University of Canterbury & [2]NIWA

In this study we used otolith shape to describe the marine larval population dynamics of one of New Zealand's whitebait species, *Galaxias maculatus*.

Fish were sampled monthly on recruitment from three latitudes. Otolith shape, analysed with Elliptical Fourier analysis and shape indices, was used as an exploratory tool to (i) discriminate between populations at regional scales and (ii) characterise within-region variability in individual dispersal patterns. Otolith shape has typically been used to characterise aggregations of fish and discriminate between individuals that were spatially or temporally discrete at some stage of their life. The basis for this is that the shape of an otolith is the product of the growth history of an individual. Latitudinal differences in temperature and spawning times may result in different growth trajectories. Given the correlative nature of growth, this may ultimately manifest in otolith shape differences. This analysis is complemented with microstructural investigations. The growth history of individuals, back-calculation of spawning dates and larval duration were derived and analysed in the context of the shape information.

Results suggest regional separation of populations and identify complex dispersal histories. We discuss these in the context of meta-population theory and the current fishery management regime.

Tuesday | 1500 | Rm. 260-098

|| Predicting the distribution of albacore tuna (*Thunnus alalunga*) using environmental preferences

Craig Marsh, Nokuthaba Sibanda & Matt Dunn

Victoria University of Wellington

My talk will describe an investigation of the relative spatial distribution of the longline albacore tuna (*Thunnus alalunga*) fishery in the oceans around New Zealand, using spatial-temporal preference based modelling techniques. This involved collating large fisheries and oceanographic datasets, the latter describing oceanographic attributes that are thought to influence the spatial distribution of albacore tuna. Results from our study suggest that the most important oceanographic attributes influencing catch rates of the albacore longline fishery are Sea Surface Temperature and Sea Surface gradient (A proxy for oceanic fronts). Using these attributes the model captured spatial and temporal variability of the fishery. I will also briefly describe an investigation of a multivariate technique “Copulas” when considering the effect of multiple oceanographic attributes on the spatial distribution of albacore tuna. This multivariate technique improved model performance but we conclude that more refinement of the technique is needed.

|| Is there a D'Urville Current?

Peter McComb, **Sarah Gardiner** & Rafael Soutelino

MetOcean Solutions

The ocean currents in the Greater Cook Strait and offshore Taranaki region have been described in many studies associated with the offshore oil industry and various resource consent applications. Notably, a reference to the D'Urville Current is frequently given as a dominant aspect of the circulation pattern in the area. A closer examination of the history behind this flow feature suggests it dates back to discrete observations made during oceanographic cruises in the 60s and 70s. Subsequent maps showing the flow regime have been updated over the years, with the D'Urville Current represented in all of them, based on these early maps. Does this flow exist and has it ever been actually measured with confidence? The metocean design studies for the Maari development, located directly in the path of the D'Urville Current as it was mapped, did not observe a strong representation of such a current — leading to some speculation about the veracity of this feature. Here, the mystery is solved with the results from a 35-year nation-wide ocean modelling reanalysis with ROMS; allowing the complex flow dynamics of this region to be described in detail.

|| Patterns and consequences of spatially variable phenotypes in an amphidromous fish

Jessie Bottcher, Mark Kaemingk & Jeff Shima

Victoria University of Wellington

Many organisms demonstrate a phenotypic plasticity in response to changing environmental conditions. Do the phenotypes of larval fishes match their environment? We sampled 20 populations of *Galaxias maculatus* (inanga, an amphidromous fish that recruits to freshwater after marine larval development) and quantified morphological traits associated with swimming ability. Sampled populations were paired with respect to putative larval rearing environments (n=10 semi-enclosed embayments and n=10 nearby open coast sites). We controlled for variation in body size and found that fish sampled from watersheds adjacent to embayments had phenotypes that likely optimise swimming in low-flow, structurally complex environments. In contrast, fish from watersheds adjacent to open coasts were characterised by phenotypes commonly associated with higher-flow environments. Our results indicate that inanga exhibit phenotypic plasticity, and suggest that individuals may be well-matched to environmental conditions. We hypothesise that divergent phenotypes in inanga may arise from either (i) distinct developmental histories (e.g., extended larval retention in embayments) and/or (ii) strong selective mortality of larval inanga with poorly suited phenotypes. We discuss the implications of these hypotheses, and the significance of our results for carry-over effects that may determine the fates and dynamics of older stages of inanga in freshwater environments.

|| Sending them back alive: post capture survival of juvenile snapper from the Precision Seafood Harvesting trawl gear

Damian Moran, Alistair Jerrett, Suzy Black & Gerard Janssen

Plant & Food Research & Precision Seafood Harvesting

The partners within the Precision Seafood Harvesting (PSH) programme have developed a new trawl technology that allows fish to be captured with minimal physical damage. The ability to land in good condition potentially allows fishers to attain a high price for their product as the fillet quality is better than that of conventional trawl caught fish. Landing lively fish also means fishers can return non target catch with a reasonable chance of survival. In this talk we present the first set of results evaluating the survival of juvenile snapper landed in PSH trawl gear versus conventional trawl gear.

The survival of juvenile snapper 48 hours post capture was markedly higher for PSH gear (55%-100% survival, mean 84%) compared to conventional gear (7%-100% survival, mean 43%). Survival was strongly negatively correlated with depth for conventional trawl gear, whereas the survival of fish from PSH gear was reasonably stable over the range of depths tested (8-89 m). In addition to survival, a range of condition and vitality indices were used to assess the condition of juvenile snapper upon landing and after 48 hours. The condition of fish from the PSH gear was consistently higher than for conventional trawl caught fish.

|| Do macrourid fishes contribute to resilience in New Zealand marine ecosystems?

Marie-Julie Roux[1], Darren Stevens[1], Matthew Dunn[2], Matt Pinkerton[1], Kath Large[1] & Peter McMillan[1]

[1]NIWA & [2]Victoria University of Wellington

Resilience in marine ecosystems can be linked to the existence of a multi-functional intermediate trophic level, contributing “up and down from the middle” control on marine foodwebs. Rattails (Macrouridae) are a ubiquitous and diverse family of deep sea fishes that live on or near the ocean floor. Several taxa including javelinfish (Lepidorhynchus denticulatus) and species of the largest NZ genus Coelorinchus (25 species known from NZ) are a major bycatch in commercial fisheries. Rattails populations have a high ecological importance in deepwater ecosystems, yet the nature and extent of their functional role remain unknown. In this paper, we explore the hypothesis that the rattails species group constitutes a multi-functional, mid-trophic level contributing resilience in marine ecosystems of the Chatham Rise. The presentation will focus on study design and objectives, which include 1) characterising the rattails species assemblage in association with environmental variables; 2) investigating temporal changes in species composition and dominance over time and under variable fishing pressure; 3) relating time series of relative abundance of selected rattail species to other major commercial fish species to identify key interdependencies; and 4) assessing the degree of demersal-mesopelagic coupling at the level of individual rattails species and the entire species group.

|| Spatial variation in population attributes of juvenile inanga recruiting from the sea: evaluating the role of embayments versus open coasts

Vinnie Wood, Conor Neilson, Mark A. Kaemingk & Jeffrey S. Shima

Victoria University of Wellington

Inanga (*Galaxias maculatus*) are opportunistically amphidromous, and capable of completing larval development in a range of environments. Are watersheds connected to coastal embayments (e.g. harbours, estuaries) replenished by different individuals than watersheds connected to open coastal environments? We sampled juvenile inanga (i.e. individuals recruiting to rivers after a period of marine development) from ten paired open coast and embayment systems (N = 20 rivers) distributed across New Zealand's North Island. We quantified a range of life-history attributes from each population and explored variability with respect to geographic setting. Specifically we evaluated size structure (fish standard lengths), age structure, and growth rates (from analyses of otolith microstructure). Our results indicate that fish recruiting to embayment watersheds are smaller, older, and exhibit slower growth relative to fish recruiting to open coast watersheds. Analyses of stable-isotopes suggest larval stages of inanga sampled from embayment watersheds spent much of their pelagic larval duration in a different environment to fish sampled from open coast watersheds, despite close proximities. We suggest our results indicate distinct developmental histories for inanga, and that embayments (e.g. harbours, estuaries) may provide substantial retention (or entrainment) of larvae. We discuss the potential consequences of this for population dynamics and phenotypic variation.

Tuesday | 1600 | Rm. 260-098

|| Environment Canterbury- marine research, consents and construction

Lesley Bolton-Ritchie & Richard Measures

Canterbury Regional Council & NIWA

The Canterbury Regional Council is responsible for managing 800 km of coastline out to 12 nM from shore. This includes knowing about coastal water quality and ecology and understanding the influence of activities on land and in freshwater, as well as anthropogenic activities in the CMA, on the coastal environment. Council do carry out monitoring to assess some aspects of the coastal environment. However, to obtain an understanding of issues, specific scientific investigations are required. These investigations are usually contracted out to science providers. I will provide examples of some coastal investigations Environment Canterbury has commissioned including the hydrodynamic model developed for the Avon-Heathcote Estuary /Ihutai following the earthquakes. I will outline how the model has been used since it was completed. Science providers provide technical advice to resource consent applicants for activities such as discharges and construction activities including causeways, bridges and outfalls. I will provide a range of examples on recent consent applications in the Canterbury region and the types of technical information provided. Finally I will describe the collaboration between Environment Canterbury and the construction industry staff involved in rebuilding the MCCormacks Bay causeway, the Bridge Street bridge and the Ferrymead bridge after the earthquakes.

Tuesday | 1600 | Rm. 260-073 OGGB4

|| A view from the DOC side - science horizons for marine conservation

Sean Cooper

Department of Conservation

What do we want marine conservation to look like by 2030 and beyond? What science and advice is needed to help us and others support healthy functioning marine, estuarine and coastal ecosystems? These are questions the marine science teams in DOC have been considering across the broad spectrum of our work in the marine environment.

DOC's marine teams focus on developing strategy, R&D, science, advice and tools. Our key marine science work areas include: developing guidance for selecting viable Marine Protected Areas and a representative network; risk-based management and monitoring of threats to our protected species; designing frameworks for monitoring and reporting on ecological integrity; developing marine cultural health indicators with whānau, hapū and iwi; comprehensive habitat mapping; and improving our understanding of marine ecosystems and their associated services.

Building strong partnerships is fundamental to delivering New Zealand's marine conservation priorities. This includes coordinated support, broad access to systems and tools (such as SeaSketch), and empowering others to undertake ecosystem-based marine research, management, conservation and citizen science. Part of our thinking involves identifying our marine research needs, how you can help fulfil those needs, and how working with our science and government partners supports tackling critical marine conservation issues

Tuesday | 1600 | Rm. 260-092 OGGB3

|| The Ocean Biogeographic Information System (OBIS)

Kevin Mackay

NIWA

Our ability to understand, conserve, and manage the planet's marine biodiversity is fundamentally limited by the availability of relevant taxonomic, distribution, and abundance data. The Ocean Biogeographic Information System (OBIS) network has developed an expanding geo-database of marine species distribution and abundance data globally. The OBIS information system is intended to support research into the ecology and management of marine species and augment public understanding of the marine ecology by: (1) facilitating studies of impacts on threatened species, (2) testing hypotheses about biogeographic and biodiversity models, and (3) supporting modelling efforts to predict distributional changes in response to environmental change. To enhance the research and educational applications of this database, OBIS provides a broad array of web-based products and services, including rich species profiles, compliant metadata, and interactive mapping services. This system takes advantage of recent technological advances in Geographic Information Systems (GIS), Internet data standards, and content management systems to stimulate a novel community-based approach to the development of a data commons for biogeographic and conservation research.

|| Development of passive sampling devices for legacy and emerging contaminants: Waitemata Harbour case study

Michael Stewart[1], Marcus Cameron[1], Mike McMurtry[2], Sylvia Sander[3] & Billie Benedict[3]

[1]Streamlined Environmental Ltd, [2]Auckland Council & [3]University of Otago

New Zealand's marine environment is the final recipient of a large proportion of chemical contaminant loads from both natural sources and human activities and many of these contaminants are potential stressors to marine ecosystems.

State of the Environment (SoE) monitoring programmes run by councils to track these stressors need to be both cost-effective and relevant to changes in drivers of environmental health. Auckland Council's shellfish contaminant monitoring programme – designed to measure "bioavailable" concentrations of contaminants — is no longer able to meet these requirements and suitable alternatives are needed to achieve the same outcomes. Due to acknowledged advantages over biota sampling, passive sampling devices (PSDs) are gaining prominance in the international research community and acceptance in the regulatory environment. However, to date PSDs have not been widely utilized in New Zealand.

This collaborative pilot study set out to assess whether PSDs could be a cost-effective and robust replacement for biota sampling, by trialing a selection of PSDs across a concentration gradient at three historic shellfish monitoring sites in the Waitemata Harbour. Detection of both "existing" contaminants (polyaromatic hydrocarbons (PAHs) and heavy metals) and "emerging" contaminants (polybrominated diphenyl ethers (PBDEs) and wastewater markers) was achieved using these methods. This presentation will discuss these results in the context of how they could lead to future monitoring developments within New Zealand. "

|| Key Variables to Support Criteria to Design Networks of Marine Conservation Areas

Irawan Asaad[1], Carolyn J. Lundquist[2] & Mark J. Costello[1]

[1]Institute of Marine Science, The University of Auckland & [2]NIWA

International governmental agreements include criteria to aid selection of areas for conservation of biodiversity. Based on reviews of 16 international initiatives by both governmental and non-governmental organisations, we identified eight key ecological and biological criteria to identify priority areas for biodiversity conservation. Four criteria distinguished significant biodiversity values by identifying areas that contain unique and rare habitats; areas that contain fragile and sensitive habitats; areas important for ecological integrity; and areas required to include representatives of all habitats. Four additional criteria distinguish significant biodiversity values based on species-specific attributes: the presence of species of conservation concern; the occurrence of restricted-range (endemic) species; areas that contain significant biological diversity (species richness); and areas of importance for evolutionary processes. To assess these ecological and biological criteria, five key biodiversity variables are proposed to guide resources for data collection to inform criteria: habitat cover, species occurrence, species richness, species' geographic range and population abundance. These key biodiversity variables are essential to facilitate data integration toward a harmonized global biodiversity monitoring program and to support the identification of additional areas significant for marine biodiversity conservation

|| Latitudinal gradients in marine species richness at global scale

Chhaya Chaudhary & Mark.J.Costello

Institute of Marine Science, The University of Auckland

Latitudinal gradients in species richness have been an important topic of discussion for decades. The general pattern is that species richness increases towards lower latitudes and decreases toward higher latitudes. This type of distribution is known as unimodal. However, a few studies have also identified a dip in species richness near the equator and at higher latitudes, but a peak at middle latitudes. Such patterns are mostly referred to as asymmetric or bimodal. This study reviewed the various latitudinal gradients recognised in previous research and analysed the latitudinal pattern of 65,000 species at a global scale using data from the Ocean Biogeographic Information System. This analysis found a bimodal latitudinal gradient in marine species richness at a global scale. We suggest that this bimodality may increase due to global warming.

Tuesday | 1630 | Rm. 260-098

|| As clear as mud: water quality in the Piako and Waihou River estuaries

Hannah Jones, Rebecca Eivers, Pete Wilson & Hilke Giles

Waikato Regional Council

The Waihou and Piako Rivers deliver tonnes of nutrients and sediments to the Firth of Thames every year. Recently, concerns have been raised over the impact of river-borne nutrients and sediment on the Firth of Thames, however the state and functioning of the river estuaries is also unclear. Routine monitoring is carried out many kilometres upstream of the river mouths, far from the tidal influence. Water quality measurements in the muddy river estuaries have been sparse, due to difficulties associated with sampling an extremely turbid and dynamic environment. There is also limited understanding of the influence of the highly modified lowland catchment, including stopbanks, floodgates and drainage systems through peat on these ecosystems.

We are attempting to improve our understanding of the state and functioning of these somewhat neglected estuaries. Pilot sampling has shown water quality in these river estuaries can be extremely poor and highly variable, with the drivers likely to be complex and difficult to unravel. Improved understanding, and the ability to quantify nutrient and sediment loads at the river mouths, is likely to require an innovative combination of monitoring and modelling, and thus is unlikely to be solved by one individual or agency. This talk will not have all the answers, but instead will be a call for more discussion and collaboration in this area.

Tuesday | 1630 | Rm. 260-073 OGGB4

|| Systematic Marine Conservation Planning - From Data to Design

Greig Funnell & Irene Pohl

Department of Conservation

Collaborative marine conservation planning requires translating often complex science, social, economic and cultural data into information that will enable stakeholders to reach solutions that balance conservation needs with community aspirations and economic growth.

Using spatial planning decision support tools can help. The tool in use by the Department of Conservation is SeaSketch, a web-based platform that puts science data and information as well as planning design capability at the hands of non-technical stakeholders. SeaSketch allows for display of geospatial information, drawing and discussing planning options, providing access to scientific, social and cultural reports, and sharing ideas between users within SeaSketch or externally (through social media). Through appropriate use of a decision support tool, transparency, collaboration and efficiency can be greatly enhanced.

DOC will continue to work with communities to develop a nationwide network of protected areas. We see innovative tools like SeaSketch as opening the door for communities to get involved in these processes, simplifying the sharing of spatial data. It's a different way of working with people, and it starts now.

|| Tropical vs. Temperate benthic Crustacea: are they the same?

Michael Kramer, Orpha Bellwood & David Bellwood

James Cook University, ARC Centre of Excellence for Coral Reef Studies

Tropical and temperate marine habitats have long been recognised as fundamentally different systems. Yet, comparative studies are rare, particularly for small organisms such as Crustacea. Recent investigations into the ecological status (abundance, biomass and productivity) of Crustacea in both tropical and temperate microhabitats have revealed marked differences in the structure of crustacean communities. The tropical microhabitats investigated in the present study supported high abundances of small individuals (mean size = 0.65 mm vs. 1.12 mm in temperate microhabitats). In contrast, temperate microhabitats have a greater biomass of crustaceans. The most important microhabitats for crustaceans were tropical dead coral (abundance = 7779 ind. 100cm-2, biomass = 0.75 g 100cm-2, productivity = 452 µg AFDW 100m-2 day-1) and temperate Carpophyllum sp. (abundance = 3900 ind. 100cm-2, biomass = 2.00 g 100cm-2, productivity = 805 µg AFDW 100m-2 day-1). It appears that the differences between tropical and temperate microhabitats are largely driven by the size and abundance of key crustacean groups. Temperate microhabitats have a higher number of large mesograzers, such as Amphipoda and Isopoda, whereas tropical microhabitats are dominated by small detrital and microalgal feeding crustaceans. Interestingly, the role of crustaceans in tropical and temperate systems may be related to the nature of fish herbivores, with an inverse relationship between crustacean biomass and fish herbivore biomass with latitude. The ecological roles of Crustacea offer a new perspective on the trophic structures of two contrasting ecosystems.

|| Open Access Coastal Ocean Observation Network for New Zealand

Anna Madarasz-Smith[1], Paul Barter[2], Chris Cornelisen[2] & Hilke Giles[3]

[1]Hawke's Bay Regional Council, [2]Cawthron Institute & [3]Waikato Regional Council

New Zealand lacks long-term, accessible, marine water quality data. Such data are fundamental to detecting changes in water quality over time, and are therefore critical to ensuring sustainable management of marine resources.

To address national and regional information needs, Cawthron Institute, regional and unitary councils have commenced developing an openly accessible Coastal Ocean Observation Network that currently comprises three water quality monitoring buoys: TASCAM (Tasman Bay), HAWQi (Hawke's Bay) and WaiQTahi (Firth of Thames). These buoys collect continuous time-series data, including temperature, salinity, turbidity, dissolved oxygen, chlorophyll-a and currents. All data are transmitted in real-time and made freely available via the internet.

TASCAM (Cawthron) was the first buoy in New Zealand to utilise inductive instrument technology. This technology has been developed, and subsequently passed onto councils, in collaboration with the California-based Monterey Bay Aquarium Research Institute (MBARI), a not for profit research organisation.

Benefits from freely available coastal water quality data are extensive. Regional and central government can access reliable data to inform decision-making, fishers and aquaculture farmers can make better decisions on managing resources, and scientists have a valuable data to develop and validate ocean observation and forecasting tools. Toward the future NZ will have historical data critically needed to gauge changes in coastal marine health.

|| Monitoring and reporting on ecological integrity in New Zealand's marine protected areas

Debbie Freeman, Shane Geange, Laura Wakelin &Vincent Zintzen

Department of Conservation

As part of a broader biodiversity assessment framework for New Zealand, the Department of Conservation (DOC) has been developing an indicator-based system for monitoring and reporting on the ecological integrity of the marine environment, supported by a partnership with Air New Zealand. The system will allow DOC to better assess how its management or protection of the marine environment is influencing the condition of sites such as marine protected areas, while also allowing the community to become more involved in marine monitoring.

We present an overview of the marine ecological integrity monitoring and reporting programme, including the indicators and examples of their validation and assessments of implementation feasibility across New Zealand's MPA network. We also provide an overview of other components of the programme, including a "marine monitoring toolbox" that will be available for wider use and a report card system that will provide a way of presenting monitoring results in an informative, accessible and engaging way. The monitoring and reporting framework builds upon the strong body of scientific research that has developed around New Zealand's marine protected areas over several decades.

|| Latitudinal beta-diversity of fishes decreases exponentially with depth: evidence from repeated video deployments off New Zealand

Vincent Zintzen[1,2], Marti J. Anderson[3], Clive D. Roberts[2] & Euan S. Harvey[4]

[1]Museum of New Zealand Te Papa Tongarewa, [2]Department of Conservation, [3]Massey University & [4]Curtin University

Continental slopes are among the steepest environmental gradients on earth. However, they still lack finer quantification and characterisation of their faunal diversity patterns for many parts of the world. Changes in fish community structure and diversity along a depth gradient were studied from replicated stereo baited remote underwater video deployments (N=347) within each of seven depth zones (50, 100, 300, 500, 700, 900 and 1200 m) at seven locations in New Zealand (latitudinal span: 21Â°). A total of 247 fish taxa in 86 families were identified from 7251 individuals after reviewing the videos. Results showed a significant interaction between latitude and depth in fish community structure. This interaction was explained by an increased similarity of fish communities at deeper stations compared to shallower, or in other words, beta-diversity significantly decreased with depth. In addition, we found strong evidences that latitudinal beta-diversity decreased with depth following an exponential decay model. Our work provides the first rigorous quantification of large-scale latitudinal beta diversity along earth's third dimension (i.e., depth or altitude) for any taxon to date. Extrapolation of the exponential model suggests variation in fish communities is negligible at the base of continental shelves / start of abyssal plains (> 4000 m).

|| Sediment in the Firth of Thames: Turning off the tap

Pete Wilson[1], Tom Stephens[2], Andrew Swales[3], Max Gibbs[3] & Hilke Giles[4]

[1]Waikato Regional Council, [2]DairyNZ, [3]NIWA & [4]Waikato Regional Council

The Firth of Thames is a large mesotidal estuary bounded by the Auckland and Coromandel regions on the west and east, respectively. Five moderate rivers drain approximately 4200 km2 of the Hauraki Plains into the Firth of Thames, 65% of which is in pasture.

In 2014, Waikato Regional Council and DairyNZ funded NIWA to review the “ecosystem health” of the Firth of Thames. This highlighted excess fine sediment may hinder the return of high valued macrobenthic communities, absent following over-fishing in the 1960s. The review also demonstrated ongoing sedimentation within the Firth is largely driven by a legacy of past activities, with Hauraki Rivers accounting for about 40% of annual deposition in the Firth.

Little can be done regarding the ~60% of sedimentation caused by historic actions but Waikato Regional Council, NIWA and DairyNZ are now investigating sources of sediment carried down Hauraki Rivers.

Here we describe the compound-specific carbon stable-isotope technique used to identify relative contributions of sediment by land use across the Firth catchment and support for collaborative venture across government, industry, and institute. Ultimately, the findings will inform our understanding of ongoing sediment sources in the Firth and where best to target support for current land users.”

|| Examining Blackfoot Paua Metrics & Habitat Requirements at Different Scales to Better Understand Observed Patterns & Responses to Protection

Alix Laferriere & Jonathan Gardner

Victoria University of Wellington

A critical question for ecologists and fisheries managers is what drives the demographic processes that dictate the abundance and size structure of species. In New Zealand, the blackfoot paua is important in customary, recreational and commercial fisheries. However, demography and growth rates of paua are highly variable across spatial scales. Juvenile success, habitat quality and fishing pressure may all contribute to population structure and dynamics. Marine reserves (MR) are an ideal laboratory to examine species variability and the effects habitat may have on ecological patterns. We conducted surveys of paua density, individual size and habitat types within and outside four marine reserves in central New Zealand to disentangle and quantify a reserve effect from a habitat effect. Habitat types were comparable in and outside reserves and paua responded positively to protection, confirming a reserve effect. These positive results prompted us to consider juvenile population response and habitat scale. Within the Taputeranga MR we conducted surveys of paua metrics and habitat types at several experimental unit levels. We present stage-specific density and size structure data for paua and their specific habitat requirements. We discuss the importance of ontogenetic stage and examining habitat at various scales when designing and evaluating the efficacy of marine reserves.

Tuesday | 1700 | Rm. 260-092 OGGB3

|| The taxonomy of marine sponges - combining morphology with molecules

Sam Mc Cormack, Chris Battershill, Phil Ross &Ian Hogg

University of Waikato

Sponge taxonomy is a notoriously difficult enterprise on account of their plastic morphology. Furthermore, a shortfall in biologists who practice traditional alpha taxonomy, has resulted in a sponge identification crisis, where it difficult to properly assess biodiversity in many taxonomic groups. A molecular DNA barcoding approach has been suggested as a tool that can be used to complement and accelerate traditional alpha taxonomy and be used as an identification proxy in the absence of competent taxonomists.

Here we present an application of two different techniques, molecular and alpha taxonomy, to the task of marine sponge's identification. In what was probably the first assessment of sponge biodiversity in the Bay of Plenty, fifty five sponge species are described of which 34 are new to science. We undertake a systematic revision of the fauna correlating 'historical' taxonomy with a modern phylogenetic assessment, and determine whether sponge identifications based on genetic barcoding are congruent with those produced via traditional morphological methods.

|| Integrated management of aquaculture in the Waikato region

Hilke Giles[1], Chris Cornelisen[2], Barrie Forrest[2], Nigel Keeley[2] & Dave Taylor[2]

[1]Waikato Regional Council & [2]Cawthron Institute

Consent-related environmental and State of the Environment (SOE) monitoring in the Waikato coastal marine area are presently not well integrated. There is also a lack of consistency in the monitoring of consented activities in terms of the depth and breadth of requirements. Furthermore, there are few standards/limits against which monitoring data can be assessed. SOE monitoring is limited so that background conditions, the impact of various activities and diffuse-source effects as well as cumulative effects are poorly understood.

To address these short-comings, Waikato Regional Council (WRC), in collaboration with Cawthron, has developed a regional environmental monitoring framework. Aquaculture has been chosen as the first case study for this framework to support the management of upcoming fish farming developments, the anticipated increase in shellfish farming and to assist aquaculture by providing clear guidance on monitoring requirements.

Here we will introduce the framework and describe how it is being implemented. We will illustrate how such an integrated approach promotes the understanding of effects of anthropogenic activities against natural background variability. Through the development of this approach, WRC aims to make monitoring more efficient and effective, and increase the value and utility of data that are acquired for council, aquaculture farmers, scientists and the public.

|| Unravelling the relationship between rocky reef type and abundance of the spiny rock lobster *Jasus edwardsii* within no-take marine reserves

Tim Haggitt, Shane Geange, Debbie Freeman & Nick Shears

eCoast Ltd

The Department of Conservation undertakes routine monitoring of spiny rock lobster (*Jasus edwardsii*) populations at several no-take marine reserves within north-eastern New Zealand. Lobster have responded positively to protection, with abundance estimates of recent surveys (2013-2014) within Tawharanui (TMR), Cape Rodney to Okakari Point (CROP), and Te Whanganui-a-Hei (Hahei) marine reserves being 9.6, 6.9 and 8.9 times higher than non-reserve areas.

A broad range of rocky reef habitat types are sampled during monitoring, ranging from large to small boulder fields, complex platform reef with horizontal and vertical fissures, to low-lying platform reef with minimal complexity. An evaluation of lobster abundance relative to rocky reef type at each marine reserve and adjacent non-reserve sites indicated that 74-88% of lobsters occurred within boulder habitat. However, the availability of boulder habitat and of other habitat types (that may be used more frequently as lobster densities near carrying capacity) are seldom incorporated into density estimates.

We discuss the potential importance of boulder habitat and *Jasus edwardsii* life history, the merits of focussing sampling within specific habitat types and integrating electivity metrics to remove abundance estimate biases. We also discuss the implications for understanding the responses of lobster to marine protection and the value of incorporating habitat-related associations into marine protected area design.

CANCELLED

Tuesday | 1715 | Rm. 260-092 OGGB3

|| A comparison of animal positioning methods in passive acoustic telemetry

Fernando Cagua[1], Martin W. Pedersen[2] & Romain Roy[3]

[1]School of Biological Sciences, University of Canterbury, [2]Technical University of Denmark & [3]Institut national de recherche en sciences et technologies pour l'environnement et l'agriculture

Passive acoustic telemetry is a widely used tool to study the behaviour, movement and site fidelity of marine animals. However, the poor resolution of location data sometimes prevents the identification of fine scale patterns of habitat use that are essential for effective management. Two methods are commonly used to obtain finer positioning. The first, which requires careful design and implementation, is to obtain high precision estimates of animal location using the Vemco Positioning System (VPS). The second, is to calculate rough Centres of Activity based on weighted means of the detecting receivers' positions. Here we show that a third - recently developed - method based on a state space model, offers position estimates that are comparable to VPS at a fraction of the cost. We benchmarked the positioning error of the three available methods against GPS positions of a boat-towed tag. We found that the state space model is vastly superior to Centres of Activity. Also, while VPS is more accurate under ideal conditions, the state space model is more robust to increased environmental noise or structural complexity. Finally, we introduce `PAcTeR`, an R-package with a suite of statistical tools to estimate animal positions, and analyse and interpret acoustic telemetry data.

|| Marlborough District Council's coastal monitoring programme: the benefits of a public controversy over resource use

Steve Urlich

Marlborough District Council

The controversial application to establish nine new salmon farms in the Marlborough Sounds attracted national and international attention in 2012. A well-funded coastal monitoring programme has now been established by Marlborough District Council (Council), in response to criticism of the paucity of state of environment monitoring by the Environment Protection Agency's Board of Inquiry. Council now has regular coastal water quality sampling, as well as hydrodynamic models for both Pelorus and Queen Charlotte Sounds. Monitoring is also underway in estuaries and in subtidal significant marine sites for biodiversity. Council is also grappling with a lack of fundamental information on seabed composition and the need to characterise long-term ecosystem change to understand shifting baselines. In this talk, I will provide an overview of the current monitoring programme, and describe in more detail some key initiatives, along with a synopsis of results from several different projects. I will also discuss planned and future projects, and how Council is engaging with the community in the coastal programme.

|| Do the big fish eat (or just scare) the little ones? Interacting effects of marine reserves and habitat associations on New Zealand triplefins

Adam Smith & Marti J. Anderson

Massey University

Many large predatory fishes, often primary targets of fishing, have shown substantial recovery inside marine reserves and, in some cases, this has led to reports of indirect effects on their prey. Previous research suggested that predation by restored populations of snapper (*Chrysophrys auratus*) in a marine reserve near Leigh had reduced densities of some small cryptobenthic fishes, including some endemic triplefins (family Tripterygiidae). Here, we re-examined this finding by surveying small benthic fishes and small-scale habitat features in a broader study spanning three marine reserves and three years. Using hierarchical Bayesian generalised linear mixed models, we found no evidence for an overall main effect of reserves on densities, but some species showed stronger associations with refuge-providing habitat features inside vs outside marine reserves. These results are consistent with a behavioural risk effect, whereby prey fishes are more strongly attracted to habitats that provide refuge from predation in areas where predators are more abundant. This work highlights the potential for marine reserves to affect communities via mechanisms other than simple density-mediated predator-prey interactions, such as the habitat-mediated risk effect suggested here, which may be important in maintaining habitat associations and assemblage-level biodiversity at small spatial scales.

Tuesday | 1730 | Rm. 260-092 OGGB3

|| 'Shrinkage' in the sea

Matthew Pawley, Insha Ullah, Beatrix Jones & Adam N.H. Smith

Massey University

Baseline monitoring programmes typically sample the environment and/or biota at a set of sites through time. A 'control chart' approach, which measures how new samples differ relative to baseline data, seems like a natural method for determining whether newly collected data are unusual, or if the system may be changing. However, ecological data commonly contain many species, and having so many variables can cause problems for both exploratory data analysis and formal modelling. We will demonstrate (in an intuitive, non-mathematical way) why standard analytical methods such as control charts can fail in this high-dimensional setting. Using data from a marine monitoring programme as an example, we will provide a solution using 'shrinkage'. We propose that this technique may improve many of our estimates based on big data.

|| Guiding Coastal and Marine Resource Management: the coastal SIG science research strategy

Natasha Berkett[1], **Oliver Wade[1]**, Chris Cornelison[2], Mark Newton[2] & Karen Bell[3]

[1]Hawke's Bay Regional Council, [2]Cawthron Institute, & [3]Enviro Solutions Ltd.

Regional councils and unitary authorities have statutory responsibilities for the sustainable management of the coastal marine area (CMA) under the New Zealand Coastal Policy Statement 2010 and the Resource Management Act 1991. However, the lack of a nationally consistent framework for monitoring and reporting on the state of the CMA and gaps in our understanding of coastal ecosystems and processes make sustainable management challenging.

This presentation describes the need for, and the development of, a national science research strategy for the regional council and unitary authority Coastal Special Interest Group (C-SIG). The purpose of the C-SIG Strategy is to promote a nationally consistent approach toward the CMA and support its sustainable management.

The Strategy will provide a framework for research information that will enable council scientists and planners to better fulfil their statutory obligations. The Strategy is also intended to be used by funding providers to help guide funding into avenues that address the needs of the coastal/ marine sector. Finally, the Strategy will be useful for research providers wishing to align their funding proposals with the research needs of regional councils and unitary providers.

|| 40 years since New Zealand's first marine reserve - What have we learnt and what's new?

Nick Shears[1], Tim Haggitt[2], Evan Brown[1], Josh Richardson[1], Pamela Kane[1] & Richard Taylor[1]

[1]Leigh Marine Laboratory, University of Auckland & [2]eCoast Ltd

Research carried out over the last 40 years in New Zealand's oldest marine reserve at Leigh has provided many insights into the ecology of important species and reef habitats, the effects of fishing on these as well as on ecosystem processes, and how these effects can be reversed with protection. Many of these changes have also been demonstrated following protection in other long-established reserves in New Zealand. However, recent research carried out in the Leigh marine reserve suggests that increasing fishing pressure on the surrounding coast may compromise the effectiveness of this reserve. Populations of snapper and crayfish have declined within the reserve over recent years. Currently, biomass levels of crayfish in the reserve are lower than they were in fished areas in the mid-1990's. Legal-sized crayfish are very rare at fished sites and biomass is ~1% of historic values. Crayfish are intensely potted along the offshore boundary, which is only 800 m offshore, and the observed decline in the reserve reflects recent declines in CPUE in the CRA2 fishery. Increasing fishing pressure has also been observed on an increasingly wide range of fish species on reefs adjacent to the reserve. Consequently, more species are now showing a positive effect to protection than previously (e.g. parore, leatherjacket). These results suggest that while the Leigh reserve has offset the effects of increasing pressure on some species, it is not large enough to buffer the wider effects of fishery declines for others. The findings also have clear implications for marine protected area design and fisheries management in areas of high commercial and recreational fishing pressure.

|| Shifting paradigms towards non-hypothesis driven research in marine molecular biology

Tim Young[1], Andrea C. Alfaro[1], Silas Villas-Bôas[2] & Samantha L. Gale[3]

[1]Institute for Applied Ecology, Auckland University of Technology, [2] The Centre for Genomics, Proteomics and Metabolomics & [3]Cawthron Institute

Modern molecular biology has experienced huge shifts in the way that we approach and execute biological research. With the advent of omics-based technologies, we now have the ability to analyse a vast array of genes, proteins and metabolites simultaneously which allows us to generate large amounts of data. This data can be mined using new bioinformatics processes to identify patterns, generate new hypotheses, and gain novel insights into the functioning of organisms on a systems-wide level. Using recent examples from our own group and that of others, we highlight some of the benefits which can be gained from such non-hypothesis driven research in marine science.

Tuesday | 1800 | Rm. 260-098

|| POI: Diversifying NZ's science investment portfolio through new partnerships and collaboration

Bill Dyck & Chris Cornelisen

Pacific Ocean Initiative & Cawthron Institute

New Zealand, with a population roughly the same as Los Angeles and an economy one quarter the size, shoulders the responsibility for the world's fifth largest ocean estate (EEZ), which boasts many attributes of global significance; seabird capital, world's marine mammal hotspot, and leading seafood production to name a few. An ever-changing, limited pot of government funding will not enable us to carry out the science needed to adequately address ocean health issues in a sustainable and collaborative manner. Addressing ocean health issues requires a culture of collaboration and development of new relationships across scientific disciplines and between ocean users. The Pacific Ocean Initiative (POI) was established as an independent charity in 2014 to connect ocean users, knowledge providers and funders to work towards wise use of a healthy Pacific Ocean. One year on, POI has established a board of trustees and assembled an advisory group for guiding the prioritization and development of projects. There are a number of project concepts currently in development for securing further investment through non-government funding sources ranging from individual donors to foundations to sponsorships. Some of the areas currently being pursued include estuary and shellfish restoration, marine biosecurity, and citizen-based science initiatives.

|| Understanding the impacts of global change in the marine environment at local scales, against a content of multiple stressors

Judi Hewitt, Simon Thrush & Joanne Ellis

NIWA, The University of Auckland & Cawthron Institute

Global climate change will undoubtedly be a pressure on marine ecosystems, potentially not only affecting species distributions and physiology but also ecosystem functioning. Other broad-scale environmental changes such as sea level rise and ocean acidification will also become increasingly important. To date we have a poor understanding of how climate-related environmental changes may affect marine ecosystems or which environmental variables are likely to produce priority effects. We also have little knowledge as to how other, more local, anthropogenic stressors may interact with climate-change driven variables, especially in the coastal zone. Using time series data on macrofaunal abundances we derive models suggesting that threshold responses will be common, and that a number of different drivers will interact to produce responses. We also observe some indications that species sensitive to another stressor respond more strongly to lesser environmental change at the stressed site than the unstressed site. The observed interactions between climate variables, effects on key species or functional traits, and synergistic effects of additional anthropogenic stressors have important implications for the responses of coastal ecosystems to climate change. From these results and other studies we can begin to determine areas of research that appear to be most needed.

|| Where do the world's largest rays eat? An insight into the diet of *Manta birostris* in the Eastern Pacific using stable isotope analysis.

Katherine Burgess[1], Michael B. Bennet[t2], Anthony J. Richardson[3], Andrea D. Marshall4, Scarla J. Weeks[2] & Lydie I.E. Couturier[5]

[1]The University of Queensland/The Marine Megafauna Foundation, [2]The University of Queensland, [3]CSIRO, [4]The Marine Megafauna Foundation & [5]The University of Queensland & Project Manta

The characterisation of diet for the largest ray species in the world, the giant manta ray *Manta birostris* has been problematic due to their large scale movement patterns and the difficulty in obtaining stomach contents from this species. Existing information is based on observational data which is limited to feeding events occurring at the sea surface during daylight hours. Recently, biochemical analyses have provided new insights into the diet of the reef manta ray *Manta alfredi*, but little published information currently exists for *M. birostris*. Here, stable isotope analysis (15N and 13C) was conducted on surface zooplankton and M. birostris muscle to test the relationship between consumer and prey stable isotope values. As in *M. alfredi*, δ13C values for M. birostris muscle tissue were not consistent with this species feeding predominantly on surface zooplankton. Results support previous studies in showing that the diet of Manta species is likely dominated by a δ13C enriched food source such as deep sea or demersal zooplankton. Given the conservative life history and fisheries pressure on large planktivores, knowledge on their trophic role and foraging strategies is essential to better understand their ecology and develop effective conservation measures.

|| Developing yellowtail kingfish (*Seriola lalandi*) and hāpuku (*Polyprion oxygeneios*) for New Zealand aquaculture

Seumas Walker, Jane E. Symonds, Steve Pether, Yann Gublin, Dave McQueen, Alicia King, Glen W. Irvine, Alvin N. Setiawan, J. Andrew Forsythe & Michael Bruce

NIWA

Two high value species, yellowtail kingfish (*Seriola lalandi*) and hāpuku (groper, *Polyprion oxygeneios*), have been identified as suitable new candidates for New Zealand marine aquaculture. This presentation provides an overview of the research by NIWA and collaborators conducted to test the biological, technological and economic feasibility of farming these two species. NIWA now has the capability to produce sufficient kingfish fingerlings to meet the needs of the early stages of an industry. Advances in hāpuku aquaculture have also been significant, from spawning in captivity through to the selection of juveniles for improved growth. Recently, the first spawning of captive hāpuku F1 broodstock and production of F2 eggs, larvae and juveniles was achieved. Although hāpuku larval survival remains variable, the ability to close the life cycle, and the availability of domesticated broodstock, provide a significant step forward and increase the chances of this species being commercially farmed.

|| Understanding the impacts of global change in the marine environment at local scales, against a content of multiple stressors (Cont'd)

Judi Hewitt[1], Simon Thrush[2] & Joanne Ellis[3]

NIWA[1]*, The University of Auckland*[2] *& Cawthron*[3]

Global climate change will undoubtedly be a pressure on marine ecosystems, potentially not only affecting species distributions and physiology but also ecosystem functioning. Other broad-scale environmental changes such as sea level rise and ocean acidification will also become increasingly important. To date we have a poor understanding of how climate-related environmental changes may affect marine ecosystems or which environmental variables are likely to produce priority effects. We also have little knowledge as to how other, more local, anthropogenic stressors may interact with climate-change driven variables, especially in the coastal zone. Using time series data on macrofaunal abundances we derive models suggesting that threshold responses will be common, and that a number of different drivers will interact to produce responses. We also observe some indications that species sensitive to another stressor respond more strongly to lesser environmental change at the stressed site than the unstressed site. The observed interactions between climate variables, effects on key species or functional traits, and synergistic effects of additional anthropogenic stressors have important implications for the responses of coastal ecosystems to climate change. From these results and other studies we can begin to determine areas of research that appear to be most needed.

|| Determining whale shark diet at Ningaloo Reef (Western Australia) using signature fatty acid analysis

Lara Marcus Zamora[1], Patti Virtue[2], Heidi R Pethybridge[3], Mark G Meekan[4] & Peter D Nichols[5]

[1]Institute for Marine and Antarctic Science, University of Tasmania, [2]Institute for Marine and Antarctic Studies, University of Tasmania, [3]CSIRO Oceans, [4]Atmosphere Flagship & [5]Australian Institute of Marine Science

CANCELLED

|| The evaluation and selection of yellowtail kingfish (Seriola lalandi) families for New Zealand aquaculture

Alvin Setiawan, Seumas P. Walker, Steve Pether, Yann Gublin, Dave McQueen, Alicia King, Glen W. Irvine, Michael Bruce & Jane E. Symonds

NIWA

Several species of *Seriola* are currently cultured commercially and undergoing aquaculture development in many countries around the world. In New Zealand, yellowtail kingfish (*Seriola lalandi*) was identified as an ideal marine aquaculture species in the late 1990s because of its rapid growth rate, culture ability and excellent flesh quality. Over the last decade over 100 wild kingfish broodstock have been reared at NIWA's Bream Bay marine aquaculture facility as part of the captive breeding programme. Given their communal group spawning behaviour, a multiplex microsatellite DNA marker panel was developed for kingfish to determine the parentage of the resulting F1 progeny. In 2013 and 2014 six tanks of communal spawning wild broodstock were established and fertilised eggs collected and incubated. A total of 6,381 juveniles were individually tagged and assigned to 62 different crosses (families). These families are now undergoing growth performance analysis as part of their evaluation and selection as broodstock. The results of the evaluation of these families and estimation of breeding values in preparation for broodstock selection prior to spawning in 2016 will be reported.

|| Climate change impacts and implications for coastal ecosystems

Carolyn J. Lundquist[1,2], Rob G. Bell[1], D. Murray Hicks[1], Graham McBride[1], Helen L. Rouse[1] & Andrew Swales[1]

[1]NIWA & [2]The University of Auckland

New Zealand faces a huge challenge to respond and adapt to climate change, especially in coastal and estuarine ecosystems. By the middle of this century water and air temperatures are predicted to increase ~1°C from 1990s temperatures, accompanied by sea level rise of ~25-35 cm. Average rainfall is expected to increase in the west and south and decrease in the east and north, with increased frequency of heavy rainfall events. For coastal ecosystems, increased frequency of strong winds and waves associated with storm events, riding on the back of sea-level rise, will exacerbate erosion and retreat of soft shorelines and increase the threat of tidal inundation. Sediment supply associated with heavy rainfall events is predicted to have both direct and indirect impacts on coastal ecosystems, through smothering during large sedimentation events, changes in bed level height, changes in sediment characteristics, and increased turbidity. Changes in the distributions of coastal habitats are expected in response to a combination of sea-level rise, tidal inundation, wind and wave exposure, coastal squeeze, and land subsidence. New Zealand's policy framework provides guidance for local government in adapting to climate change and maintaining the physical and ecological functions provided by coastal ecosystems.

|| Reassessing the trophic role of reef sharks as apex predators on coral reefs

Justin Rizzari & Ashley J. Frisch

ARC Centre of Excellence for Coral Reef Studies, James Cook University

In this study, we used stomach contents and stable isotopes to estimate diet, trophic position and sources of primary production of reef sharks and evaluated their assumed functional role as apex predators by comparisons with other sharks and large predatory fishes. We found that reef sharks do not occupy the apex of coral reef food chains, but instead have functional roles similar to those of large predatory fishes, which are typically regarded as mesopredators. We hypothesize that a high degree of functional redundancy exists within this guild of predators, potentially explaining why shark-induced trophic cascades are rare or subtle on coral reefs. We also found that reef sharks participate in multiple food webs and are sustained by multiple sources of primary production, some of which are susceptible to climate-related stressors and may confer vulnerability to reef sharks. These results highlight that large conspicuous predators in any ecosystem should not axiomatically be regarded as apex predators. In the case of reef sharks, we recommend reassigning them to an alternative trophic group such as mesopredators. This change will increase the accuracy of ecosystem models, providing resource managers with improved tools for understanding how removal of predators via fishing might affect ecosystem properties.

|| The influence of diet and hormone treatment on wild hāpuku (*Polyprion oxygeneios*) spawning contribution, egg quality and larval survival

Jamie-Lee Brewer, Seumas P. Walker, Alvin N. Setiawan, Steve Pether, Alicia King, Glen W. Irvine & Jane E. Symonds

NIWA

To be successful hāpuku (*Polyprion oxygeneios*) aquaculture requires a reliable source of good quality eggs and larvae. To test the influence of diet and the use of gonadotropin-releasing hormone (GnRHa) slow release implants on egg quality and larval survival, four broodstock tanks were established with mixed groups of wild males and females with known communal spawning history. Two diets were tested (different mixes of fish, squid and supplements), with and without the GnRHa treatment. From August to November 2014, 143 egg batches were collected and quality was assessed based on fertilisation and floating percentages and blastomere morphology. 79 batches were incubated and survival to hatch and 9-10 days post-hatch (start of exogenous feeding) was determined. 51 batches were sampled for microsatellite DNA genotyping to determine parentage and compare spawning behaviour and individual contribution. Egg quality was highly variable and the best quality eggs overall were produced by a tank that did not receive the GnRHa treatment. However, one of the GnRHa treated tanks produced the best and worst egg batches during the season and had the highest mean survival during incubation. The results also showed that diet influenced egg production and the number of first feeding larvae produced per female.

Wednesday | 900 | Rm. 260-098

|| Decadal changes in SST, wave forces, and intertidal structure in New Zealand

David Schiel, Stacie Lilley, Paul South & Jack Coggins

University of Canterbury

Dire warnings about the ecological impacts of climate change now permeate the scientific and popular literature. Determining future impacts and their consequences is, however, an inexact science based on models, known thresholds, trajectories and speculation. Here we 'hindcast' to examine changes to coastal New Zealand over the past few decades, especially with respect to sea surface temperature and wave climate. We examine the site-specificity of environmental variables and their relationship to changes in intertidal community structure over reefs spanning 500km of the South Island. Although important changes are evident, the mismatch in spatio-temporal dynamics and ecological dynamics of reef organisms makes it challenging to detect effects without very long-term appraisal.

|| Wake Up and Smell the Evolution: Variation in Olfactory Bulb Size in Cartilaginous Fishes

Kara Yopak[1], Thomas J. Lisney[2] & Shaun P. Collin[1]

[1]University of Western Australia & [2]Queens University

Olfaction is a universal modality by which all animals sample chemical stimuli from their environment. In cartilaginous fishes, olfaction is critical for various survival tasks, including localizing prey, avoiding predators, and chemosensory communication with conspecifics. Little is known, however, about interspecific variation in olfactory capability in these fishes, or whether the relative importance of olfaction in relation to other sensory systems varies with regard to ecological factors. In this study, we have quantified interspecific variation in the size of the olfactory bulbs (OB), the region of the brain that receives the primary sensory projections from the olfactory nerve, in 58 species of cartilaginous fishes. Our results show that the OBs maintain a substantial level of allometric independence from the rest of the brain across this group and that variability in OB size is correlated with ecological niche. The relatively largest OBs were found in pelagic-coastal/oceanic sharks, especially migratory species such as *Carcharodon carcharias* and *Galeocerdo cuvier*. Deep-sea species also possess large OBs, suggesting a greater reliance on olfaction in habitats where vision may be compromised. In contrast, the smallest OBs were found in the majority of reef-associated species, including sharks from the family Carcharhinidae. These results suggest that there is great variability in the degree to which these fishes rely on olfactory cues. The OBs have been widely used as a neuroanatomical proxy for olfactory capability in vertebrates, and we speculate that differences in olfactory capabilities may be the result of functional rather than phylogenetic adaptations.

|| Nutrition during larval development and metamorphosis of the commercial sea cucumber *Australostichopus mollis*

Josefina Peters-Didier & Mary A. Sewell

School of Biological Sciences, The University of Auckland

Larval experience is crucial in the life history of marine invertebrates; it has flow on effects that impact metamorphic success, juvenile survival and adult performance. Nutrition is a major factor affecting successful larval development; optimal lipid intake will ensure energy storage from the diet. Building lipid reserves is critical for the larvae to complete the non-feeding perimetamorphic period, however, larval lipid fatty acid requirements are highly species-specific. Scientific studies leading to a thorough understanding of specific larval developmental traits and nutritional requirements are highly important; they will allow tailoring of diets and aquaculture procedures to ensure the efficient development of an industry that has shown unprecedented worldwide growth.

By combining the use of specific fluorescent dyes in live larvae under confocal microscopy, lipid class analysis (qualitative TLC and quantitative TLD/FID) and fatty acid analysis, we show the uniqueness of nutritional adaptations during sea cucumber larval development in the New Zealand planktotrophic *Australostichopus mollis*. Research on *A. mollis*, along with parallel observations in the sea urchin *Evechinus chloroticus*, shows (1) the importance of understanding larval developmental traits, (2) the need for using adequate diets to maximize larval survival of marine invertebrates and (3) the evolutionary and aquaculture implications of this research.

|| Linking oxygen depletion and ocean acidification in the Hauraki Gulf and Firth of Thames

John Zeldis & Kim Currie

NIWA

Important ecosystem services of the Hauraki Gulf are concentrated in its coastal areas - especially the Firth of Thames - where phytoplankton and zooplankton are most productive, snapper spawn most intensively, and most marine farms are located. The productivity of the Firth is promoted by nutrient loading driven mainly by riverine input, from the intensively farmed Hauraki Plains. NIWA has operated an ocean observation programme which has monitored conditions in the Hauraki Gulf and Firth since 1998, using time-series and process studies supported by mooring and ship-based surveys. This programme is revealing that the enriched water quality of the Firth introduces stressors (low oxygen interacting with low pH). The oxygen and carbonate systems vary inter-annually, in response to varying primary biomass levels, and are seasonally variable, in response to cycles of net-ecosystem metabolism. Our work aims to assess and understand the dynamics of these stressors and eventually model their trajectories.

|| Elasmobranchs vs submarine power cables: Are sharks in for a shock?

Melanie Orr & John Montgomery

Leigh Marine Laboratory, The University of Auckland

Increasing numbers of submarine cables are being laid on the ocean floor, partly due to growing interest in offshore renewable energy developments and partly because of greater electricity needs of expanding populations. The electrical current passing through a power cable induces a magnetic field around the cable. Electrically-conductive seawater flowing through these magnetic fields will, in turn, induce weak electrical fields within the seawater. The strength and geometry of these fields differs markedly between alternating current (AC) and direct current (DC) cables. Whilst cable specifications vary, the induced electrical fields around many of these submarine power cables fall within the very sensitive electrosensory detection range of elasmobranchs. Benthic elasmobranchs in particular rely on electroreception to pinpoint hidden or buried prey and are most likely to encounter submarine power cables. The potential behavioural impacts of submarine power cables on carpet sharks (*Cephaloscyllium isabellum*) and eagle rays (*Myliobatis tenuicaudatus*) are being studied in a series of tank-based experiments, with clear differences being found between AC and DC cables. Behavioural responses are also compared between foraging and non-foraging individuals.

|| How Age and Natal Origins Affect Greenshell™ Mussel Retention Rates

Rebecca Smith, Rebecca Smith, Andrew Jeffs & Jenni Stanley

The University of Auckland

The New Zealand Greenshell™ mussel industry is vulnerable in terms of supply and retention of its seed source known as mussel spat. The loss of mussel spat from nursery ropes can be as high as 100%, but is usually between 50 and 70%. This wasteful use of mussel spat costs the industry between NZD$6-10 million annually. Very little is known about the actual causes of poor spat retention in *Perna canaliculus* although secondary settlement behaviour is thought to be responsible for a majority of the spat loss from seeded mussel farm lines. The objective of this study was to look at two factors which might affect the retention rates of *P. canaliculus* spat; natal origins and the size of spat at time of seeding. Spat were collected from Kaitaia, Muriwai, Hauraki Gulf and a hatchery and then used in a series of retention experiments. Spat were sized using sieves and imaging software to divide them into size classes and a known numbers seeded onto coir twine in attachment cones. Initial attachment rates and the number of spat remaining on the twine after 10 days were recorded to give the retention rate for each treatment.

New Zealand marine macroalgae: impacts of global environmental change?

Wendy Nelson

NIWA & The University of Auckland

Global environmental and anthropogenic changes have been predicted to have a range of consequences for marine algae. In this talk I will consider particular stressors and discuss current understanding of these in the New Zealand context. Ocean acidification is thought to pose a serious threat to calcified macroalgae which are recognised as forming critical habitats in coastal ecosystems from the poles to the equator, providing structural stability in coral reefs, and with roles in the recruitment of invertebrates. Internationally loss of subtidal macroalgal forests is an increasingly common problem in temperate marine ecosystems, particularly on urbanised coasts, attributed variously to changing temperature, eutrophication, sedimentation, overfishing and shifts in predator abundance. Spectacular nuisance algal blooms are reported from around the world often attributed to eutrophication, sometimes associated with non-indigenous species. In New Zealand are we able to recognise the effects of global environmental change on the distribution of individual species and any consequent effects on seaweed diversity and distribution, and the structure and functioning of coastal communities? What is the state of our knowledge?

|| Phylogeny of longnose skates of the genus *Zearaja* inferred from complete mitochondrial genome

Carolina Vargas-Caro, Carlos Bustamante, Michael B. Bennett & Jennifer Ovenden

Molecular Fisheries Laboratory, School of Biomedical Sciences & The University of Queensland

Longnose skates in the genus *Zearaja* comprise three species, from Argentina and Chile (*Z. chilensis*), Australia (*Z. maugeana*), and New Zealand (*Z. nasuta*). There is concern for their long term survival due to low fecundity, late sexual maturity, restricted geographic distribution (*Z. maugeana*) and fishing intensity (*Z. chilensis* and *Z. nasuta*). Using next generation sequencing, the complete mitochondrial genome of all *Zearaja* species is described to conduct the first molecular phylogenetic approach for the genus. The mitogenome length, and order and structure of coding and non-coding regions was identical in all species. These mitochondrial genomes were also used to evaluate their relationship to other skates of the Family Rajidae. The Phylogenetic tree inferred from whole mtDNA genome maximum likelihood analyses revealed low interspecific genetic distances among rajids, in particular among the longnose skates. Intraspecific variation in *Z. chilensis* comprised 125 SNPs (99.3% identity) for the entire mitogenome, as expected for a single taxonomic unit. However, identity between *Z. nasuta* and *Z. maugeana* was 99.6% and sequence difference was 67 single nucleotide polymorphisms (SNPs) across the mitogenome. The genetic similarity between *Z. nasuta* and *Z. maugeana* suggests recent divergence from a common ancestor, or phenotypical adaptations of a single species.

|| Blue and green mussels: The space race

Javier Atalah[1], Hayden Rabel[2] & Barrie Forrest[1]

[1]Cawthron Institute & [2]Statistics New Zealand

The indigenous green-lipped mussel, *Perna canaliculus*, forms the backbone of the New Zealand aquaculture industry, with annual export earnings of >$218M. Crops are susceptible to the detrimental effects of fouling pests, including pre-emption of space, overgrowth and dislodgement of crops, and food competition. The blue mussel (*Mytilus galloprovincialis*) is considered to pose one of the greatest threats, with over-settlement often resulting in considerable crop losses. The Marine Farming Association (MFA) has been monitoring settlement of blue and green-lipped mussel spat throughout the Marlborough Sounds region for almost 40 years. The goal of this project is to use these data to identify patterns that could be exploited to avoid blue mussel over-settlement. Large inter-annual and spatial variability in the settlement of both species was observed, with distinct seasonal and depth patterns. Settlement was modelled in response to a number of environmental conditions (e.g. water temperature, salinity, primary productivity, Southern Ocean Oscillation Index) using spatio-temporal Bayesian approaches. A web application displaying the dataset and providing a forecasting tool will be incorporated into the MFA website. In addition to identifying seasons and growing areas less prone to blue mussel over-settlement, this work will also identify new sites appropriate for green-lipped mussel spat collection.

|| Effects of warming and acidification on Antarctic under-ice algae

Drew Lohrer[1], Vonda Cummings[1], Neill Barr[1], Peter Marriott[1], Rod Budd[1], Peter Notman[1], Scott Edhouse[1], David Bremner[1] & Simon Thrush[2]

[1]NIWA & [2]The University of Auckland

Coastal marine ecosystems at >77° south latitude in the Ross Sea can be dynamic and diverse, despite long dark winters and coverage by thick sea ice for a majority of the year. In spring, when the water column beneath sea ice contains very little phytoplankton, highly concentrated diatom films can be observed on the underside of the ice. Productivity by under-ice algae is critical to the local marine food web and supports numerous iconic Antarctic species. This talk will give an overview of the research we have conducted recently on under-ice algal productivity at coastal Ross Sea sites and the effects of in situ manipulations of seawater pH and temperature conducted using novel methodologies. Results showed marked diurnal periodicity of under-ice algal productivity, subtle positive effects of elevated pCO2 (pH 7.6), and marked reductions in under ice algal biomass with just 0.4°C of seawater warming. By linking this to benthic data from the same sites, we demonstrate how impending environmental changes and interactions between warming and acidification may have broad implications for benthic biodiversity and nutrient regeneration rates. Spoiler alert: this talk will contain pretty pictures.

|| Sex-biased dispersal in the short-tail stingray (*Dasyatis brevicaudata*)

Emily Roycroft, Agnès Le Port & Shane D. Lavery

The University of Auckland

The short-tail stingray (*Dasyatis brevicaudata*) is a large, coastal ray species with a disjunct range across the Southern Hemisphere. Recent work using mtDNA in this species from New Zealand, Australia and South Africa indicated strong population structure in the maternal line. Given the mounting evidence for sex-biased dispersal in sharks, this finding suggests that female philopatry and male-biased dispersal may also occur in stingrays. Using 11 novel microsatellite markers, we investigated the population structure of the short-tail stingray both across New Zealand and the Southern Hemisphere. We found strong evidence for male-biased dispersal in this species within New Zealand, but not across the Southern Hemisphere. Additional analyses of male-specific gene flow revealed a likely sex-bias in effective population size (Ne), with male Ne being perhaps two to five times less than females. We contribute significant findings to the now mounting evidence for the prevalence of male-biased dispersal in elasmobranch fishes.

|| The fouling barnacle *Balanus trigonus* in Greenshell mussel farms in the Hauraki Gulf

Davide Zazzaro & Andrew Jeffs

The University of Auckland

In 2009 there was an exponential increase of the triangle barnacle, *Balanus trigonus*, throughout the Hauraki Gulf, in northern New Zealand, that resulted in Greenshell mussel farms becoming heavily fouled. These fouling barnacles cause major problems for processing mussels after harvest and downgrade the marketability of the farmed mussels.

This study examines the biology of this barnacle in mussel farms in the Hauraki Gulf, including their breeding behaviour, larval biology and their patterns of settlement. These results are used to speculate about possible causes for the population explosion of barnacles in 2009-2010, as well as possible methods of managing this nuisance barnacle.

Wednesday | 1000 | Rm. 260-098

|| Measuring physiological responses to stress in marine organisms: a bioenergetic approach

Mary Sewell

The University of Auckland

Marine organisms in coastal environments live in a multi-stressor world with simultaneous changes in environmental factors (e.g., temperature, pH, oxygen, salinity). Understanding how an organism responds to a single environmental factor often involves determination of a performance curve – defining where biological performance is optimal, with decreasing performance above and below this range. In the last 15 years these transitions to decreased performance have become known as the pejus (Latin "worse"), representing a moderate stress compatible with long-term survival of populations, and the pessimum (Latin "the worst"), an unsustainable extreme stress which coincides with the tolerance limits of the population and defines the distributional range of the species. Here I discuss how universal bioenergetics markers (e.g. metabolic rate, ATP production, gene/protein expression) might be used to define the pejus and pessimum points in coastal marine invertebrates under single and multiple stressors. The intention is to provide biological information to predict changes in species survival and distribution, and link physiological phenomena to ecosystem-level processes.

|| The reproductive biology of two deep-sea chimaeras, *Harriotta raleighana* and *Rhinochimaera pacifica*

Brit Finucci & Matthew R Dunn

Victoria University of Wellington

The family Rhinochimaeridae, commonly referred to as the long-nose chimaeras, consists of eight species across three genera, two of which occur in New Zealand waters. *Harriotta raleighana*, the Long-nose chimaera, is the only chimaera species with a global distribution and is widespread across the continental slope of New Zealand. *Rhinochimaera pacifica*, the Pacific spookfish, has a more limited known distribution, including the continental shelf of the Indian and Pacific Ocean. Little is known about the biology of either species. Both species have a depth range of 400 to 1 300 m in New Zealand waters. I describe the biology of specimens (*H. raleighana*, n = 300; *R. pacifica*, n=150) collected during research surveys around New Zealand. Specimen sizes ranged from 10 to 90 cm for *H. raleighana* and from 20 cm 140 cm for *R. pacifica*, and included both juveniles and reproductively active adults. These species are characterized by their large snouts, and I show that for *H. raleighana*, this may be a secondary sexual characteristic. In this talk, I will focus on describing aspects of their reproductive biology.

Oysters not clamming up about rad new radula scrub.

Candace Loy[1], C. Radford[1], J. Dollimore[2] & A. Jeffs[3]

[1]The University of Auckland, [2]Callaghan Innovation & [3]Biomarine Ltd

Biofouling of baskets used to aquaculture oysters reduces access to food and flushing of wastes. Furthermore, the organisms growing on the bags compete with the oysters for food. This study investigated the effect of co-culturing the oysters with a common grazing gastropod, catseye or *Lunella smaragdus* (Gmelin, 1791), on biofouling of oyster aquaculture baskets.

Lunella were graded and matched to oyster bags of three different mesh sizes (6, 12, 18 mm). Bags of each mesh size were deployed with *Lunella* at three initial grow-out densities: 200, 350, 500 g per bag, in triplicate. Control bags had oysters only. Snails were measured and weighed, and oyster bags examined and photographed every five weeks.

Preliminary results indicate the presence of *Lunella* in oyster bags reduces biofouling when compared with control bags. Oyster bags with and without snails are visually identifiable. The effect on oyster survival and condition will be discussed.

|| Ageing and vulnerability of a deep-sea lanternshark, the lucifer dogfish

Annie Galland & Matthew Dunn

Ministry for Primary Industries & Victoria University of Wellington

If shark populations are to be managed responsibly an understanding of life history traits is essential, in order to help accurately determine the status of the population, and thus ensure their long-term sustainability. Among the life history parameters, precise and accurate age estimates are considered to be one of the most influential, because age data are used to derive important parameters related to population productivity and resilience, such as growth, age at maturity, and mortality rate. Deep-sea sharks are considered especially vulnerable to overexploitation, although life history data for many species is lacking. This study is the first to investigate the age, growth and maturity of a sample of lucifer dogfish (*Etmopterus lucifer*), a small deepwater shark caught as bycatch within a number of New Zealand's commercial fisheries. The maximum age observed was 14 and 17 years in females and males respectively. Both females and males had a relatively late age at maturity, reaching maturity at between 61 % and 92 % of their total maximum age. The results of this study have important implications for commercial fisheries management, and may indicate that lucifer dogfish is at risk of overexploitation.

|| Innovative wireless heart monitor to assess health in bivalves

Dung Le[1], Andrea C. Alfaro[1], Nick King[2] & Norman L. C. Ragg[2]

Auckland University of Technology & Cawthron Institute

Heart rate monitoring has been shown to be a valuable tool for assessing health in bivalves. With the advancement in sensor technology, new heart beat monitoring approaches have evolved from invasive to non-invasive method and from short distance to long distance. Heart beats of bivalves were initially recorded with impedance technology, which involved inserting two copper wires through the shell until they were in contact with the animals' pericardium. The system was subsequently improved by using infrared technology, including a sensor connected to the external shell surface. This wireless system provides new opportunities to acquire information on-site (e.g., in the nursery, ocean or farm). The wireless heart monitoring system can also be used to study burrowing species (e.g., clams) and semi-sessile species (e.g., scallops, oysters). The wireless heart monitor allows data to be collected from animals left at liberty to act naturally. Thus, use of this system can extend to a range of applications, such as characterizing phenotypic responses in selective breeding trials, assessment of climate change, and husbandry variables. Future improvement on this system will include improving sensitivity, data processing and interpretation.

|| Tracking and forecasting change in New Zealand's oceans: how can we monitor the state of the marine environment?

Matt Pinkerton

NIWA

Along with on-going and increasing human use of New Zealand's marine domain comes a need to improve our ability to monitor and anticipate change: how will climate change and fisheries affect food-web resilience? How will seabed mining affect ecosystems?

Long-term observations are crucial to understanding the dynamics of the marine environment and managing human impacts. First, long-term observations provide direct information on the amount of variability in different parts of the system. A "baseline" is rather a "base spectrum-of-variability", and its characterisation takes more than a few samples. Second, looking at how different parts of the system change over time gives information on ecosystem linkages. Even if the information is not sufficient to work out the connections directly, the data can be used to see which models can reproduce the observed changes. Third, we are likely to have low power to forecast change in the marine environment for some time to come, so indicators are needed as part of adaptive management. In this talk I will summarise what time-series of data are available, what information they provide on variability and change in New Zealand's marine environment, and suggest what could be achieved in the near future.

|| Age and growth of the grey reef shark *Carcharhinus amblyrynchos* from Papua New Guinea

Jonathan Smart[1], Andrew Chin[1], Andrew J. Tobin[1], Colin A. Simpfendorfer[1] & William T. White[2]

[1]James Cook University & [2]CSIRO

Age and growth estimates were produced for the grey reef shark *Carcharhinus amblyrhynchos* from Papua New Guinea. Age estimates were produced from vertebral analysis conducted on samples (n = 138) collected by an on-board observer program operating in the Papua New Guinea long line fishery. A multi-model approach including the von Bertalanffy, logistic and Gompertz functions was used to estimate growth rates. Candidate growth rates and models were compared, and the AICc method used to choose the most parsimonious model. The effects of including misidentified individuals within the dataset were also examined. Observers misidentified an additional 19 sharks as grey reef sharks. The effect of including these additional 19 non grey reef sharks in the length-at-age sample on the growth model outputs was examined using Kimura likelihood ratio tests. The implications of misidentification on growth modelling are discussed.

|| The aggression behaviour of female New Zealand fur seals (*Arctocephalus forsteri*) towards conspecifics during lactation

Julie Kim, Sharyn J. Goldstien & Ximena J. Nelson

University of Canterbury

Females form the majority in Fur seal rookeries and are the only long-term residents. It is, therefore, not surprising that female behaviour can drive the population dynamics within a rookery and limit the potential for expansion of the rookery. The anti- gregarious behaviour of female seals is predicted to limit the number of breeding females in the rookery through aggression. Such behaviour would play a major role in the expansion of rookeries and the colonisation of new areas for breeding, through an emigration of smaller, weaker females to areas outside of the already established rookery. The aggression behaviour of females was observed at Ohau Point seal colony in Kaikoura from November 2014 to April 2015, covering the birthing and breeding season of New Zealand fur seals. Observations suggest that the number of females able to breed in a rookery is affected by the space available and the level of aggression between females during the birthing period. From this observation, it can be deduced that knowing the size of space guarded by individual female seals during the birthing and breeding season will inform predictions of rookery expansion. Such information will significantly aid fisheries and conservation organisations in creating management plans to mitigate potential future conflicts between humans and fur seals.

|| Sea Level Rise, Big Losses of Coastal Ecosystems

Cat Davis, Damian Young, Rhian Ingley & Mark Lowe

Morphum Environmental Ltd

The sea level in the Waitemata Harbour has risen on average 1.5 mm/year over the last hundred years and could rise between 1.0 to 1.35 m by 2115 (NIWA, 2011). Even small incremental changes, such as a centimeter a year, will likely have a significant impact on low lying intertidal both marine and fresh water ecosystems. The question is how these impacts present themselves and what are the key issues to consider in the Auckland region? How will changes in sea level over time affect coastal infrastructure such as transport, pipe systems and recreational land types? How will the more frequent inundation change coastal management areas and significant ecological areas? In Little Shoal Bay located on the North Shore of Auckland, recent king tides have resulted in a change in ecological structure including large areas of native wetland habitat loss and the upstream migration of mangroves. This case study provides examples of concerns for the conservation of vulnerable coastal ecosystems requiring adaptive management for future sea level rise.

Reference:

National Institute of Water and Atmosphere, 2011. Sea-level rise synthesis for Auckland, Auckland: Prepared for Auckland Council.

|| A new approach to ageing deepwater sharks: near infrared spectroscopy

Cassie Rigby, Brett B. Wedding, Steve Grauf & Colin A Simpfendorfer

James Cook University, Department of Agriculture and Fisheries, Department of Agriculture and Fisheries & James Cook University

Deepwater sharks are more vulnerable to exploitation than shelf and pelagic sharks. They are slower growing, later maturing and longer lived and within the deep habitat their vulnerability increases with depth. Three species of elasmobranchs from the deepwater of the Great Barrier Reef, Australia were traditional aged by band counts; a dogfish (*Squalus megalops*), gummy shark (*Mustelus walkeri*) and a skate (*Dipturus polyommata*). Yet many deepwater species cannot be aged by traditional methods due to poorly calcified vertebrae. An alternative approach to shark ageing using near infrared spectroscopy (NIRS) was investigated in vertebrae, dorsal fin spines and fin clips from two species of deepwater dogfish: *S. megalops* and *S. montalbani*. Their ages were successfully predicted from dorsal fin spines, and from vertebrae and fin clips that had no visible growth bands. Nonlethal ageing using NIRS fin spines could significantly reduce the numbers of sharks that need to be lethally sampled. As NIRS is a rapid, cost-effective approach it also offers the ability to age large numbers of sharks rapidly and improve reliability of age information for stock and risk assessments. The NIRS approach for ageing sharks is applicable to a wide range of shark taxa, and potentially all chondrichthyans.

|| Demographic and biological evidence for the causes of decline of NZ sea lions

Jim Roberts[1], Simon Childerhouse[2], Wendi Roe[3], Phoebe Stewart-Sinclair[4] & Ian Doonan[5]

[1]NIWA, [2]Blue Planet Marine, [3]Massey University, [4]Bay of Plenty Polytechnic & [5]NIWA

The largest breeding population of the nationally critical NZ sea lion occurs at the Auckland Islands in the NZ Sub-Antarctic region and this has declined by ~50% since the late 1990s. The other known breeding populations at Campbell Island, Stewart Island and the NZ mainland are likely to have increased in size over the same time period and the causes of decline at the Auckland Islands have not been explained. A new demographic assessment of females at the Auckland Islands found that periods of low pup and adult survival and poor pupping rates are all likely to have contributed to population decline. *Klebsiella pneumoniae* infection was identified as the main cause of death in pups during a period of particularly low pup survival since 2005. In addition, a positive correlation with pup mass indicates that pup survival may also have been compromised by maternal nutritional status. Temporal shifts in diet composition, a decline in maternal condition and depressed pupping rates are also consistent with changes in nutritional status. A range of factors may be influencing the decline of NZ sea lions at the Auckland Island, though nutritional stress and disease-related mortality are likely to be significant contributors.

|| Limited Scope for Latitudinal Extension of Reef Corals

Paul R. Muir[1], **David Aguirre[2]**, Carden C. Wallace[1] & Terence Done[3]

[1]Museum of Tropical Queensland, [2]Institute of Natural and Mathematical Sciences, Massey University & [3]Australian Institute of Marine Science

Coral reefs are under the immediate threat of climate change, particularly from increasing sea surface temperatures, which cause corals to bleach, succumb to disease and die en masse. However, contemporary and fossil evidence for poleward range expansions of staghorn corals associated with increasing sea temperatures has fuelled the belief that ocean warming will promote continued tropical coral expansion into temperate latitudes. Here, we evaluate support for this hypothesis using a global dataset of 104 species of staghorn corals. The growth of phototrophic corals such as staghorn corals is determined by three primary latitude-correlated environmental factors: solar radiation, temperature and aragonite saturation. We found that the dose of photosynthetically active radiation during winter was the best predictor of staghorn coral occurrence, and could, in principle, exclude staghorn corals from shallow substrata otherwise deemed suitable for corals based on temperature and aragonite saturation alone. Among the primary drivers of coral growth, only one - the amount of PAR that penetrates into the ocean and fuels photosynthesis - is unlikely to change substantially with climate change, and will ultimately limit any latitudinal extension of the range of staghorn corals made possible by anthropogenic warming of temperate seas.

Wednesday | 1145 | Rm. 260-073 OGGB4

Finding their way around, rig shark movement patterns

Warrick Lyon[1], Peter De Joux[2], John Montgomery[1] & Malcolm Francis[2]

[1]The University of Auckland, School of Biological Sciences & [2]NIWA

Rig sharks (*Mustelus lenticulatus*) are small endemic New Zealand sharks (Triakidae) that use sheltered harbours, estuaries and bays as pupping grounds during spring and summer. This brings them into heavily human populated areas where many environmental pressures now exist. To further understand how these environmental pressures may affect rig sharks we had to understand more about their movement patterns within a local estuary.

Using a custom-built shallow-water tracking system that gives accurate GPS positions, we tracked the movements of 20 rig sharks for between 3 hours and 3 days, with location fixes every 60 - 90 sec. The step-lengths and turns of these tracks were analysed using FRACTAL by V. Nams to identify scales of orientation and a MLE (Maximum Likelihood Estimation) model by Humphries MBA (Marine Biological Association) to determine if rig use random walks.

We identified both direct and random walks that varied at different spatial scales, indicating that rig sharks may use cognitive maps to orient themselves to areas that are beyond their sensory range.

|| Trends in population abundance and survival in the bottlenose dolphin populations of Fiordland: The benefits of long-term studies

Tom Brough[1], Richard Kinsey[2] & Steve Dawson[1]

[1]University of Otago & [2]Department of Conservation

Long-term studies on population dynamics for long-lived, slow reproducing species are scarce due to the significant investment needed to acquire long-term data. A collaborative study between Otago University and DOC currently investigates population trends in two bottlenose dolphin sub-populations (Doubtful Sound and Dusky Sound) within the greater Fiordland population. Photo-ID data from this collaboration were available for the Doubtful Sound population between 1990 and 2014, and from Dusky Sound between 2007-14. Population abundance and calf survival rates were modelled in programme MARK, using Lincoln-Petersen and Cormack-Jolly-Seber models respectively. Population abundance in both populations was highly variable, showing an overall decline in abundance in Doubtful Sound and a slight increase in Dusky Sound. Calf survival rates (i.e. birth to 1 year) from Doubtful Sound have varied substantially, and show declines to rates lower than published from any non-provisioned bottlenose dolphin population worldwide. Over the last four years, low calf survival rates have increased to 0.85 at 2014. In contrast, calf survival rates in Dusky Sound have remained higher, and stable at around 0.73. These results indicate substantial demographic stochasticity in both populations and demonstrate the continued vulnerability of Fiordland's bottlenose dolphins. This study also highlights the necessity of long-term data for understanding population trends in long-lived, slow reproducing species.

|| Temperate marine herbivorous fishes will likely do worse, not better, as waters warm up

Elizabeth Laman Trip-Jensen[1], Kendall D. Clements[2], David Raubenheimer[3] & J. Howard Choat[4]

[1]Nelson Marlborough Institute of Technology, [2]The University of Auckland, [3]The University of Sydney & [4]James Cook University

Increases in temperature are associated with reduced body sizes, life spans, and reproductive outputs in shallow water marine fishes. Herbivorous fishes have been seen as an exception to this trend, based on the hypothesis that physiological and demographic processes in these species are constrained by the inability to digest algae at low temperatures. It is thus argued that increased temperatures deliver a net benefit to herbivorous fishes. This study examines an alternative argument, that warming temperatures can have increasingly inimical effects on temperate piscine herbivores. We consider the hypothesis that herbivores experience greater oxidative stress at warmer temperatures. We use the age-pigment lipofuscin to examine the rate of oxidative damage accumulation in populations of a temperate marine herbivorous fish, *Odax pullus* (Labridae), at different latitudes (temperatures). We show a 55% faster rate of oxidative damage accumulation in shorter-lived fish living at warmer latitudes. In these populations, it took 33-50% fewer years to accumulate similar amounts of oxidative damage than in those living at colder latitudes, indicating greater oxidative stress in fish living at warmer temperatures. We conclude that at least some temperate piscine herbivores will be exposed to negative demographic impacts at their low latitude range margins as temperatures increase.

|| Ontogenetic phase and seasonal habitat partitioning of bronze whaler sharks in the Bay of Plenty

Melissa Kellett

University of Waikato

The coastal environments of the Bay of Plenty provide a variety of habitats supporting a wide range of marine organisms, including a significant elasmobranch species diversity. However, proximity to Tauranga city and other surrounding coastal settlements means that these ecosystems are vulnerable to a number of human impacts including pollution, habitat loss and fishing. This study will specifically examine bronze whaler sharks (*Carcharhinus brachyurus*) - an apex predator which is ecologically important in coastal New Zealand environments. Objectives are to determine their distribution and abundance in the waters of the Tauranga coastal region, and to examine the utilisation of different habitats at different life history stages, with particular focus on habitats used by juveniles. Survey methodology will include acoustic tagging techniques, baited remote underwater video surveys (BRUVS) and stomach contents analyses, set into the context of the range of habitat character. Furthermore, vertebrae analysis using Laser ablation-inductively coupled plasma mass spectrometry (LA-ICPMS) and isotope analysis techniques will investigate the biophysical nature of the habitats being used at the neonate and yearling stages of this species.

|| Aerial surveys reveal distribution patterns of cetaceans in the Hauraki Gulf, New Zealand

Lily Kozmian-Ledward[1], **Rochelle Constantine[1]**, Rachel Fewster[2] & Leigh G. Torres[3]

[1]School of Biological Sciences & Institute of Marine Science, The University of Auckland, [2]Department of Statistics, The University of Auckland & [3]Department of Fisheries and Wildlife, Marine Mammal Institute, Oregon State University

The Hauraki Gulf is a productive environment supporting a rich diversity of marine species, including approximately one-fifth of all known cetacean species. Bottlenose dolphins, common dolphins and Bryde's whales are the most frequently sighted cetaceans in the Gulf and occur year-round. To determine the habitat influencing the spatial distribution of cetaceans during the warm water months (December 2013 - April 2014), we conducted nine replicate aerial transect surveys of the Gulf, totalling 3,887 km of effort. These surveys collected data on the distribution and group size of cetaceans together with concurrent observations on near surface aggregations of potential prey: plankton and fish. Generalised additive models (GAMs) were used to examine the distribution patterns of each species in relation to prey, physiographic and remotely-sensed variables. Three types of model were built for each species to investigate the influence of spatial scale and explanatory variables. Using 79 observations of cetacean groups and 94 potential surface prey aggregations, the GAMs indicated that depth and distance to shore were the most important factors driving the spatial distribution of cetaceans, with evidence of habitat partitioning between the species. Point-pattern models found that the distribution of plankton patches was a significant predictor of whale distribution ($p=0.015$) but no significant relationship was found between dolphins and fish aggregations. Our research demonstrates that aerial surveys are an effective method of surveying the Gulf in a short time-frame. This allows a rapid large-scale assessment of ecosystem interactions to inform conservation management processes.

|| The Long-term effects of climate change induced ocean acidification on the physiology and molecular biology of sea urchins

Emily Joy Frost

The University of Auckland

The projected changes in oceanic water carbonate chemistry will have enormous impacts on an array of physiological processes, such as calcification, growth, reproduction, metabolism and the overall functioning of marine invertebrates and their respected ecosystems. Research conducted within the past decade suggests that the effects of ocean acidification vary based on ontogeny, life-history, environment and physiology, with calcifying organisms (particularly those which secrete aragonite exoskeletons) the most vulnerable. Two major questions are evident from this; 1) How does ocean acidifcation affect calcifying marine invertebrates; 2) What mechanisms are employed by these organisms in order to compensate changes in seawater pH and pCO2?

This presentation will focus on the effects of long-term exposure to elevated pCO2 on the calcification, growth, energetics and ion- and acid/base-regulation of adult Southern temperature sea urchin *Evechinus chloroticus*. Specifically, I am assessing the relative sensitivity and vulnerability of *E.chloroticus* by changes in exoskeleton bio-mineralization signatures, coelomic Mg2+, Ca2+, ammonium, pH and cCO2, biometrics, oxygen consumption, GSI, gonadal structure and mRNA transcript abundance of Na+/K+-ATPase (±-subunit), Na+/H+ exchanger (NHE-2), Na+/HCO3- co-transporter (AE-2) and carbonic anhydrase (CA-2).

|| Exploring the murky world of the sevengill shark *Notorynchus cepedianus* in southern New Zealand

Jordan Housiaux, Dr Will Rayment, Dr Chris Hepburn & Dr Sheri Johnson

University of Otago

The broadnose sevengill shark, *Notorynchus cepedianus*, is an important marine apex predator. This study represents the first systematic data on abundance, seasonal distribution and population connectivity of sevengill sharks in New Zealand. Sharks were attracted to coastal sampling sites in Otago and Stewart Island using burley, during 100 sampling trips in 2014 and 2015. Sharks were implanted with fish tags (n = 59) and photographs of unique dorsal markings (n = 23 unique individuals) were obtained. High rates of shark encounters in the summer (sharks were sighted on 86% of trips in both locations), and low rates of shark encounters in winter (0% Otago, 33% Stewart Island) suggest strong seasonal migratory behaviour. Low tag and photo-ID re-sight rates support this hypothesis. Long-term stability of natural marks and higher re-sight rates suggest photo-ID is an effective, less invasive alternative to physical tagging. Phylogenetic relationships among sevengill shark populations were explored to assess population connectivity, but indicate no differentiation in mtDNA (COI, ND4) at a national scale (n = 50), suggesting low breeding site fidelity. These findings provide some of the first data to help us understand the important role these predators have in structuring multiple coastal ecosystems.

|| Accounting for uncertainty in group size and duplicate identification in mark-recapture distance sampling: A case from the Hauraki Gulf, New Zealand

Olivia Hamilton, Sophie Kincaid, Rochelle Constantine, Lily Kozmian-Ledward, Cameron Walker & Rachel Fewster

The University of Auckland

Obtaining robust estimates of wildlife abundance is critical when testing theory and applying findings for conservation management of species. Challenges in the analysis phase can arise when behavioural and environmental factors complicate data collection, and thus the application of statistical methods to real populations. It is critical that these issues are addressed and uncertainty is accounted for. In this study, we investigated how the abundance and variance of two dolphin species were affected by particular data processing protocols associated with mark-recapture distance sampling. A total of 22 aerial surveys were conducted from November 2013 - October 2014 in the Hauraki Gulf, New Zealand using double-observer line-transect sampling. We developed methods to impute missing group size estimates, to identify observations made by two observers of the same group of dolphins i.e. duplicate classification, and account for the uncertainty associated with these two aspects in the coefficient of variation. Our models estimated 2,535 (CI 1652, 3647; CV 21%) common dolphins and 265 (CI 103, 484; CV 37%) bottlenose dolphins. The approach developed in this study provides a framework that reduces the number of arbitrary assumptions needed for mark-recapture distance-sampling modelling, and allows for the uncertainty associated with assumptions of observer's group size estimates duplicate classification to be quantified.

|| Ocean acidification and the swimming performance of sea urchin sperm

Michael Hudson & Mary Sewell

The University of Auckland

Increasing levels of atmospheric CO2 are resulting in large scale change in our global oceans including driving both increasing seawater temperatures and ocean acidification (OA). The resulting environmental changes to carbon chemistry and seawater pH will have direct implications for marine life with varied and contrasting outcomes. In general, species are suggested to be optimally adapted to the environmental conditions they are exposed to over evolutionary time, and as a result have limited capacity to tolerate change. The early life stages are reportedly the most sensitive to environmental perturbations. As the critical first step of fertilisation success (FS) of the broadcast spawning sea urchin, kina (*Evechinus chloroticus*), depends on egg and sperm encounters, the swimming performance of kina sperm was examined here at present day to IPCC predicted future levels (380, 1000 & 1800 ppm). Preliminary analysis shows that although on average % motility is not changed by increasing levels of pCO2, sperm swimming speed is with a >15% decrease at the highest treatment level. This research examining the differences in swimming performance between individuals looks at a possible mechanism underlying OA induced changes in fertilisation success in kina; an ecologically, recreationally and culturally important species.

|| Nearshore movement ecology of a medium-bodied shark, the creek whaler *Carcharhinus fitzroyensis*

Samantha Munroe[1], Colin A. Simpfendorfer[1], James Moloney[1] & Michelle R. Heupel[2]

[1]*James Cook University &* [2]*Australian Institute of Marine Science*

The movement and habitat use patterns of medium-bodied nearshore sharks are poorly understood. However, these species face some of the highest levels of exposure to anthropogenic development. The present study used passive acoustic telemetry to evaluate the residency, space use and habitat use patterns of the creek whaler *Carcharhinus fitzroyensis* in a nearshore embayment in Queensland, Australia. Half of the monitored population were highly resident to the bay but several individuals spent less than two weeks in the bay, suggesting broader movements may occur in a portion of the population. Activity space size varied between months and time of day but was also not affected by animal size. All *C. fitzroyensis* spent the majority of time in seagrass habitat (70%) and deep water (> 5m) mud substrate (20%). Shallow mudflat, sandy inshore, and reef habitats were rarely used. Although the sample size of immature individuals was relatively small, results indicated immature and mature *C. fitzroyensis* shared space and habitats. Overall, *C. fitzroyensis* used a combination of nearshore movement patterns typically exhibited by small- and large-bodied species. Given the consistent use of seagrass habitat, *C. fitzroyensis* are likely vulnerable to population decline as a result of seagrass habitat loss.

|| Looking at resting behaviour of Bryde's whales in the Hauraki Gulf

Sahar Izadi[1], R. Constantine[1], N. Aguilar de Soto[2] & M. Johnson[3]

[1]Institute of Marine Science, The University of Auckland, [2]Sea Mammal Research Unit, University of St Andrews, Scotland & BIOECOMAC, Department of Animal Biology, La Laguna University, Canary Islands

The Hauraki Gulf is the primary habitat for a small, year-round population of Bryde's whales (*Baleaenoptera brydei*) which is categorised as critically endangered nationally. The most significant threat to this population is vessel-strike mortality. Whales are most vulnerable when they surface to breathe, in particular while resting at or near the surface. Thus, it is important to understand Bryde's whale surfacing and resting behaviour to determine their vulnerability to vessel-strike throughout the day. Seven sound and movement archival tags (DTAGs) were deployed on Bryde's whales in the Hauraki Gulf; four deployments (42 hrs) recorded sufficient data to assess the whale's diurnal dive patterns. A detector based on acceleration rate (jerk) and roll was coded to recognise different activity levels as an indicator of resting, foraging and travelling behavioural states. Analysing dive profile patterns and activity as indicated by jerk showed that, during night, dives were significantly shorter (average = 0.9 min vs. 1.4 min; $p<0.05$) and shallower (5.5m vs 7.3m; $p<0.0001$), and whales were less active (with less and lower peaks in jerk, and mean jerk 3.14 vs. 1.26; $p<0.0001$). These clear patterns of diurnal behaviours suggest that reductions in vessel speeds are especially crucial at night to mitigate the risk of vessel-strike mortality.

|| Sponge physiology and function in a changing ocean: responses to ocean acidification and climate change

Tracey Bates & James J. Bell

Victoria University of Wellington

As a result of anthropogenic impacts, our oceans are expected to undergo an increase in seawater acidity of up to 0.4 pH units, and a concurrent increase in temperature of up to 4oC, over the next 100 years. Despite global interest in climate change, the effects of warmer, more corrosive waters on marine sponges are largely unknown, and the majority of studies conducted have focussed on tropical species. This study investigated the effects of pH and temperature on two temperate sponges, *Tethya bergquistae*, and *Crella incrustans*. Each species was subjected to 29 day experiments looking at the separate effects of seawater pH (ambient and pH 7.6), and temperature (ambient, 18, 20, 22°C). Temperature significantly impacted sponge respiration rates and survival for both species, with lethal effects experienced in the highest treatments of 20 and 22°C. In contrast, seawater pH appeared to have very little effect on any response variables measured, despite specimens being subjected to the worst case IPCC prediction. These results suggest that some sponge species may be able to tolerate decreasing pH with the onset of global climate change. However, stress associated with seawater temperatures, may result in declining sponge populations in rocky reef ecosystems.

|| Running the Gauntlet: Regional Movement Patterns of Manta alfredi through a Complex of Parks and Fisheries

Elitza Germanov[1,2] & Andrea D. Marshall[2]

[1]Murdoch University & [2]Marine Megafauna Foundation

Manta rays are economically important for fisheries and tourism in Indonesia. Manta rays are listed by the IUCN Red List as 'Vulnerable' to extinction; therefore, human exploitation of manta rays must be regulated. A better understanding of the habitat use and movement patterns of manta rays in Indonesia is needed in order to employ effective conservation measures. To gain insight into the movements of *Manta alfredi* we used 'Manta Matcher', an online database with an integrated matching algorithm, to compare photographs from 2,604 encounters of *M. alfredi* collected by recreational divers and dive operators throughout Indonesia over a nine-year period. This photographic comparison revealed that manta rays migrated between regional sanctuaries such as Nusa Penida, the Gili Islands, and the Komodo National Park (up to 450 km straight-line distance). The areas between these sanctuaries are heavily fished and trafficked by ships, and when manta rays travel through these regions they risk being fished and injured by ship strikes. These long-range manta ray movements suggest connectivity between *M. alfredi* populations in neighboring islands and raise concerns about the future management of regional populations. It is recommended that a national conservation strategy be developed to protect the remaining populations in the country.

|| Seasonal abundance and site fidelity of Bryde's whales in the Hauraki Gulf, New Zealand

Gabriela Tezanos-Pinto[1], Krista Rankmore[1], Nicky Wiseman[2], C. Scott Baker[3], Blair Outhwaite[1], Catherine Lea[1] & Karen A. Stockin[1]

[1]Massey University, [2]The University of Auckland & [3]Oregon State University

Bryde's whales (*Balaenoptera edeni/brydei*) are the least known of the large whales. In the Hauraki Gulf, New Zealand, they occur year-round with seasonal fluctuations in abundance and higher occurrence of whales during winter. Daily photo-identification surveys were conducted during 2003-06 (n=674) and 2011-13 (N=373) following similar methodologies. These resulted in a photo-identification database containing a total of 498 sighting records of 62 unique Bryde's whales. Mean trip encounter rates (TER) between periods were similar (0.56 and 0.57, respectively) and there were no significant differences comparing mean TER values per year between periods (U=0.01, df=1, P=0.98) or seasons (H=0.13, df=3, P=0.99). Overall, 15 whales were sighted in both periods whereas two out of four whales that showed moderate site fidelity during 2003-06, were not resighted at all during 2011-13. In addition, there were three new whales using the gulf on moderate basis suggesting changes in individual site fidelity over time. Seasonal abundance was estimated using mark-recapture analysis in MARK. The Robust design model that best fitted the data resulted in variable estimates of abundance among seasons. The temporary emigration rates during time intervals when whales had been absent in the previous period were higher (0.321, SE=0.11) than the temporary emigration rates for those present in the previous period (0.085, SE=0.04). This implies that some whales leave the study area for multiple seasons but subsequently return. Seasonal abundance with open POPAN models ranged from 50 - 55 whales during 2003-06 and 41 - 52 during 2011-13 with a 'super-population' estimate of 113 whales (CI = 94-135) for both periods combined. We acknowledge that the Hauraki Gulf forms only a restricted part of the known home range for Bryde's whales, but it still appears that this region is of importance to the population; especially to those whales that display moderate site fidelity. Moreover, this study reports individual changes in the use of the region by whales over time that has until now, gone undetected.

|| Energetic and physiological effects of ocean acidification and warming on adult *Patiriella regularis*

Kate Sparks & Miles Lamare

University of Otago

Patiriella regularis is an important sea star with a wide geographic range across New Zealand, and is a recently- introduced species in Australia. Ocean warming and acidification have been shown to impact larvae of this species, but adult responses may be more complex. If warming temperatures influence physiological tolerances, this species may be able to expand its' range into new areas. This study will present the first data from an ongoing long-term study, focussing on adult metabolism, tissue biochemistry and sexual development, used to assess adult *P.regularis*' potential for success in a warmer, high-CO2 ocean. Understanding the physiological costs of survival and reproduction under high temperatures and high pCO2 may enable a more thorough understanding of key species' continued roles in their ecosystem.

|| Blue shark behaviour - a 3D insight on one of the greatest pelagic migrators

Riley Elliott & John Montgomery

The University of Auckland

The blue shark is of the most common shark species in the big blue backyard, but like most, they have declined rapidly via shark finning. What does the removal of 20million blue sharks a year mean for the pelagic realm? Satellite tagging data provides a unique assessment of their behavior, showing migrations of entire oceanic basins each year, daily dives to 2000m, below thermoclines and stratification layers, recycling nutrients to surface waters.

3 years of satellite data has been collected and analysed to define critical habitat and migration routes of the South Pacific blue shark population. Dive profiles quantify behavioral strategies and thermoregulation, reflecting a calculated apex predator that plays a key role in the pelagic food web.

|| A bird's eye view: An assessment of UAV population sampling methods for coastal mammals

Oliver Gooday, Sharyn Goldstien & Peyman Zawar-Reza

University of Canterbury

Current methods of estimating populations of coastal mammals, such as seals and sea lions are highly invasive and pose a danger to both the seal and the scientist. The New Zealand fur seal (*Arctocephalus forsteri*) is in a state of recolonisation in New Zealand and Australia, following the near extinction it faced during the sealing period of the 1800's. Population counts in New Zealand colonies have been conducted for the past 30 years using mark-recapture methods techniques which are the most accurate method, but, are highly invasive and present a real danger to seal pups as the colonies grow. In 2015 we conducted the first Unmanned Aerial Vehicle (UAV) population surveys of *A.forsteri* at New Zealand's largest breeding site, Ohau Point, Kaikoura. We used a Vertical Take-off and landing quad-copter to determine whether UAV remote sampling could be an effective and less invasive replacement for traditional mark-recapture studies. We found that UAV sampling using a quad-copter caused little to no disturbance to the seal colony whilst conducting a fly-over population count. We have compared the counts from various fly-overs to those obtained by more traditional methods and will report on these comparisons and the overall efficacy of the UAV technology.

|| Projected increased in seawater temperature affects developmental physiology of the sea urchin *Evechinus chloroticus*

Natali Delorme & Mary A. Sewell

School of Biological Sciences, The University of Auckland

Seawater temperatures are projected to increase in the next century due to anthropogenic climate change. Temperature is one of the main factors affecting the normal functioning of marine animals and therefore an understanding of how changes in seawater temperature affect development of marine invertebrates is particularly important. In the present study, the overall physiology of developmental stages of *Evechinus chloroticus* was determined by measuring the respiration rate, the utilization of lipids and the morphometrics of different developmental stages cultured at different temperatures. The results showed an increase trend in respiration rate with temperature in each larval stage, as well as higher utilization of lipids through development to the 8-arm larval stage as temperature increased. In addition, larvae from the highest temperature treatment developed faster and were larger compared to the lower temperature treatments. Overall, the results suggest that development of *E. chloroticus* at higher temperatures results in larger larvae which require more energy during development in order to compensate for a higher metabolic rate. In the wild, the larvae may not have enough food (i.e., energy) in order to successfully complete development, which could have important population consequences and flow-on effects to the shallow subtidal communities in New Zealand.

|| Conservation challenges of sharks with continental scale migrations

Michelle Heupel[1], Colin A. Simpfendorfer[2], Mario Espinoza[3], Amy F. Smoothey[4], Andrew Tobin[2] & Vic Peddemors[4]

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Understanding movement and connectivity of populations is increasingly important as human and climate change pressures become more pervasive, but can be problematic in difficult to observe species such as large marine predators. We examined the movements of bull sharks, *Carcharhinus leucas*, using acoustic telemetry arrays along the east coast of Australia. Approximately half of 75 individuals released in temperate waters moved into tropical reef regions, with both sexes undertaking long-range movements and multiple individuals making return trips. Only 3% of 39 individuals released in tropical reef habitats moved south to temperate waters, but approximately 25% moved to southern reef or subtropical coastal areas. These results reveal complex linkages along the east coast of Australia which suggest a tropical reef based population comprised of individuals that migrate to multiple regions. Connectivity between locations along the east coast of Australia creates important conservation challenges for resource managers in multiple jurisdictions.

|| Piecing together the colossal squid puzzle

Aaron Evans & Kathrin S. R. Bolstad

Auckland University of Technology

The colossal squid (*Mesonychoteuthis hamiltoni* Robson, 1925) has been known to science for 90 years and is thought to play an important role in Antarctic food webs, yet little is known of its biology or ecology. Large specimens in good condition have only become available for study within the past decade and these have generally been examined cautiously in order to maintain specimens' value for display. However, a more thorough sampling of a recently collected specimen was facilitated by the Museum of New Zealand Te Papa Tongarewa in late 2014, and was also the subject of a live webcast event viewed in more than 180 countries. This examination provided a unique opportunity to collect data for a variety of systematic, molecular, chemical, trophic, and reproductive studies, now underway on this species, which together will greatly improve our understanding of this enigmatic animal. Insights gained into the colossal squid's biology may also provide information on the poorly studied family Cranchiidae Prosch, 1847, one of the most diverse and ecologically important deep-sea squid families.

|| Impacts of local and global stressors in coastal habitats: influence of altered nutrient, sediment and temperature levels on the early life history of three habitat-forming macroalgae

Tommaso Alestra & David R. Schiel

University of Canterbury

The decline of forests of canopy-forming macroalgae is one of the biggest threats to temperate coastal systems worldwide. This phenomenon is usually associated with anthropogenic disturbances at local scales such as increased nutrient and sediment loads, but there is uncertainty about the compound impacts of local stressors and altered global climate conditions. In a series of laboratory experiments we tested short- (48 h) and long-term (eight weeks) effects of different combinations of nutrient, sediment and temperature on the early life stages of the habitat-forming fucoids *Hormosira banksii*, *Cystophora torulosa* and *Durvillaea antarctica*. Sediment affected the post-settlement survival of *Hormosira* and *Cystophora* germlings within 48 h and reduced growth and survival of all species over eight weeks. Temperature and nutrient effects were subordinate to those of sedimentation. In the absence of sediment, germling survival was reduced by increased temperatures (+ 3°C) for all species after eight weeks, while nutrient enrichment stimulated the growth of *Hormosira* and *Cystophora*, but caused a decline in the survival and growth of *Durvillaea*. These results highlight mechanisms that may well apply in natural contexts, and they reinforce the need for appropriate management of local stressors in order to mitigate the impacts of altered climate conditions.

|| Simulation based marine reserve design for recovering deep-sea shark populations

Ross Daley[1], Alistair Hobday[2], Jayson Semmons[1], Alan Williams[1] & Mark Green[1]

[1]University of Tasmania & [2]CSIRO Oceans and Atmosphere

At least 10 deep-sea shark species have suffered major population declines in the Atlantic, Pacific and Indian oceans due to overfishing. Marine reserves are aiding recovery for at least two species in Australia but need to be integrated with other management arrangements where populations extend beyond closures. We analysed passive acoustic tracking data collected inside an Australian closure designed for deep-sea sharks then developed an individual based simulation model to estimate movement in the study region. Scenario evaluation found that that population trends were intrinsically sensitive to biological uncertainty (particularly fecundity), the size of individual home range, and the varying tendencies of different species to return to a particular region. The effect of different fishing pressures was explored by simulating and varying the size of the closure, the amount of fishing effort, the type of gear used, and release survivorship (handling practices). These results can be used to make quantitative predictions about the trade-offs between conservation and resource use associated with designing marine reserves for deep-sea sharks.

|| Does giant squid ink taste good?

Chris Pook & Kathrin S. R. Bolstad

Auckland University of Technology

Giant squid, *Archetuethis* sp., live in the mesopelagic and are rarely recorded in shallow waters. Despite its aphotic habitat, these species have retained the ability to release substantial quantities of ink as a defence mechanism. Using methyl chloroformate derivatisation and GC-MS we compared the chemical constituency of ink from two giant squid specimens to that of the common New Zealand arrow squid, *Nototodarus gouldi*. All three were rich in amino acids, supporting the theory that released ink functions as a phagomimic, distracting predators with appealing chemotactic cues while the animal escapes. We report the presence in squid ink of several other organic compounds in abundance and discuss their likely contribution to phagomimicry. Compounds such as the tripeptide glutathione, creatinine, putrescine and several fatty acids, were found in only one of the giant squid samples, suggesting that sampling and storage techniques are critical to future analyses of this rare and fascinating creature.

|| A Limpet's Legacy: Carry-Over Effects across Life Stages and Generations

Gustav Kessel & Nicole E. Phillips

Victoria University of Wellington

Siphonaria australis is a native limpet that, like many intertidal invertebrates, possess a complex life history, passing through a series of discrete life stages before reaching maturity. Conditions experienced during one of these stages can dramatically influence performance in subsequent stages through "carry-over effects". Such effects may also occur trans-generationally, in which case experiences of the parental generation manifest as alterations to offspring performance through non-genetic mechanisms. Therefore, the way a limpet larva responds to its environment is intricately tied to both its own history of stress exposure and that of its progenitors. Most studies focus on single-stressor carry-over effects and examine only one life stage or generation, thus failing to replicate the complex "stress legacies" that may be caused by anthropogenic climate change and other disturbance. Consequently, I will aim to elucidate the role of stress legacies in determining vulnerability to global change scenarios by examining how the effects of multiple stressors (UV, temperature, copper pollution) carry-over from adults through to the various life stages of their offspring. The detection of deleterious carry-over effects may imply that coastal systems are more vulnerable to stress than commonly recognised, since each generation of invertebrates may be predisposed to successively poorer performance.

|| Bycatch and post-release mortality of protected spinetail devilrays in the skipjack tuna purse seine fishery

Malcolm Francis & Emma Jones

NIWA

The spinetail devilray (*Mobula japanica*) is caught incidentally by tuna purse seine vessels operating around northern North Island during summer. The species was protected in New Zealand in 2010 and efforts have since been made to develop improved handling and release methods and to estimate mortality of released rays. Rays are caught mainly along the north-east coast North Island between Great Barrier Island and Bay of Islands. Catch rates peak along the edge of the continental shelf over seabed depths of 150-350 m. Use of a large-mesh cargo net has been promoted to 'sieve' the rays from the tuna and release the former, but this measure is still not a requirement and it has had limited uptake by industry. Tagged and released rays that appeared healthy have suffered high mortality rates although the available sample size is small. Depth data from one tagged survivor revealed variable vertical movement, often including diel diving patterns between the surface and 200 m, with some dives as deep as 649 m.

|| Population genetics of 'arrow' squids, *Nototodarus gouldi* and *N. sloanii* (Cephalopoda, Ommastrephidae), in New Zealand waters

Heather E. Braid & Kathrin S. R. Bolstad

AUT Lab for Cephalopod Ecology & Systematics, Institute for Applied Ecology New Zealand, Auckland University of Technology

The New Zealand arrow squid (*Nototodarus gouldi* and *N. sloanii*) fishery is one of New Zealand's largest and most valuable fisheries, providing an annual revenue of $100-300 million over the past decade. Both species are currently managed as a single stock, but pre-fishing-season biomass estimates are not available because of their short life span and rapid stock-size fluctuations, which are poorly understood. The presence of two separate species further complicates understanding of the stock's biomass and potential interactions throughout the Exclusive Economic Zone (EEZ); *Nototodarus gouldi* occurs in northern waters, and *N. sloanii* in southern waters, with some overlap between the two species. The overall purpose of this study is to gain insight into the population structure of *N. gouldi* and *N. sloanii* in New Zealand waters to inform management decisions in order to create a sustainable fishery. This study aims to design microsatellites for each species using Illumina paired-end sequencing and then use the microsatellite markers to examine the population structure of arrow squid from around New Zealand. In addition, a combination of microsatellite markers and DNA barcoding will be used to determine whether the Auckland Islands population of *N. sloanii* is genetically distinct.

|| Effects of copper toxicity on the sea urchin *Evechinus chloroticus* (kina) across multiple life stages and using realistic exposure scenarios

Agnes Rouchon & Nicole Phillips

Victoria University of Wellington

Metal pollution has long been recognised as a major concern for marine species. However the impact of metals in more complex and realistic exposure regimes is still poorly known.

We investigated the effects of copper on kina across multiple life stages using a range of realistic exposure scenarios in the laboratory: 1) the latent effects on larvae and juveniles, using low copper concentration (2 – 10 ¼g/L) and short pulses of exposure; 2) the effect of dietary intake as well as waterborne exposure; 3) the toxicity of copper in low salinity (24 ppt) on larvae; 4) the effect of a 2 week exposure to 50 ¼g/L on adults.

Strong latent effects were observed at low concentration and short exposure time, especially when copper was present in the diet rather than dissolved in water. Low salinity increased copper toxicity under chronic exposure to high levels (15 ¼g/L) but not under episodic exposure (4 days) to low concentration (5 ¼g/L). Finally, exposed adults had poor spawning success and elevated copper burden in gonads.

These results demonstrate the need for considering toxic effects across multiple life stages and using realistic exposure regimes to better understand the likely impact of metal pollution on marine populations.

|| Bycatch reduction tools for longline fisheries: using weak electricity to deter sharks from bait

Sunkita Howard & Michael G. Paulin

University of Otago

Low-value, non-target shark catches are common in longline fisheries in New Zealand and internationally. Sharks' specialised electric sense enables them to detect electric stimuli well below those perceptible by teleost species that are the fisheries' targets. Electropositive metals which produce electric currents when immersed in seawater have shown some promise as shark deterrents, but they are expensive and corrode rapidly. We used small, cheap microprocessors to produce electric stimuli in bait choice experiments on 16 groups of 3 captive juvenile sandbar sharks (*Carcharhinus plumbeus*). We found that weak electric currents can significantly reduce the frequency of sharks consuming bait adjacent to the current sources, compared to control baits. Despite strong reductions in bait removal, tracking individual sharks' use of tank space in the absence of bait or olfactant showed that they did not avoid the electrodes' location (n = 12). The absence of avoidance behaviour indicates that reduced bait removal may be due to the electric stimulus interrupting the final stages of sharks' feeding response, rather than eliciting an aversive response.

|| Big squids for everyone: The value of hosting public science events

Kat Bolstad, Aaron B. Evans, Heather E. Braid & Jesse T. Kelly

AUT Lab for Cephalopod Ecology & Systematics, Institute for Applied Ecology New Zealand, Auckland University of Technology & Auckland University of Technology

Large cephalopods such as the “giant” and “colossal” squids (*Architeuthis dux* and *Mesonychoteuthis hamiltoni*, respectively) have intrigued scientists and the public for centuries, yet many basic questions about their biology remain unanswered. While worth studying in their own right, these charismatic megafauna have additional value as ambassadors for the marine environment. They attract considerable public and media interest, and can provide an initial point of engagement that facilitates subsequent education about marine environments and issues. One particularly useful means of disseminating information directly to the public is the live web-cast, which enables researchers to invite the public into our laboratories to participate in and observe science as it happens. Popular interest in these sorts of events is clear; two large web-cast squid examination events in 2014 attracted thousands of real-time viewers, and participants across a variety of media. These events, which provided invaluable sampling opportunities for more than a dozen internationally collaborative scientific projects, also made science more accessible and enabled online participants across the world to feel a connection to the marine environment.

|| Impacts of a major storm event on substrate, macroalgal cover and fish phenotypes in Wellington Harbour

Becky Focht, Jeff Shima, Daniel McNaughtan & Abi Powell Victoria

Victoria University of Wellington

In June 2013, a large storm affected the Wellington south coast, producing waves in excess of 15 metres and sustained wind speeds in excess of 100km/hour. Shallow sub-tidal habitats along the south coast were substantially altered, with scouring/removal of sand, small cobbles and macroalgae. We quantified the effects of this storm by measuring the cover of macroalgae, cobble characteristics, and fish densities along transects before- and after the storm at several sites in the Wellington region. We also sampled the common triplefin (*Forsterygion lapillum*) and quantified shifts in the distribution of phenotypes within populations (using otolith-based traits and morphological measurements) in response to the storm. We evaluate our results in the context of disturbance regimes and discuss the potential implications of this work for the dynamics of local reef fish populations.

|| The NPOA Sharks - what is it?

Tiffany Bock & Rich Ford

Ministry for Primary Industries

In January 2014 the revised New Zealand National Plan of Action for the Conservation and Management of Sharks (NPOA-Sharks 2013) was released. This document was drafted by a collaborative group including the Department of Conservation, Ministry of Foreign Affairs and Trade, environmental organisations (WWF, Forest & Bird), and the fishing industry and led by the Ministry for Primary Industries.

The NPOA-Sharks 2013 provides goals and objectives to improve our research and information regarding sharks, and base conservation and management actions on an assessment of risks. Just over a year on, progress has been made against many of the objectives of the NPOA, including the banning of shark finning, the completing of a risk assessment, the development of indicators of abundance for migratory sharks and a decision on whether New Zealand will become a signatory to the Convention on Migratory Species Memorandum of Understanding on the Conservation of Migratory Sharks.

Additional work is planned and/or underway to meet other objectives of the NPOA-Sharks including developing indicators for abundance for other shark species, age and growth work on at risk shark populations, work on mitigation of fisheries effects and improving identification of sharks by fishers and observers.

|| The influence of habitat characteristics on toheroa *Paphies ventricosa*

Katrin Berkenbusch, Edward R. Abraham &Philipp Neubauer

Dragonfly Data Science

The surf clam toheroa (*Paphies ventricosa*) is endemic to New Zealand, where it inhabits the intertidal zone of exposed sandy beaches in North and South Island regions. This species is of great cultural importance, and has a long history of supporting customary, recreational and commercial fisheries. Population declines have led to the closures of all fisheries, except customary take. Factors contributing to the declines have included changes in land use and habitat characteristics. The present study assessed the toheroa population at Oreti Beach (Southland) in 2014, and some of the habitat characteristics that may influence the distribution and abundance of this species. The population of large toheroa appeared stable in 2014, but the estimated number of juvenile toheroa was about one third of the previous estimate in 2009. A marked change in 2014 was the increase in the occurrence of gravel, with 24% of all quadrats containing gravel, whereas no gravel or stones were recorded previously. Statistical modelling indicated a negative association between juvenile toheroa and the presence of gravel, and between juvenile toheroa and ghost shrimp (*Biffarius filholi*) burrow density. The influence of these habitat characteristics on juvenile toheroa may affect recruitment to the adult population.

|| What do sediment traps tell us about sedimentation on rocky reefs?

Blake Seers, Nick, T. Shears & Russell & B. Millar

The University of Auckland

Runoff of sediment into coastal waters is a major stressor of coastal ecosystems that is likely to intensify with climate change. Sediment traps have been a popular environmental monitoring tool for measuring “sedimentation” and the effectiveness or impact of land-use practices. Despite the prevalence of programmes and studies involving sediment traps, there is still a lack of knowledge on the spatio-temporal interactions driving sediment trap rates on rocky reefs, and if or how trap rates relate to coastal runoff. In this study we analyse over seven years of sediment trap data, from sites spanning a wave exposure gradient in the Hauraki Gulf, to investigate the process determining fine-sediment trap rates. A hierarchical, bayesian model is fitted to monthly, trapped sediment data from 41 sites throughout the Hauraki Gulf, northern New Zealand. Trapped sediment rates are overwhelmingly related to waves and resuspension mechanisms, and the magnitude of these effects differ along the coastal exposure gradient, and the depth to the nearest sand. Resuspension of sediment from the trap is also evident, highlighting the need for appropriate models to account for this potential bias. This study suggests that trapped sediment is primarily related to local drivers causing resuspension on rocky reefs, rather than documenting sediment runoff in these coastal environments.

|| New Zealand's expert-based assessment of the risk to sharks from commercial fisheries

Rich Ford & Annie Galland

Ministry for Primary Industries

Actions to be implemented under the NPOA-Sharks (covering all cartilaginous fishes) will be prioritised to species dependent upon the outcomes of a risk assessment (RA). The expert-based RA completed used a Scale Intensity Consequence Analysis (SICA) approach to assess the relative risk to shark species from commercial fisheries at a national scale over the last five years. The expert panel scored the intensity and consequence (both on scales of 1 to 6) of fishing for each shark based upon examining the best available data (this was compiled prior to the workshop). These scores were then multiplied to get a total risk score per species.

Results were reported within the three management classes of sharks (Quota Management System (QMS), Non-QMS and Protected species). Carpet shark (Non-QMS) and rough skate (QMS) attained the highest total risk scores (both scored 21). The highest scoring protected species was basking shark (total risk score of 13.5). No evidence was available to support commercial fishing causing serious unsustainable impacts to any shark taxa. The expert panel recommended more data mining, grooming or analysis to improve inputs to assessment scores, better taxonomy and education to improve identification of sharks, and collection of more biological information.

|| The effects of the MV Rena on the water quality, chemistry and zooplankton of Otaiti

Te Puea Dempsey, Phil M. Ross, Christopher N. Battershill & Adam Hartland

University of Waikato

Although the effects of anthopogenic pollution in the world's oceans is relatively well studied, we have only limited knowledge of the ecological consequences of large, complex, point source pollution events such as ship wrecks. Larval settlement is a process that is heavily influenced by chemical cues and water quality. Consequently, changes in water chemistry resulting from shipwrecks may influence recruitment, the composition of benthic communities and result in the entrainment of contaminants into the reef food web.

Research was undertaken to address these uncertainties as they pertained to the recovery of Otaiti (Astrolabe Reef) following the MV Rena shipwreck. Research investigated (1) the influence of the ship and associated debris to the chemistry and quality of water in the benthic zone around the wreck, (2) the influence of Rena contaminants on survivorship of planktonic larvae, and (3) the influence on contaminant plumes on planktonic behaviour.

There is a clear effect from the Rena and debris field on the water quality and chemistry of Otaiti. Behavioural responses of pelagic and settling invertebrates to Rena pollution highlighted sensitivity to contaminant plumes, and increased mortality with increased contaminant concentrations. This suggests that contaminants presently residing on Otaiti may have significant ecological consequences on the recruitment and survivorship of larvae that rely on reef conspecifics and chemical cues to initiate settlement.

|| Inter-tidal sampling at Long Bay and the responses of organisms to tidal height and structural complexity: Morton revisited

Marti Anderson[1], Emma Betty[1] & Wilma Blom[2]

[1]Massey University & [2]Auckland War Memorial Museum

John Morton's book "Seashore Ecology of new Zealand and the Pacific" is a must-read for marine ecologists in New Zealand who want to ground their understanding of local marine communities in the rich cultural backdrop of natural history. We used Morton's description of the inter-tidal communities at Long Bay as a touch-stone and inspiration to develop a quantitative field sampling protocol for engagement of 3rd-year students in marine ecology. We used rigorous quantitative sampling methods and support from taxonomic experts at Auckland War Memorial Museum, then applied modern statistical techniques to investigate the responses of ecological communities to: (i) tidal height; (ii) structural complexity of the substratum and (iii) their interaction. In addition to uncovering and estimating the main gradient of change in community structure vs tidal height, an interaction with complexity was also uncovered – specifically, structural complexity became more important for communities high on the shore. We reflect on how modern tools can synergise with historical field-based natural history to enhance ecological understanding.

|| A sustainability risk assessment framework for fish by-catch in New Zealand deepwater fisheries

Marie-Julie Roux[1], Charles T.T. Edwards[1], Alistair Dunn[1], Ben R. Sharp[2] & Malcolm R. Clark[1]

[1]NIWA & [2]Ministry of Primary Industries

New Zealand deepwater fisheries incidentally harvest more than 100 non-target fish species on an annual basis, including protected species such as the basking shark *Cetorhinus maximus*. Until recently, the majority of by-catch species in New Zealand have been managed using qualitative indicators of status, without reference to estimates of productivity or exploitation rate. A semi-quantitative, spatially-explicit framework for sustainability risk assessment of fish by-catch is presently under development. The framework uses an impact/threshold approach to risk evaluation, whereby risk for a species is evaluated as the ratio of an impact level to a maximum impact sustainable threshold (MIST). The impact level is estimated using information on species distribution, fisheries overlap and catchability, whereas the MIST is derived from life history dependent productivity estimates. The framework implements an integrated approach that allows uncertainty in all these components to be quantified and propagated through the assessment process. An important outcome is that both risk and uncertainty can be partitioned and distinguished among fishery sectors, allowing more focused management action. This presentation will give an overview of conceptual framework design, including key components, structural assumptions and spatial considerations, with reference to data limitations and the information needs of fisheries managers.

|| Trap selectivity for *Jasus edwardsii*: A comparison between lobster catch and diver surveys

Pamela Kane

The University of Auckland

The management of any fisheries requires accurate assessments of stock abundance, demographics and distributions. Understanding how catch relates to the actual size and sex distributions, and abundance of lobsters on the seabed is important, especially for fisheries management.

Commercial lobster traps are known to be very selective and sometimes only sample small portions of the lobsters that are actually on the seabed in a given area, during the immersion time of the trap. Therefore the interpretation of catch per unit effort (CPUE), size or sex distributions may not be proportional or relate to the population within the vicinity of the trap.

Lobster catch from trap surveys were measured and sexed, and compared to lobsters measured and sexed on the seabed from diver surveys within the Cape Rodney to Okakari Point Marine Reserve, and in fished areas outside the reserve. Trap surveys were found to be size and sex selective, catching larger lobsters, and had a different sex ratio to the population on the seabed. Trap catch appeared to be slightly correlated with density of lobsters on the seabed.

|| Cues prompting predator avoidance behaviour in sea urchins

Arie Spyksma, Richard B. Taylor & Nick T Shears

The University of Auckland

Chemical cues have the potential to alter species interactions. For prey, chemical cues associated with the risk of predation are especially important as they may be used to initiate predator avoidance behaviour. In a mesocosm experiment, the prevalence of sheltering behaviour in the sea urchin *Evechinus chloroticus* increased strongly in response to the scent of crushed conspecifics. We determined the specificity of the cue prompting flight behaviour in *Evechinus*, using time-lapse photography in the field. We assessed the response of *Evechinus* to crushed conspecifics, crushed pilchards, and the possible disturbance caused by a bait-pot (housing the chemical cues). *Evechinus* within a 50cm radius of the bait-pot responded strongly, by fleeing, from crushed conspecifics, but crushed pilchards had little effect and the empty bait-pot had none. These results indicate that *Evechinus* can accurately detect relevant predation cues and respond in a manner likely to reduce their vulnerability to predators. Implications of this will be discussed further in regards to the predator-sea urchin-kelp trophic cascade.

|| The status of Australian shark, rays and chimeras

Colin Simpfendorfer[1], Andrew Chin[1], William White[2] & Peter Kyne[3]

[1]James Cook University, [2]CSIRO & [3]Charles Darwin University

Concern for the status of shark and ray and ray populations world-wide have increased in recent decades, increasing the call for conservation and management action. This study investigated the status of all of Australia's shark and rays using the IUCN Red List categories and criteria. The outcomes of these assessments will form the basis of a report card for Australian sharks and rays. This output will provide management and conservation agencies with consistent information across the whole taxon within Australian waters to assist with prioritization of efforts. To enhance the utility of the outputs, and to make them comparable to fisheries status reporting products an equivalency with Red List categories has been developed. This talk will provide preliminary outcomes for the status assessments and consider the status of Australian populations relative to the rest of the world.

|| Characterisation of hearing thresholds in decapod crustaceans

Kevin Tay, Craig Radford & Jenni Stanley

The University of Auckland

Ambient underwater sound is a prominent feature of marine environments and results from a combination of abiotic, biotic and anthropogenic factors. More importantly, it can provide important biological cues for a variety of marine animals, including crustaceans. Sound comprises of two components: sound pressure and particle motion, with crustacean hearing being most sensitive to particle motion, through detecting small oscillations primarily via the statocyst organ. The aim of this study is to characterise and compare the hearing thresholds of different decapod crustaceans from different habitats, using auditory evoked potentials (AEPs), a minimally invasive method of characterising the neural responses of an organism to sound stimuli. The majority of studies investigating crustacean hearing have used an underwater speaker as the stimulus - producing both pressure and particle motions. Comparisons will be made between the “traditional” AEP (dual-source, speaker) technique and the shaker table AEP (particle motion only) technique to determine the respective contributions of the two sound components to crustacean hearing. This study will provide important experimental evidence of particle motion hearing in crustaceans and possible differences between the species from different habitats. Additional insight will also be gained regarding the potential effects of anthropogenic noise on these animals.

Wednesday | 1700 | Rm. 260-098

|| Assemblage and understory carbon production of native and invasive canopy-forming macroalgae

Leigh Tait[1] & David R. Schiel[2]

[1]NIWA & [2]University of Canterbury

No abstract

|| How effective is Australia's management of sharks in commercial fisheries?

Samantha Sherman, Colin A. Simpfendorfer & Andrew Chin

James Cook University

Shark populations are declining, mainly due to unsustainable catch in fisheries. A fishery's effectiveness in managing shark catch is directly correlated to fishery sustainability. A management effectiveness evaluation (MEE) was developed and used to evaluate current management of Australian fisheries that catch sharks. The MEE examined 23 different attributes across 5 categories (management context, management arrangements, non-targeted catch, fishing patterns, and compliance and enforcement). Almost half of Australian fisheries were found to catch sharks as either target, byproduct or bycatch, and in 16% of fisheries there were insufficient data available to determine if sharks were caught. Overall management effectiveness of Australian commercial fisheries ranged from 8-71% of a perfect score, with a mean of 42%. The best performing fisheries, on average, were those that only caught sharks as bycatch and did not keep any shark products. Within each of the 23 attributes, some fisheries performed very well while others did not, meaning there are already management solutions in place for some areas of weakness in Australian fisheries management of shark catch. A fishery that scored poorly in a specific attribute could improve their management in that area by incorporating policies from a fishery that performed well, leading to better management overall.

|| Evaluating marine social, conservation, and economic values in Golden and Tasman Bays using ecosystem modelling

Vidette McGregor[1], Peter Horn[1], Alistair Dunn[1] & Beth Fulton[2]

[1]NIWA & [2]CSIRO

Tasman Bay/Golden Bay is a relatively shallow semi-enclosed embayment system at the north of South Island. It supports numerous commercial fisheries and marine farming activities, and active recreational and customary fisheries. The area is a destination for tourists and for large flocks of migratory shorebirds. Farming, forestry, residential development, fishing, marine farming, and other coastal changes have modified the marine environment.

ATLANTIS is an ecosystem model which can be used as an environment in which different scenarios can be played out to test for different results and learn how a system may be reacting to changes within it, and includes the ability to compare social, conservation, and economic outcomes. This model can be extremely useful for management strategy evaluation, and has been applied to multiple marine systems in Australia and the United States.

We present an ATLANTIS model of the physical environment, biological and ecological components, including predator and prey relationships in Tasman Bay/Golden Bay. We include fishing in the system and assess effects of taking out catches and of altering the habitat in response to some fishing methods. We calibrate these effects with survey and fishery abundance indices. We then describe how this ATLANTIS model will be used to evaluate the effects and trade-offs from fishing, alternative management scenarios, and climate change in the bays across social, conservation, and economic outcomes.

Wednesday | 1715 | Rm. 260-098

|| Kelp forest productivity - past, present and future

Kirsten Rodgers & Nick Shears

The University of Auckland

Habitat-forming kelp forests are important components of coastal ecosystems that provide a range of values and ecosystem services. Primary production is a critical service provided by kelp forests that will be strongly influenced by climate change due to the strong coupling between photosynthesis and both light and temperature. Using a physiological model of net primary production (NPP) that combines in situ measurements of kelp photosynthetic parameters, biomass and underwater light we compare current vs. historical kelp forest NPP in the Goat Island marine reserve. We also apply this modelling approach to the results of a mesocosm experiment to predict how NPP may be influenced by future changes in temperature and light. Comparing current productivity to estimates of historical kelp productivity indicated that changes in kelp distribution resulting from marine reserve protection has led to an approximate doubling in total kelp production within the Goat Island marine reserve. Experimentation and modelling predicted NPP would likely decrease under a combination of warmer ocean temperature and reduced light conditions, particularly when combined with additional perturbations. These estimates of past, present and future kelp forest productivity provide increased understanding of the effects of changes in distribution and the broader effects of changing climate on temperate reef ecosystem function.

|| Novel Psa biovar 3 agrichemicals from New Zealand bioactive marine natural products

Ashleigh Browne[1], Christopher N. Battershill[1], Joel L. Vanneste[2], Michele R. Prinsep[1] & Michael J. Clearwater[1]

[1]University of Waikato & [2]Plant and Food Research

Bioactive compounds produced by living organisms (natural products) for chemical defence have had extensive use in pharmaceutical, agrichemical, and bioremediation sectors. Increasing application harnesses the unique structure and chemical diversity of the compounds, providing relevant biological activities unsurpassed by synthetic compounds.

Marine natural products represent unexplored potential for novel bioactive compound use in pest management. *Pseudomonas syringae* pv. *actinidiae* (Psa), which causes bacterial canker of kiwifruit, threatened the viability of the New Zealand kiwifruit industry. Too few products are available for control of this disease; there is a need to find new products which kill or inhibit Psa. Previous biomedicinal work examining activity against Pseudomonas species provides insight into bioactive marine organisms which elicit defence mechanisms in the plant resulting in a decrease of disease incidence-or which kill or inhibit Psa. Such compounds are likely to be novel given their natural product origin, therefore they will be commercially marketable and exclude terrestrial pathogen resistance for agrichemical use.

Using a hypothesis driven approach that examines reported Pseudomonas bioactivities, the study seeks to identify bioactive marine organisms that possess Psa inhibition properties. Initial discovery will focus on targeted coastal marine species from genera that are known to produce desirable bioactivities in related pathogens.

|| Mapping rocky reefs from outer space

Jarrod Walker[1] & Boyd Taylor[2]

[1]Auckland Council & [2]EcoGIS

Mapping of habitats has been undertaken across multiple temporal and spatial scales but are typically limited by these same scale dependant parameters. With advances in remote sensing technologies there is now the capability to remotely sense multiple habitats across multiple spatial scales. In this talk, results of a fine scale (4 - 8 m) mapping exercise across a broad scale (10's of km) using multispectral imagery from the World View 2 satellite will be outlined. The basis of this exercise was to determine whether shallow (< 20 m depth) subtidal reefs could be accurately mapped in the Hauraki Gulf using satellite imagery. This study was one of the first attempts at broad scale mapping of subtidal reefs using World View 2 satellite imagery in the Hauraki Gulf The potential and limitations of this technique will be discussed. Resultant maps of rocky reefs and the associated and biological reef habitats (e.g. kelp forests) will also be presented with estimates of the total area of rocky reef habitats in the Hauraki Gulf to demonstrate the relative uncommonness of shallow rocky reef habitats in comparison to the dominant benthic substratum

|| Deep-sea biodiversity-the need to look at the bigger picture

Malcolm Clark, Ashley A. Rowden, David Bowden, Daniel Leduc

NIWA

Biodiversity studies in the deep sea are often based on single habitat types, such as seamounts, or abyssal plains. For many years New Zealand research has had a seamount focus, because major commercial fish species such as orange roughy form aggregations on such features for spawning or feeding, and the impacts of trawling has a major effect on their coral-dominated benthic communities. However, deep-sea features are not isolated, and different types of habitat need to be considered as part of a much larger ecosystem, and in recent years, research has evolved to address the biodiversity and vulnerability of multiple deep-sea habitats. Two dedicated surveys have examined multiple habitat types, covering continental slope, canyons, seamounts (including knolls and hills), hydrothermal vents, and cold seeps in two regions. A range of gear types have been deployed, sampling a variety of faunal communities from infaunal macrofauna through to epibenthic megafauna. Sampling occurred at 4 consistent depths (700m, 1000m, 1200m, 1500m) to enable comparisons of faunal change with depth both within, and between, habitats. Results show that overall benthic communities differ between habitats, but the level and pattern of dissimilarity varies with the type of community, depth, and region. There appears to be a complex interaction between environmental aspects of each habitat that need further work to untangle. However, hydrothermal and seep communities with their specialised chemosynthetic species are highly distinct from communities of slope, canyon and seamount habitats. The extent of the community dissimilarity among habitats, and the life habits and history of the taxa that characterise the communities of the different habitats, are being translated into relative vulnerability profiles to assess the ecological risk of human activities, and subsequently inform improved management of bottom trawling and seabed mining on the range of deep-sea environments in the New Zealand region.

|| Mapping reefs using multibeam echo-sounder to identify habitats for marine biodiversity

Helen Neil[1], Arne Pallentin[1], Tim Kane[1], Steve Urlich[2] & Karlien Heyns[2]

[1]NIWA & [2]Marlborough District Council

Marlborough District Council recently identified a number of significant marine sites from published literature, and historical and contemporary local ecological knowledge. One site identified is a ~6000 ha area of bryozoan beds to the west of D'Urville Island. A joint mapping initiative using NIWA's Kongsberg EM2040 high resolution multibeam echo-sounder was undertaken to identify and map habitat types in this significant marine area. During May the mapping survey acquired close to one hundred square kilometres of multibeam bathymetry consisting of over 200 million soundings which have been gridded at 1 to 2 m-resolution.

Bathymetry data reveal the shape and depth of the seafloor, the strength of the return signal (backscatter or imagery) provides valuable information on the bottom types and habitats. In addition, data recorded throughout the full water column (from echo-sounder to seafloor) can be used to characterise habitat type and water masses, identify seeps and plumes, detect fish schools and other features not normally imaged in the bathymetry data.

NIWA has produced a range of digital products that can be used by Marlborough District Council to inform habitat types in this significant marine site near D'Urville Island. The approach used here can aid endusers in characterising marine areas and planning for preservation of indigenous biodiversity. This greater knowledge of the state of important habitats for biodiversity will assist in improving monitoring the state of the coastal environment.

Thursday | 910 | Rm. 260-098

|| A benthic potpourri - cornflakes, mud, and worms.

Keynote: Keith Probert

2014 NZMSS Award Recipient

University of Otago

New Zealand's continental margin is particularly interesting for its diversity and the opportunities it offers in benthic ecology. Striking differences, for instance, in sediment yields to the shelf make for strongly contrasting sedimentary environments, from relict-biogenic gravel to modern mud dominated. Correspondingly, there are major differences in the structure and functioning of macrobenthic communities, from those typified by habitat-forming epifauna to those dominated by deposit-feeding infauna. In addition, major oceanographic features that characterize the region provide a chance to examine bathyal benthic systems within reasonable proximity that are subject to dissimilar regimes of benthic-pelagic coupling. This miscellany looks at three main areas of the New Zealand continental margin in relation to these broad patterns, why worms are the weapon of choice, and includes historical asides that highlight important studies of earlier researchers in this field.

|| Risk assessment for the effects of fishing on protected species

Martin Cryer, Ben Sharp, Rohan Currey, Nathan Walker & Neville Smith

Ministry for Primary Industries

To underpin the assessment and management of the effects of fishing on non-target species, MPI has developed a quantitative, spatially-explicit, seasonally-disaggregated risk assessment framework. The method uses: overlap between fishing effort and the distribution of each affected species; captures observed by government observers; and proxy information for species productivity. It generates estimates of potential annual fatalities in each affected population, even if only sparse or non-representative observer data are available. These estimates can be compared with explicit or implied management targets or limits (e.g., Potential Biological Removals, PBR) to estimate risk. The method generates absolute rather than relative estimates of impact and risk, propagates uncertainty in all inputs, provides for disaggregation of risk by season, location, or fishing fleet, and can readily assimilate new information. Such risk assessments provide powerful tools for fisheries and research managers to target and prioritise information collection, mitigation, or management action. The method has been applied to 70 species of New Zealand breeding seabirds and is the basis for management targets defined in New Zealand's 2013 NPOA-seabirds. It is currently being applied to all marine mammals resident in New Zealand and similar approaches are under development for non-target fish species.

|| Reducing uncertainty around the impacts of fishing on protected species

David Middleton

Trident Systems LP

Fisheries interact with a range of protected species. Determining whether accidental captures of protected species are having a significant impact on the population requires both quantification of the number of captures, and information on the population size. Captures of protected species in fisheries are rare events and may be clustered. This leads to high variance in capture estimates, especially when the level of observation is low.

Increasing the level of observation in fisheries to better quantify the level of protected species interactions is costly and logistically challenging. The potential to use video based observation has been explored periodically in New Zealand for over a decade, but has faced a number of technical challenges. However, there is evidence that these challenges are now being successfully overcome.

Video observation offers a number of potential advantages over normal fisheries observation, not least of which is the ability to assess the same footage multiple times and so quantify the probability of detection of rare events. An experimental trial being carried out in the snapper bottom longline fishery aims to quantify the detection rate of seabird captures via video observation. The trial design and early results will be described.

|| Threats to protected corals

Di Tracey

NIWA

Protected corals are diverse and widespread in the New Zealand region and the nature and extent of the threat to coral species has been the subject of several research projects. Deep-sea corals can be fragile, slow growing and long-lived, and vulnerable to impact from bottom trawling. They form an important part of our deepsea habitat but the ecological consequences of fishing and of other human activities, along with impacts from various environmental stressors, are still not well understood. This presentation will highlight some of the results of NIWA's coral-related research that includes examining benthic invertebrate data from commercial and research vessels that has provided us with information as to where coral fauna are most at risk from interactions with the fishery and what these species are. These data and the use of predictive models have been used to improve our knowledge of the region's species diversity and spatial variability. In-aquaria experiments and radiocarbon dating have helped determine the age and growth of species such as *Solenosmilia variabilis*, but additional biological parameters are required to help obtain a better measure of the extent of impact due to fishing activity and the potential of the species to recover.

|| Assessment of ecosystem services in New Zealand Marine Protected Areas: moving from theory to practice

Michael Townsend, Shane Geange[2], Drew Lohrer[1], Dana Clark[3] & Joanne Ellis[3]

[1]NIWA, [2]DOC, [3]Cawthron Institute

Ecosystem service approaches are increasingly utilised in coastal areas, often as part of an ecosystem based management or adaptive governance framework that aims to address complex coastal problems. Ecosystem services are appealing in this context because they link human well-being to the functioning of ecosystems, and provide a common language for negotiating trade-offs. This approach is enticing in situations where there are a multiplicity of stakeholders, conflicting values, and accompanying disputes. However, while ecosystem services approaches are a promising way to address coastal problems, many models are currently deficient at incorporating context-specific cultural services and other social values. A participatory approach to model-building can help to restore social values to ecosystem services while simultaneously contributing to the generation of social capital which is needed to address complex coastal problems. This research draws on a case study from an urban estuary in the Manukau Harbour to explore how a novel participatory modelling method integrated a diverse range of social values into an ecosystem service approach while also enhancing social learning and social capacity among participants.

|| Seabirds and set nets - how can we mitigate bycatch mortality?

Ursula Ellenberg

La Trobe University

Seabird mortality in fishing gear is a globally recognised problem and thought to be responsible for population declines in many species. Mitigation efforts have so far focused on reducing the bycatch of albatrosses and petrels in long-line and trawl fisheries. The threat posed by gillnets/set nets to diving seabirds is recently receiving increasing attention. As long-lived mesopredators, penguins have life-history traits that make them particularly vulnerable to additional adult mortality. Bycatch may be substantial; however, to date there is insufficient information available on the full extent of the problem. In New Zealand, Yellow-eyed and Fiordland penguins are bycaught in set nets. Potential impact of bycatch mortality on population viability will depend on fishing effort, timing and type of sets deployed in important penguin foraging areas. While other threats penguins are exposed to such as climate change, pollution and marine habitat degradation are complex and difficult to manage, reducing bycatch mortality appears straight forward. Increased survival will considerably improve their ability to cope with the many other challenges they currently have to face. Hence the urge to increase efforts of finding solutions to mitigate seabird bycatch in set nets.

|| Contributory Value of Coastal-Marine Ecosystems

Murray Patterson

School of People Environment and Planning, Massey University

The ecosystem services concept is becoming increasingly important in conservation management as a way of demonstrating a comprehensive range of benefits derived from protecting ecosystems, and provides a mechanism whereby the Department of Conservation can integrate ecosystem components into Marine Protected Area (MPA) planning processes. Last year an 'Ecosystem-Service Matrix' was constructed based on the contributions of 76 New Zealand marine taxa and habitats to 16 ecosystem services (0-200m depth). Here, we discuss a spatial adaptation of the matrix with a focus on supporting and regulating services. Importantly we include two key components i) the minimum sizes of biogenic habitats needed to yield ecosystem services and ii) a consideration of habitat 'quality', and the implications this has for service generation. We integrate these components with the matrix and show how this can be used to assess and compare areas of the marine realm for their generation of ecosystem services. We demonstrate how this can be used proactively to identify benefits during the selection of new sites, or retrospectively to highlight the benefit and to add value to existing Marine Protected Areas.

|| Sea lion exclusion devices (SLEDs): have SLEDs effectively mitigated sea lion bycatch in the NZ subantarctic squid trawl fishery (SQU6T)?

Bruce Robertson

Department of Zoology, University of Otago

ver 1300 threatened New Zealand sea lions (*Phocarctos hookeri*) are estimated to have drowned in trawl nets of the New Zealand squid fishery (SQU6T) around the subantarctic Auckland Islands since 1992. The use of sea lion exclusion devices (SLEDs) is now thought to have resolved this bycatch. SLEDs are assumed to allow sea lions to escape trawl nets, while dead animals are retained as bycatch. Retention of dead sea lions (retention) allows bycatch to be accurately estimated by government fisheries observers. The assumption of retention allows managers to ascribe the observed decline in sea lion bycatch to high SLED efficacy. However, design of bycatch reduction devices does not always equate to performance, and, to date, there has been no specific work to address retention. Here I use existing underwater video footage from SQU6T trawls to explore the hypothesis of high SLEDs retention of dead sea lions. This footage indicates that dead sea lions may be passively ejected from trawl nets via SLEDs, because large catch species are observed to fall out of nets during regular backwash events. Consequently, claims that widespread SLED use has resolved sea lion bycatch in SQU6T are not supported by the available information at this time.

|| Coastal ecosystem services in Manukau Harbour: A participatory modelling approach to integrating social values

Kathryn Davies, Karen Fisher, Mark Dickson, Simon Thrush, Richard LeHeron

Ecosystem service approaches are increasingly utilised in coastal areas, often as part of an ecosystem based management or adaptive governance framework that aims to address complex coastal problems. Ecosystem services are appealing in this context because they link human well-being to the functioning of ecosystems, and provide a common language for negotiating trade-offs. This approach is enticing in situations where there are a multiplicity of stakeholders, conflicting values, and accompanying disputes. However, while ecosystem services approaches are a promising way to address coastal problems, many models are currently deficient at incorporating context-specific cultural services and other social values. A participatory approach to model-building can help to restore social values to ecosystem services while simultaneously contributing to the generation of social capital which is needed to address complex coastal problems. This research draws on a case study from an urban estuary in the Manukau Harbour to explore how a novel participatory modelling method integrated a diverse range of social values into an ecosystem service approach while also enhancing social learning and social capacity among participants.

Keywords: ecosystem services, Manukau Harbour, participatory modelling, social capacity, social capital, social learning, social values

|| Demographic analysis of the New Zealand sea lion reveals ineffective bycatch mitigation in Auckland Islands trawl fishery

Stefan Meyer, Bruce C. Robertson, B. Louise Chilvers & Martin Krkosek

Department of Zoology, University of Otago, University of Otago, Massey University, University of Toronto

New Zealand is a leader in fisheries research, yet limited attempts have been made to quantify the demographic response of non-target species to fisheries bycatch. However, to develop effective conservation actions for bycatch species, it is crucial to know if the level of bycatch is unsustainable or not. We demonstrate that a matrix population model is a feasible tool to explore the demographic response of marine mammals to bycatch and how this information can be used to determine the required efficacy of bycatch mitigation measures (BMM). We demonstrate this approach using the threatened New Zealand sea lion (NZSL) *Phocarctos hookeri,* which is affected by a commercial trawl fishery that spatially and temporally overlaps with foraging NZSLs. Despite the use of BMMs, a 50% population decline has continued, suggesting that current management actions are not effective. Our results indicate that demographic effects can be seen in the NZSL population as a result of bycatch; hence effective bycatch mitigation should have brought the population back to stability. Our findings underpin the scepticism that current BMMs for NZSL management are not effective. We highlight the use of demographic studies to evaluate the efficacy of bycatch mitigation and provide solutions to investigate BMM efficacy.

|| Using ecosystem services assessment to enhance marine management: experiences from the trials in the English Channel

Steve Fletcher

UNEP World Conservation Monitoring Centre, Cambridge & Centre for Marine and Coastal Policy Research, Plymouth University, UK.

It is often asserted that ecosystem services assessment (ESA) can provide a bridge between natural capital and societal values in marine management. However, there are limited cases in which this assertion has been properly tested and even fewer cases which explore how ESA can be integrated into marine decision-making. An exception is the EU-funded VALMER project which undertook a systematic evaluation of the use of ESA to support marine management in six coastal communities in the Western English Channel. The VALMER project, which ended in March 2015, demonstrated that ESA *can* support marine management, principally through improving the evidence base for, and stakeholder engagement with, marine decision-making. However, it was notable in the project that undertaking an ESA represents a significant investment of time, money and human resources. To ensure that such an investment is used effectively to support marine management, the following measures were identified as important: 1) commissioning an ESA should be undertaken in partnership with communities, marine managers and researchers; 2) a structured ESA process, such as the Triage Approach, should be used to ensure the ESA is focused on priority evidence needs for the decision to be taken; 3) the ESA should be co-produced with marine communities with tailored engagement processes; 4) the ESA format, method, quantification units, and form of output should be agreed with stakeholders to ensure the evidence produced is credible and locally-meaningful; and 5) that ESA results, especially monetary valuations, should be handled with care to ensure they are not taken out of context and become counter-productive. The study concluded that when ESA is co-produced with stakeholders as an integral component of a marine management process, the ESA results can provide useful evidence to support improved decisions and the ESA process can enhance social capital amongst all participants. However, generating these benefits requires careful planning and ongoing communication with marine communities. For more information about the VALMER project visit: www.valmer.eu.

|| Averting the extinction of Maui's dolphins through science-based management

Barbara Maas

NABU International

Maui's dolphins are the smallest and rarest marine dolphins on earth. Numbers decreased by 97% as a result of fishing since the 1970s. Maui's dolphins currently survive in a small, declining population of an estimated 41 to 49 individuals, down from 59 (55 individuals 1 year and older) in 2010/11. They can sustain just one human induced fatality every 10-23 years. Fisheries bycatch alone depletes the population by 3.28-4.16 Maui's dolphin per annum - over 54 times the sustainable level or PBR. A small extension of protection measures introduced in 2013 increased the protected area for gillnetting by 3% from 16% to 19%. No further protection was added for trawling and less than 5% of Maui's dolphin habitat is currently protected from this fishery. Extinction as a result of fisheries bycatch alone could occur as early as 2030 under these conditions. An Expert Panel of New Zealand and international scientists, convened by the New Zealand government in 2012, attributed 95.5% of all Maui's dolphin mortalities to gillnetting and trawling. Since then there has been an upsurge of seismic testing in or near the dolphins' habitat as well as oil and gas production, which further threatens the survival of this subspecies.

|| Effectiveness of extensions to Maui's dolphin protection in 2012 and 2013

Elisabeth Slooten

Otago University

The effectiveness of recent extensions to Maui's dolphin (*Cephalorhynchus hectori maui*) protection was estimated using two different methods. An Expert Panel of New Zealand and international scientists, convened by government in 2012, estimated that 5 Maui's dolphins were killed in fishing gear each year (1 in trawl fisheries, 4 in gillnet fisheries). The number of trawl mortalities is unchanged, as no additional protection from trawling has been implemented. A simple analysis of the proportion of the population protected by the extensions indicates a reduction of gillnet mortalities from 4 to at best 2 per year, reducing the total level of bycatch from >75 times to >54 times the sustainable level of 0.044-0.1 individual per year. An individual-based model, incorporating movements of dolphins and fishing gear, indicates that bycatch has been reduced from 5 Maui's dolphins to at best 4 caught per year. Both analyses indicate continued population declines. Bycatch could be reduced to sustainable levels, using science-based boundaries for protected areas and consistent regulations for gillnet and trawl fisheries. Data on offshore distribution of Maui's dolphins support the 100 m depth contour as an offshore boundary. At least 20 nautical miles offshore, as recommended by the International Whaling Commission.

New Zealand Marine Sciences Society & Oceania Chondrichthyan Society 2015 Poster Presentations

|| Getting to the roots of anemone aggression

Georgia Balfour, Dianne Brunton & David Aguirre

Institute of Natural and Mathematical Sciences, Massey University

All living organisms are capable of aggression. In most cases the mechanism underlying aggressive behaviours is competition for resources (e.g. access to mates, nutritional resources or refuge sites). In sessile marine invertebrates, space is one of the major limiting resources, and in some anemone species, individuals will defend their patch by clubbing neighbouring anemones with specialised fighting tentacles. However, not all interactions among conspecific anemones elicit an aggressive response — individuals react less aggressively when confronted with genetically similar individuals compared with more genetically distinct individuals. In turn, these small-scale aggressive interactions are expected to influence the distribution of aggressiveness across the population. Specifically, proximal neighbours should be less aggressive towards each other than more distant neighbours. Our first aim is to test whether aggressiveness increases with increasing distance between neighbouring *Actinia tenebrosa* individuals. Our second aim is to investigate whether genetically-determined aggressive responses can be enhanced or subdued by modifying the environment in which anemones develop. Here, we will establish experimental populations of aggressive and passive anemones at two different densities and examine changes in the level of aggression. The results of our second experiment will establish whether aggressiveness in anemones is determined by nature or nurture.

|| Age Estimation and Growth of Long-finned Pilot Whales (*Globicephala melas*) in New Zealand Waters: Evidence from Strandings

Emma Betty[1], Sinead Murphy[2], Barbara Breen[1], Karen Stockin[3] & Mark Orams[1]

[1]Auckland University of Technology and Massey University, [2]Institute of Zoology London & [3]Massey University

The long-finned pilot whale (*Globicephala melas*) is the most frequent mass-stranding cetacean on the New Zealand coast, though the reason(s) why remain a matter of speculation. More than 8,000 long-finned pilot whales have been recorded in the Department of Conservation New Zealand Whale and Dolphin Stranding Database since regular reporting began in 1978. The high incidence of stranding has provided a unique opportunity to establish valuable archives of samples that can provide insight into age, growth, reproductive biology and diet of *G.melas* in New Zealand waters. Preliminary data on age and growth are presented here based on age analysis and morphometric measurements of 229 female and 153 male *G.melas* stranded between 2008 and 2014. Males ranged in total body length from 180 to 622cm and females from 176 to 485cm. At least one tooth from each whale was sectioned using standard procedures and age estimated by counting annual growth layers. Growth curves have been developed following standard methods (Gompertz, Von Bertalanffy) and compared with published growth data for *G.melas* populations elsewhere. Determining age structure, maximum total body length obtained, growth models, natural longevity (maximum age), and age-at-death of individuals from stranding events is helpful for understanding the dynamics of a population. This study provides the first data on the age structure, growth and sexual dimorphism of New Zealand long-finned pilot whales.

|| Can underwater images be used to determine sex and maturity status in *Carcharias taurus* when claspers are not visible?

Deborah Bowden & Mike B. Bennett

University of Queensland

Morphological data are important for taxonomic studies, identification of life-stages and quantification of biological traits. Collection of morphometric data from large, live sharks is often problematic. The current study explores whether sex of the Vulnerable *Carcharias taurus* can be determined from photographs of sharks collected for spot-pattern photo-identification, even when claspers are obscured or otherwise not visible. Immature individuals often present with claspers that cannot be reliably seen in many images. Analyses involved proportional measurements of body features in relation to, e.g. dorsal fin sizes, inter-fin distance, second dorsal fin insertion in relation to the pelvic fin. 100 sharks of known dimensions and pre-caudal length (PCL), of 91 - 190cm PCL (juveniles - mature adults) were included in the study. Results also demonstrate that 'clasper length to inter-dorsal space' can successfully categorise maturity status and/or PCL in sharks from photographs, while other ratios and measures returned mixed results. This quantitative analytical approach has potential to enhance demographic and ecological data obtained from long-term photo-identification monitoring programs. This technique may also prove suitable for other elasmobranch species that would otherwise be difficult to assess.

|| Resolving the taxonomic status of a rare squid, *Asperoteuthis lui* Salcedo-Vargas, 1999 (Cephalopoda, Chiroteuthidae), using integrative taxonomy

Heather E. Braid

Institute for Applied Ecology New Zealand, Auckland University of Technology

Asperoteuthis Nesis, 1980 is an enigmatic genus of meso-bathypelagic squids in the family Chiroteuthidae Gray, 1849. This genus is characterised by the presence of a secondary fin, the absence of arm and visceral photophores, and unique tentacle clubs that lack suckers on the proximal half. Asperoteuthis has four named species, and Clarke's (1980) '?*Mastigoteuthis* A' is currently believed to also belong in the genus. However, recent ecological studies from the Southern Ocean have continued to apply the original, incorrect, vague, and undefined classification of this species as a mastigoteuthid. This is problematic because it underestimates the importance of *Asperoteuthis* in the diet of marine predators, and affects overall estimate of consumed prey biomass. The only asperoteuthid squid known from New Zealand waters, A. lui, was described from a single, badly damaged, partial specimen taken from the stomach of a ling (*Genypterus blacodes*). The purpose of this study was to resolve the status of *A. lui*, in light of additional, recent, locally collected material. Using a combination of mitochondrial genes and morphology, *A. nesisi* Arkhipkin and Lapitkhovsky, 2008 and '?*Mastigoteuthis* sp. A' both appear to be synonyms of *A. lui*, with *A. lui* having a circumpolar distribution in the Southern Ocean.

|| Sighting trends of the giant manta ray *Manta birostris* at a key aggregation site in the eastern equatorial Pacific

Katherine Burgess[1], Giles W. Winstanley[2], Michael B. Bennett[3], Andrea D. Marshall[2], Scarla J. Weeks[3] & Anthony J. Richardson[4]

[1]The University of Queensland/The Marine Megafauna Foundation, [2]The Marine Megafauna Foundation, [3]The University of Queensland & [4]CSIRO

Large planktivorous elasmobranchs are highly mobile and feed low in the food web. Their zooplankton prey is influenced by a range of environmental variables and sightings of these planktivorous species likely fluctuate in response to these variables. The Humboldt upwelling system in the eastern Pacific Ocean and its associated fronts host the largest photographically identified sub-population of *Manta birostris* in the world. Here, sightings and environmental data were collected from Isla de la Plata, Ecuador from 2010-2014. Generalised linear models were used to correlate number of individual manta rays sighted via photo identification methods to the physical environment. Environmental variables included were good predictors of manta ray sightings and the model explained 31% of total variance. Manta ray sightings were higher during the dry season (May-December), full moons and at high monthly wind speed averages. Sightings of mantas were negatively correlated to the Multivariate ENSO Index (MEI), which indicates that even moderate El Niño conditions affect the distribution of *M. birostris* off mainland Ecuador. Examination of sightings data alongside physical variables at other aggregation sites for *M. birostris* will help corroborate drivers of their distribution or large scale movement patterns and provide ecological information on this Vulnerable species.

|| New database of all marine species biological and ecological traits

Mark Costello[1], Simon Claus, Stefanie Dekeyzer, Leen Vandepitte[2], Éamonn Ó Tuama[3], Dan Lear & Harvey Tyler-Waters[4]

[1]University of Auckland, [2]Vlaams Instituut voor de Zee, Oostende, Belgium, [3]Global Biodiversity Information Facility, Copenhagen, Denmark & [4]Marine Biological Association, Plymouth, Devon, UK.

The World Register of Marine Species (WoRMS) is being expanded to include species' biological and ecological traits, and their socio-economic 'status'. In contrast to traits, a species status may vary in place and time. However, a species status is of great importance to society and thus species of conservation concern, introduced, fishery or aquaculture resource, harmful, or used as an ecological indicator, are so noted in the database. WoRMS is a complete inventory of named marine species, managed by over 200 experts, and contains additional information and links on many species. We prioritised inclusion of traits where they could be applied to most taxa, were easily available, and their inclusion would result in new research and/or management applications. Numerical traits were favoured over categorical. The top ten prioritized were taxonomic classification, environment, geography, depth, substratum, mobility, skeleton, diet, body size and reproduction. Habitat can be derived from a selection of these traits. New use-cases may further subdivide and expand upon these traits. Each new attribute (trait or status) multiplies the number of analyses possible from the database. Contributions and enquiries are welcomed.

*This work is part-funded by the European Commission European Marine Observation and Data Network (EMODnet) Biology project.

|| New Zealand Marine Habitat Mapping

Helen Curtis

Department of Conservation

New Zealand's Marine Protected Area policy seeks to protect marine biodiversity by protecting representative examples of a full range of marine habitats and ecosystems, including those that are internationally or nationally rare or distinctive. Accurate biophysical habitat maps against which levels of protection can be assessed are important for achieving this. Existing New Zealand marine habitat mapping at a national level is broad scale and may not represent finer scale habitats, species associations and ecosystem processes. Finer-scale regional and local habitat maps exist where a need and resourcing has been identified; however, these are inconsistent in their level of detail, with patchy coverage and varying quality of underlying data. Habitat mapping in the offshore marine environment is broader still, with modelled outputs limited by the often coarse resolution of the input data. To help address these issues, there is a need for coordination between organisations and research institutes to highlight lesser-known existing data that can be used for habitat mapping, to develop consistent mapping classification schemes and coordinate future data collection in key areas to increase accuracy and coverage of marine habitat mapping. This poster reviews the current marine habitat maps held by DOC within and beyond 12 nautical miles, mapping and modelling methodologies, and highlights gaps in existing data.

|| When do trees grow? High resolution stem growth in mangroves

Jarrod Cusens, Sebastian C. Leuzinger & Alicia M. Donnellan

School of Applied Sciences, Auckland University of Technology

Mangroves are among the most carbon dense forest ecosystems. They straddle the boundary between terrestrial and marine environments and play a role in the carbon cycling in both systems. Wood growth is the predominant sink of carbon in trees. However, the factors that drive/limit growth over short time scales (i.e. inter-day) are not clearly understood. In particular whether growth is limited by carbon supply or environmental factors conducive to cell growth. We measured stem radius changes (SRC) at different positions on mangrove (*Avicennia marina*) stems 10 minute resolution with high precision (µm). At daily timescales trees had clear and consistent diurnal-SRCs with maximum values between dawn and midday and minimum values around sunset. However, over longer time scales the patterns in SRC, both within and between trees, differed substantially with inconsistent seasonal trends. In general SR increased rapidly in response to rainfall in all trees at all positions. Daily SRC was higher when atmospheric vapour pressure deficit was low and humidity was high. Freshwater supply appears to be the main limitation to growth in mangroves. The inconsistency in long term SRC is likely due to the atypical wood morphology of *A. marina* that results in patchy growth along the stem.

|| Is *Cominella maculosa* a disjunct population along the Wairarapa Coast of North Island NZ?

Melanie Dohner, Peter Ritchie & Nicole Phillips

School of Biological Science, Victoria University of Wellington

The New Zealand coastline has been classified by different biogeographic regions, but understanding of the mechanisms that determine how populations are structured between these regions is limited. A recent genetic study found that the direct-developing endemic whelk, *Cominella maculosa*, had a strong genetic break at a known biogeographic boundary along the Wairarapa coast. A pattern of genetic isolation-by-distance was also found throughout the majority of its distribution. It was uncertain whether the Wairarapa coast break was an artifact of the sampling, or if there was a barrier to dispersal among populations. The aim of this project is to more thoroughly examine the Wairarapa break by expanding the genetic sampling and directly investigating potential dispersal ability. A fine-scale genetic analysis along the Wairarapa coast will be used to more precisely identify the locations of the genetic break or show a continued isolation-by-distance pattern. Adult whelks exhibit low vagility, but the crawl away hatchlings emerging from egg capsules can easily be suspended into the water column by weak water currents. The potential for these hatchlings to survive drifting in oceanic currents will be investigated.

|| Fishing vessels as research platforms

Jack Fenaughty1 & David Middleton2

Silvifish Resources Ltd & Trident Systems

In many CCAMLR exploratory fisheries much of the research information required for fishery management comes from observations and data collected by scientific observers and by scientists affiliated to industry and government organisations aboard fishing vessels. CCAMLR prescribes a number of basic requirements for data collection and observation required for CCAMLR's management of exploratory fisheries. Additionally, other projects of a more detailed and specific nature are also undertaken. For example there is a joint project between NIWA and Sanford Limited towing a continuous plankton recording (CPR) unit which has been providing samples and associated data between New Zealand and the Ross Sea for the past seven seasons, there has been a a shelf survey focusing on sub adult Antarctic toothfish as a method of determining recruitment variability with a view to forecasting population trends, and recent multinational exploratory abundance and biological survey work in previously fished areas of the northern Ross Sea. Details of these and similar such projects are shown in a poster display.

|| Age and growth study of protected deepsea coral in aquaria

Di Tracey[1], **Malindi Gammon**[1], 2 & P. Marriott[2]

[1]NIWA & [2]Victoria University

Some coldwater corals can form large reef-like three-D matrix structures in the deepsea that provide habitat for numerous other species. These structures are often fragile and easily damaged by human activities such as bottom trawling. A clear overlap exists between coral distributions and the deepsea trawl footprint. Our knowledge of the potential recovery rate of these habitats and their associated communities is growing but limited by our lack of knowledge on their age and growth. One of the most widespread species in the South Pacific is the protected species *Solenosmilia variabilis*. This species has been shown to be a robust candidate for in aquaria studies and experiments to determine how these deep-sea corals might tolerate and respond to anthropogenic impacts are underway. Several newly sampled live coral colonies from the region have been collected and we are now conducting laboratory trials on these corals to investigate growth as well as ocean acidification impacts. To date we have measured radial and linear extension, buoyant weight, and used image analysis as 1st steps to observe changes in morphology and growth. We acknowledge length increment studies need to be undertaken for several years as this coral is a very long-lived species.

|| Running the Gauntlet: Regional Movement Patterns of *Manta alfredi* through a Complex of Parks and Fisheries

Elitza Germanov[1,2] & Andrea D. Marshall[2]

[1]Murdoch University & [2]Marine Megafauna Foundation

Marine Megafauna Foundation Manta rays are economically important for fisheries and tourism in Indonesia. Manta rays are listed by the IUCN Red List as 'Vulnerable' to extinction; therefore, human exploitation of manta rays must be regulated. A better understanding of the habitat use and movement patterns of manta rays in Indonesia is needed in order to employ effective conservation measures. To gain insight into the movements of *Manta alfredi* we used 'Manta Matcher', an online database with an integrated matching algorithm, to compare photographs from 2,604 encounters of *M. alfredi* collected by recreational divers and dive operators throughout Indonesia over a nine-year period. This photographic comparison revealed that manta rays migrated between regional sanctuaries such as Nusa Penida, the Gili Islands, and the Komodo National Park (up to 450 km straight-line distance). The areas between these sanctuaries are heavily fished and trafficked by ships, and when manta rays travel through these regions they risk being fished and injured by ship strikes. These long-range manta ray movements suggest connectivity between *M. alfredi* populations in neighbouring islands and raise concerns about the future management of regional populations. It is recommended that a national conservation strategy be developed to protect the remaining populations in the country.

|| Computer vision and data mining of pigmentation patterns in common dolphins (*Delphinus* sp.) assists photo-identification

Matthew D.M. Pawley, **Krista Hupman**, Ting Dong, Karen A. Stockin & Andrew Gilman

Natural and Mathematical Sciences, Massey University

The recognition of individuals through photo-identification is often of great use for estimating population dynamics. However, many organisms lack clear, distinguishing marks and large population sizes make it logistically difficult to manually match individuals. For example, common dolphins (Delphinus sp.) lack the pronounced nicks and notches on their dorsal fins commonly used for identification, and populations can consist of thousands of individuals. We have applied computer vision and machine learning methods to aid in the recognition of individuals. We analyzed 916 photographs of 187 individuals to assess the recognisability and temporal variation of pigmentation patterns. We automatically extracted robust features of the pigmentation pattern and assessed a variety of classification techniques. We found regularized linear discriminant analysis achieved the greatest classification success: (top-1 57%, top-10 82%). We found differences in pigmentation patterns between age classes, but no evidence of seasonal variation within the catalogue. Our oldest recorded catalogued individuals exhibited stable pigmentation patterns over 11 years. This is the first dolphin study using only pigmentation patterns as an identifying feature and an exemplar of how machine learning and computer vision methods, with their ability to automate and enhance identification are providing new opportunities to ecologists

|| Big Data: Nationwide collection of coastal scientific information.

Rhian Ingley

Morphum Environmental & Our Seas Our Future

Adopt-a-Coast is a practical project aimed primarily at schools, community groups, and families. By combining education on environmental issues such as plastic pollution with the Marine Metre Squared citizen science programme the 'Adopt-a-Coast' programme promotes a sense of stewardship for the environment as well as facilitating the collection of some big data. At the NZMSS conference 2014, the scientific community was surveyed to gauge how scientists perceived the usefulness of citizen collected data. Our Seas Our Future provide expert volunteer assistance to run Adopt-a-Coast events and can facilitate matching appropriate community groups with specific research questions. Marine Metre Squared provides an invaluable framework for data collection and training of volunteers for the questions that you, the scientific community, are interested in. Bring your data needs and interests with you to the conference so we can discuss ways that citizens and communities can be part of bigger scientific goals.

|| *Undaria pinnatifida*: The BIG marine invader

Kate James

The University of Auckland

Undaria pinnatifida is a large and fast growing kelp endemic to north-eastern Asia. Understanding the impacts of *U. pinnatifida*, on native communities and anthropogenic activities, requires an understanding of how population ecology manifests at different locations. Two and a half years of monitoring was conducted at three sites in the Hauraki Gulf to assess abundance, growth, recruitment and reproductive capacity in relation to sea surface temperature. Monitoring confirmed a winter annual population cycle with maximum growth rates of up to 3cm day-1 and peak abundances of 120 plants m-2¬. Plants reached maximum lengths of around 1.2m during spring. The annual growth cycle began later in the year and was condensed as compared to that seen in its native range and at cooler-water non-native sites. Sea surface temperature was the determinant factor in population cycling; temperatures greater than 20°C during the summer months limit *U. pinnatifida* to a winter annual presence. Invasive impacts in northern New Zealand are therefore likely to be less than those reported at cooler-water sites, where populations can persist year-round.

|| Biofouling in marine finfish aquaculture: a feasibility study into biological control

Arron Jones[1], Salvador Delgado Ora[1] & Alix Laferriere[2]

[1]New Zealand King Salmon Co. Ltd. & [2]Victoria University of Wellington

Biofouling, the gradual accumulation of aquatic organisms on wetted structures is a costly problem faced by maritime industries worldwide. This is especially true for marine aquaculture, where it has been implicated in bio-corrosion of infrastructure, impeded water-flow through grower nets and a source point for invasive species and detrimental organisms to product health. Remedial action takes two main forms: anti-fouling paint and mechanical removal. These methods have both economic and environmental implications for the aquaculture industry. For New Zealand King Salmon Ltd, New Zealand's largest Chinook salmon (*Oncorhynchus tshawytscha*) producer, we have opted for mechanical removal as opposed to potentially toxic antifoul paint. Economically, mechanical removal has a cost in terms of labour units required, which has prompted us to investigate the feasibility of a biological control system. Herein we asked three main questions: first, is biological control feasible both in cost and effort? Secondly, what is the best method to integrate a biological control program? And finally, what species will offer the best outcomes? We designed and implemented a pilot biocontrol experiment at Otanerau Salmon farm in the Marlborough Sounds. We present our preliminary results and discuss the feasibility and potential for future applications within large marine aquaculture facilities.

|| Scavenging in a mid-slope fish community

Matthew Jones & Barbara Breen

Auckland University of Technology

Scavenging is an important energy conduit in the deep-sea. Many deep-sea fish species are assumed to be facultative scavengers, but the proportion of their diet obtained from carrion is either difficult to ascertain or unknown. We investigated the proportion of scavenging in the diets of eleven common deep-sea fish species from mid-slope depths on northeastern Chatham Rise, New Zealand. We found that basketwork eel (*Diastobranchus capensis*), Baxter's dogfish (*Etmopterus baxteri*), and serrulate rattail (*Coryphaenoides serrulatus*) were scavengers. Shovel-nosed dogfish (*Deania calcea*) and long-nosed velvet dogfish (*Centroselachus crepidater*) may scavenge. Orange roughy (*Hoplostethus atlanticus*), warty oreo (*Allocyttus verrucosus*), robust cardinal fish (*Epigonus robustus*), four-rayed rattail (*Coryphaenoides subserrulatus*), black slickhead (*Xenodermichthys copei*), and big-scaled brown slickhead (*Alepocephalus australis*) did not show evidence of scavenging. These results correlate well with the presence or absence of fish at baited landers in recent studies, with the scavengers appearing at baited lander deployments (n > five appearances per deployment), while the non-scavengers were rarely seen or absent. Scavengers may benefit from fisheries bycatch discards, which could influence the trophic structure of mid-slope communities.

|| Improving fuel efficiency and reducing unwanted bycatch in the inshore trawl fishery; a science -industry partnership in Hawkes Bay

Emma Jones[1], Oliver Wade[2], Rich Burch[3], Ian Tuck[1], Derrick Parkinson[1], Rosemary Hurst[1] & Laws Lawson[4]

[1]NIWA, [2]Hawkes Bay Regional Council, [3]Nancy Glen II skipper & [4]Te Ohu Kaimoana

Innovation in fishing practices is required to continue to develop the fishing industry and meet the demands of today's consumers, including expectations of sustainability, minimal bycatch and environmental impact. A 'grass-roots' collaboration between industry and science in Hawkes Bay has been exploring different ways to reduce the catch of unwanted small fish, as well as reducing fuel consumption and potential environmental impact. A lightweight demersal trawl has been developed over a number of years, with different mesh size combinations tested to improve selectivity. Most recently, underwater camera observations of a novel escape panel and large mesh lengthener indicated species-specific behaviour that can be used to improve selectivity further. An evaluation was also made of the performance of semi-pelagic trawl doors fished in combination with the lightweight demersal trawl. This technique has the potential to provide fuel savings whilst reducing environmental impact.

|| The status of deep-water elasmobranch abundance from a long term trawl survey: evidence of minimal recovery from past fishing activities?

Francis Neat1, Finlay Burns[1], **Emma Jones**[2] & Tom Blasdale[3]

Marine Scotland-Science, Aberdeen; NIWA & Joint Nature Conservation Committee

Data from a scientific deep-water trawl fisheries survey in the north-east Atlantic were analysed to determine the spatial and bathyal distribution of elasmobranch species and assess change in relative abundance over the period 1998-2013. During this period commercial fisheries for deepwater sharks went from being entirely unregulated, to being briefly managed, to being completely prohibited. Twenty-two species of shark and 10 species of skates and rays were recorded between depths of 300-2000m. All showed strong species-specific depth-related trends in abundance. Out of 11 of the more common species 5 showed no change in relative abundance over time, 2 squaliforme species (*Centrophorus squamosus* and *Centroselachus crepidator*) declined significantly and 4 species increased in relative abundance (*Apristurus aphyodes*, *Apristurus microps*, *Galeus melastomus* and *Deania calceus*). The overall ratio of biomass of elasmobranch species to that of teleost fish species remained constant over the study period. Assuming these populations were depleted by fisheries in the past, the current data do not suggest there has been an overall recovery. Positive signs for some species in the most recent years suggest movement or recruitment back into the area, however, it is of concern that 2 species continued to decline. Clearly there is a continued need to protect these elasmobranch species for the time being and the current ban on landings remains appropriate.

Snapper (*Chrysophrys auratus*) connectivity between the Bay of Plenty and Hauraki Gulf

Staci King[1], Phil Ross[1] & Darren Parsons[2]

[1]University of Waikato & [2]NIWA

Knowledge of population dynamics and connectivity is important for fisheries management. A recent study examining head morphology of snapper (*Chrysophrys auratus*) in the Hauraki Gulf, identified one group of spawning snapper as having a different head shape to fish examined throughout the rest of the gulf. It was hypothesised that these fish had migrated into the Hauraki Gulf to spawn before migrating back to their home territory. Historical tagging data has hinted at seasonal migrations of spawning fish between the Hauraki Gulf and Bay of Plenty. Here we present a comparison of head morphology between Bay of Plenty and Hauraki Gulf sourced fish to test this hypothesis. Interim results, analysing the key morphometric parameters, found Bay of Plenty snapper to be more similar to the average Hauraki Gulf fish than to the anomalous Hauraki Gulf spawning group. Hence, the source of these morphologically different fish remains a mystery.

|| The Genetic Status of Tiger Shark (*Galeocerdo cuvier*) Populations in Australian Waters

Safia Maher, Jennifer R. Ovenden, Einar E. Nielsen, Mike B. Bennett & Bonnie J. Holmes

University of Queensland, Molecular Fisheries Laboratory

The tiger shark (*Galeocerdo cuvier*) occupies tropical and warm temperate regions of Australian coastal and shelf waters, and like many large elasmobranch species, faces various anthropogenic threats, particularly fishing-related mortality. The population structure and genetic diversity of *G. cuvier* is unknown and data allowing evaluation of the effect of current levels of exploitation of the species is lacking. Using data obtained from mitochondrial DNA analyses, this study will examine the phylogeography of *G.cuvier* to provide crucial baseline data concerning the genetic status of tiger sharks in Australian waters. This project will focus on the contemporary population structure in Australian waters, assessment of genetic diversity in geographic regions with and without lethal shark control programs and temporal genetic diversity trends based on DNA analyses of tiger shark material from decades past to the present day.

|| Desperate measures for desperate larvae: does failing to find fresh water limit recruitment success in *Galaxias maculatus*?

Chris McDowall, Mark Kaemingk & Jeff Shima

Victoria University of Wellington

Galaxias maculatus is a geographically widespread amphidromous fish that typically completes larval development in the marine environment and recruits to freshwater environments. The duration of larval development is flexible, and while this potentially affords additional opportunities to maximise recruitment success in juveniles, the costs of a delayed transition are unknown. We conducted an experiment to evaluate (1) the recruitment success of 'desperate larvae' in varying salinities, and (2) the potential costs of a delayed freshwater transition. We collected juveniles at the onset of their transition from saltwater to freshwater and returned them to saltwater rearing conditions for 9 weeks, making them 'desperate larvae'. Next, we used a replicated lab experiment to evaluate the effect of salinity (treatments ranging from 0 - 36 ppt) on juvenile growth and survivorship over a further 28 days. We found no difference in growth, but observed that juveniles transferred to freshwater survived better. Our results suggest that (1) desperate larvae may be limited in their ability to recruit to sub-optimal habitat (e.g., brackish or saltwater environments), and (2) a delayed transition to freshwater may be physiologically costly. We discuss the potential consequences of this for long-distance dispersal and population dynamics.

|| Green harbours: Marine infrastructure with minimised biodiversity loss.

Connor McKenzie[1], Marti Anderson[2] & David Aguirre[1]

[1]Institute of Natural and Mathematical Sciences, Massey University & [2]New Zealand Institute for Advanced Study, Massey University

The transport of freight by sea remains a driving force behind our global economy. However, the construction of ports and artificial structures to accommodate these industries has transformed our coastal environments into subsurface concrete jungles. Modified environments always favour some species over others and result in dramatic changes to the biodiversity of local marine communities. Furthermore, the regular traffic facilitates invasions from distant communities, sometimes by species which are extremely good at monopolising space in these standardised environments. Together, declines in biodiversity in combination with the enhanced spread of invasive species, has led to global bio-homogenisation of marine communities within harbours. Our goals are to identify which of the common materials used in marine construction maintain the highest level of biodiversity and endemism. Furthermore, we will investigate whether experimentally attaching mussels to these materials enhances or modifies the accumulation of biodiversity. Overall, our study will provide data that can be used in green-engineering projects aimed at promoting healthy marine communities within harbours by reducing the anthropogenic impacts on the hard-substrate epifaunal invertebrates.

|| Incorporating ecological dynamics into seafloor disturbance models

Lukas Meysick[1], Carolyn J. Lundquist[2,3], Giovanni Coco[3], Simon F. Thrush[3] & Mark Pritchard[2]

[1]Carl von Ossietzky Universität Oldenburg, [2]NIWA & [3]University of Auckland

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. Interactions between species occur as juvenile-adult interactions, where the presence of adults influence the probability of juveniles to settle new locations, and adult-adult interactions, which are considered as competition interactions in each cell for each time step. Balancing these interactions in the way that they follow natural ecological behaviours is the main goal of this study. By correlating different spatial and temporal rates of disturbance for different functional groups adapted to specific habitats, the prospective long term ambition of this model is to predict strategies to help minimise disturbance impacts on seafloor communities.

|| Transport and retention of benthic invertebrate larvae in a large semi-enclosed meso-tidal estuary

Bradley Monahan[1], Conrad A. Pilditch[1], Karin R. Bryan[1], Joanne Ellis[2] & Niall Broekhuizen[3]

[1]University of Waikato, [2]Cawthron Institute & [3]NIWA

Field observations and numerical simulations have been used to investigate the effect of hydrodynamics on the transport and retention of estuarine benthic invertebrate larvae. Tauranga Harbour is a large (218 km2) meso-tidal estuary, with a tidal prism that indicates the harbour is flushed every 0.8 to 1.5 days. However, residence times may vary throughout the harbour, likely as result of residual circulation patterns caused by the complex channel morphology and constricted entrances to sub-estuaries. Results of the field observations indicate an increased abundance of invertebrate larvae in the upper harbour compared to the lower harbour. These results suggest that retention in the upper harbour may provide a source of larvae for the lower harbour when transported by tidal currents. A calibrated 2D Delft-flow hydrodynamic model was coupled to the larval transport lagrangian model (LTRANS), to investigate the transport of pathways of larvae from different parts of the southern harbour. Model results agree with field observations highlighting regions in the harbour where circulation patterns promote larval retention providing an internal source of new recruits.

|| Does the larval rearing environment matter? Using otolith microstructure to evaluate spatial variation in growth rates in larval Inanga

Conor Neilson, Vinnie B. Wood, Mark A. Kaemingk & Jeffrey S. Shima

Victoria University of Wellington

Inanga (*Galaxias maculatus*) are amphidromous fish that typically undergo larval development in marine environments before permanently settling back into fresh water. Recent evidence suggests some fish larvae may be retained near natal sources (e.g. in coastal embayments, etc.), while others may undergo long distance dispersal. We evaluate the potential consequences of different larval rearing environments on the individual growth history of inanga. We collected newly settled inanga from 10 paired coastal and harbour systems from New Zealand's North Island. We hypothesized that harbour systems might be more likely to retain larval fish in a nutrient-enriched environment compared to coastal systems, resulting in faster larval growth rates. We quantified daily growth increments from otoliths and found that recruits to harbour sites differed from recruits to coastal sites in their patterns of larval growth through ontogeny, and in their age-at-settlement. Our results indicate that larval rearing conditions may have profound implications for metapopulation dynamics of this species.

|| Biofilms: The key to understanding the effect of ocean acidification on marine invertebrate settlement?

Katie Nelson

University of Otago

An overview of the experimental design and methods used to investigate the effect of ocean acidification (OA) on the settlement of marine invertebrate larvae. This poster specifically focuses on the role of biofilms in invertebrate settlement, initially using barnacle larvae, *Austrominius modestus*, as the model species. Four key research components are summarized in order to address if and how OA may alter invertebrate settlement; 1) Current in situ high resolution seawater pH and carbonate chemistry parameters at the sample site in the intertidal and sub-tidal zones; 2) Biofilm microbial community composition, chlorophyll concentrations and diatom diversity and abundance in situ and in vitro under OA treatments; 3) The effect of seawater pH on barnacle larvae development and settlement selectivity; 4) Settlement assays isolating the effect of seawater pH, biofilm pH development and larvae pH development on settlement success. The goal of this research is to understand the effect of OA on the entire settlement process and determine if an OA response is driven by isolated factors such as larval capability/ competency and biofilm development or if results are interactive. This project is in process and preliminary results may be included.

Potential use of laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) techniques for determining larval dispersal of *Austrovenus stutchburyi* in Whangarei Harbour

Craig Norrie[1], **Carolyn J. Lundquist[2]**, Brendon J. Dunphy[1] & Joel A. Baker[1]

[1]The University of Auckland & [2]NIWA

Determining population connectivity through observing larval dispersal is difficult. Elemental fingerprinting overcomes many problems with directly observing larval dispersal. The potential for elemental fingerprinting to estimate population connectivity of *Austrovenus stutchburyi* in the Whangarei region was examined.

Laboratory experiments investigated the effect of increased [Sr], [Mg], and [Ba] in the surrounding water on trace element uptake to *A. stutchburyi* shell. Only higher [Sr] resulted in an increased levels in shell. Results suggested elemental composition of *A. stutchburyi* shell likely reflects a number of environmental and biological conditions. Separate experiments examined the effect of sediment chemistry, and showed no significant influence of sediment on shell composition.

LA-ICP-MS elemental fingerprinting of *A. stutchburyi* in Whangarei Harbour was used to investigate spatial differences in the shell of individuals collected from 14 sites. Using discriminant analyses strong spatial differences were found to exist (79% discriminant function analysis classification success). Classification success increased when sites were grouped regionally (88% classification success). Variation in elemental fingerprints over time was investigated at one site over 6 months. Temporal changes negatively affected classification success (45-99%).

It was concluded that LA-ICP-MS elemental fingerprinting is a potentially valuable technique for determining larval origins of A. stutchburyi in the Whangarei region.

|| Influences on statolith chemistry in two common NZ squid: southern arrow squid and warty squid

Tyler Northern[1], Abby Smith[1], Jean McKinnon[1], Keith Gordan[1] & Kathrin Bolstad[2]

[1]University of Otago & [2]Auckland University of Technology

Cephalopods are amazing mineralisers, however we don't know very much about how this mineralisation is influenced by the habitat that the animal lives in. Squid mineralise a small calcium carbonate gravity receptor called a statolith. This project aims to analyse the overall mineralology and trace element composition of statoliths between populations of squid that come from different water masses to see if statolith chemistry changes with water mass of origin. This analysis will be carried out on two species of squid that are common in New Zealand waters: warty squid (*Onykia ingens*) and southern arrow squid (*Nototodarus sloanii*). Statoliths grow outwards forming rings, sectioned statoliths from warty squid contain two distinct 'zones' (an inner zone and an outer zone), these zones are thought to be due to a habitat shift during the life-history. This study will compare the chemical composition of these two zones to see if a change in statolith chemistry is associated with this habitat shift. Mineral analyses will be conducted using laser based Raman spectroscopy and trace element analyses will be conducted using LA-ICP-MS. Methods for sectioning and analysing statoliths will be discussed in detail along with preliminary results.

|| Assessing the impact of shipwreck-derived copper on the recruitment of benthic invertebrates to Astrolabe Reef

Amy L. Platt, Philip M. Ross, & Christopher N. Battershill

The University of Waikato

Heavy metal contamination of marine environments can adversely impact ecosystem functionality and biodiversity. While many laboratory studies have demonstrated negative effects of heavy metal contamination at the level of the individual, fewer have looked at the effects on communities. The 2011 grounding of the MV Rena on Astrolabe Reef has provided an opportunity to examine the effects of metal contaminants on recruitment and settlement processes for sessile marine organisms. Following the sinking of the Rena, copper pollution at Astrolabe Reef is a major concern. 23 000 kg of granulated copper, formally inside a container, is now deposited on the seafloor on the north eastern slope of Astrolabe Reef. Here we present a proposal to examine effects of copper contaminants on the ecology of Astrolabe Reef. Settlement plates will be deployed adjacent to the contamination site and at suitable control locations, and used to assess the impacts of the copper on recruitment and settlement of sessile marine organisms.

|| Conservation Planning with SeaSketch

Irene Pohl & Greig Funnell

Department of Conservation

SeaSketch is an online tool specifically designed for use in marine conservation planning. Developed by researchers at the University of California Santa Barbara, SeaSketch is being used in New Zealand in the implementation of the Marine Protected Areas Policy. As no two MPA planning processes are alike SeaSketch is tailored to reflect case-specific process and planning objectives. Within this context SeaSketch allows the customization of four core functionalities:

1. User-friendly browsing through spatial information
2. Instant feedback via analytical reports that show how a proposed MPA fares against planning objectives incl. MPA network design principles
3. Online sharing and discussing of MPA designs with stakeholders
4. Collection of spatial information via SeaSketch's built-in 'space monkey' allows the general public or experts provide valuable georeferenced data needed in a MPA planning context. Come and explore how these functionalities are being used in current conservation projects.

|| A benthic mesocosm facility for whole-community acidification experiments

Cintya Del Rio, Chris Pook & Kay Vopel

Auckland University of Technology

The past decade of ocean acidification research has seen a variety of perturbation experiments, each with different but complementary strengths and weaknesses: single-species experiments, micro- and mesocosm experiments, and experiments with artificial communities. All of these experiments can reveal cause-and-effect relationships — investigators manipulate the seawater carbonate chemistry in one experimental system for comparison with a control system.

Single species experiments, which exclude natural environmental interactions, dominate the literature. Although mesocosm experiments on natural species assemblages are less represented, the few pelagic experiments have proven to be very successful. Their contribution, however, has yet to be met by the community of 'benthic researchers'.

Establishing benthic mesocosms is relatively easy; simple tubes, for example, enable the isolation of a subset of a soft sediment ecosystem in form of a sediment core. Under controlled conditions in the laboratory, the biota of this sediment core will maintain many of their interactions with their biogeochemical environment, which facilitates future transfer of experimental results to the natural environment.

Here we describe and discuss the performance of a new mesocosm facility for whole-community acidification experiments with cores of coastal cohesive sediment. We designed this facility for two reasons. Firstly to study the effects of a shifting carbonate chemistry baseline on the benthic microbial degradation of organic matter and the resulting sediment-seawater solute exchange. Secondly to investigate the effects of benthic biota on short-term variations in the carbonate chemistry of the sediment-seawater interface.

|| The role of Nonstructural carbohydrates in assessing plant physiological responses to drought

Sridevi Ravi[1], Sebastian Leuzinger[1] & Cate Macinnis-Ng[2]

[1]Auckland University of Technology & [2]The University of Auckland

Plants are exposed to stress factors resulting from climate change, with drought being the most important one affecting plant life. Better understanding how drought affects plant physiological mechanisms and plant mortality is of utmost importance. Mechanistic explanations of how plants die have not been conclusive and are continuously revised. Nonstructural carbohydrates (NSC) are thought to be key determinants of how plants cope with drought. Here, we aim to use mangroves and New Zealand native angiosperms and gymnosperms to shed light on the role of NSC in low soil water potential stress, caused both via drought and salinity. We do this by experimentally manipulating NSC, drought, and salinity in seedlings of the New Zealand mangrove species Avicennia marina. Secondly, we will manipulate NSC in seedlings of native gymnosperm and angiosperm communities to determine their responses to differential levels of NSC at the onset of drought. Thirdly, we aim to manipulate NSC in mature trees of A. marina and relate NSC levels to salinity stress. This will for the first time shed light on differences between the role of NSC in seedlings vs. mature trees in terms of drought response.

|| Grinding South Taranaki Bight iron sand: trace metal mobilization as function of particle size

John Robertson & Kay Vopel

School of Applied Sciences, Auckland University of Technology

The offshore environment of South Taranaki Bight, New Zealand, contains a source of black iron ore comprising vanadium pentoxide, titanium oxide, and magnetite, a form of iron oxide with natural magnetic properties. Specialized steel mills can use this ore to manufacture steel, either as a blend with other ores or as a dedicated steel-making feed. The extraction of this ore from ~40 m water depth is feasible but concerns about environmental effects have caused heated debate in past years.

One proposal for the exploitation of this resource envisages the deployment of seabed dredges that pump slurry of the ore to an offshore beneficiation plant. This plant screens the slurry to remove large particles and then extracts and concentrates the ore with alternating steps of magnetic separation and grinding. Grinding changes the state (grain size, grain size disposition and the grain shape) and reactivity of the solid potentially leading to accumulation of trace metals in the stream of seawater that feeds the ore through the plant and returns to the sea.

Here, we mimicked offshore processing of iron sand in the laboratory to study the potential release of copper and zinc from magnetically concentrated iron ore into the stream of process seawater as a function of particle size. To do so, we used a ball mill to grind concentrated iron ore in three consecutive steps to a final average d(0.5) of 11 µm. For zinc, we found no correlation between particle size and metal concentration in the iron ore suspension. For copper, particle size and elutriate concentrations were negatively linearly correlated ($r = -0.89$). That is, the concentration of copper in iron ore suspensions increased with decreasing particle size. We will discuss these results in light of practical process considerations and ANZECC & ARMCANZ water quality guidelines.

|| From CliFlo to clifro: New Zealand's climate data in R

Blake Seers & Nick T. Shears

University of Auckland

Publicly available and accessible weather and climate data is necessary for transparent, reproducible and credible research not only within the atmospheric sciences, but any discipline requiring the use of such data. While many public repositories exist online making the data accessible to the public, the information is typically not readily usable for analysis and plotting. Furthermore, weather data are often complicated and provided in unfamiliar formats that require advanced plotting techniques, such as visualising wind speeds and directions through time. The National Climate Database (maintained by NIWA's CliFlo) contains publicly available data collected from around 6,500 weather stations throughout New Zealand, providing a necessary repository for any study involving New Zealand's weather or climate.

The clifro R package has been developed to provide a means of accessing the database via CliFlo and downloading the data in a format that is easily analysed. In addition, clifro provides a variety of elegant methods for easily visualising and exploring the complex weather data, including time-series plots and wind roses. Clifro permits users to download, analyse and plot New Zealand's climate data easily, and allows for transparent and reproducible research when using these data.

|| An investigation into the reproductive strategies of temperate reef sponges

Megan Shaffer & James J. Bell

Victoria University of Wellington

Reproduction is a universal characteristic that drives evolution, though it is often unclear how exactly different modes of reproduction create genetic variation or influence population dynamics. Understanding this is crucial for developing sustainable management practices for any species. Sponges, which reproduce both sexually and asexually, offer a unique opportunity to examine the role that reproduction plays in shaping populations as they are ubiquitous, sessile and occupy a range of diverse habitats. The abundant New Zealand sponges *Tethya bergquistae* and *T. burtoni* are fast-growing and reproduce both by sexual reproduction and budding, making them especially ideal models. In the early phase of my PhD, I am seeking to describe environmental factors that influence the reproduction of *Tethya* spp., as little is currently known about their basic reproductive ecology. In addition, I intend to develop microsatellite markers for both population structure and parentage analyses in order to examine population connectivity, the frequency of sexual vs. asexual events, and whether fitness varies between sexually reproduced and clonal sponges. Ultimately, my results will allow for a greater understanding of the processes that influence reproduction and impact populations, which are key in preserving an ecologically and economically important species, like sponges.

|| Tairua Harbour āfirst year of monitoring

Nathan Singleton

Waikato Regional Council & Julia Simpson

In April 2001 Waikato Regional Council initiated the Regional Estuary Monitoring Programme (REMP) in the southern Firth of Thames and Whaingaroa (Raglan) Harbour. It is a long-term programme with the objective of monitoring the current status and temporal changes in intertidal benthic macrofauna and sediment characteristics as 'indicators' of the health of the region's estuaries. WRC has recently expanded REMP into Tairua Harbour, with a pilot study conducted in 2012. From the eight pilot sites five were selected for long term monitoring which began in August 2013. On each sampling occasion 10 replicate cores (13 cm in diameter and 15 cm deep) are taken to sample intertidal benthic macrofauna from random positions within each monitoring plot. Sediment samples are also taken from each plot for analysis of physical and chemical characteristics. Sites are monitored quarterly. This poster describes the findings of the first year of monitoring Tairua Harbour. Preliminary results show the macrofaunal communities at each site have relatively small changes, even through three major flood events.

|| Age and growth of the silvertip shark *Carcharhinus albimarginatus* from Papua New Guinea

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Carcharhinus albimarginatus is listed as near threatened on the IUCN red list. Population fragmentation makes local populations particularly vulnerable to targeted fishing particularly in the absence of informed fisheries management. Without life history data, informed management is difficult and no age and growth data is available for *Carcharhinus albimarginatus*. Age and growth estimates from length-at-age data (n= 53) were produced for the silvertip shark *Carcharhinus albimarginatus* from Papua New Guinea. Age estimates were produced from vertebral analysis conducted on samples collected by an on-board observer program operating in the Papua New Guinea long line fishery. As size class bias was present in the data due to gear selectivity, back calculation techniques were used to add interpolated data to the juvenile size classes. A multi-model approach incorporating AICc was used to estimate growth rates which included the von Bertalanffy, logistic and Gompertz growth functions as candidate growth models.

|| Open water multi-trophic aquaculture as a tool for enhancing the environmental and economic sustainability of aquaculture in New Zealand

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This study intends to investigate the benefits of multi-species aquaculture (Integrated Multi- Trophic Aquaculture or IMTA) designed to enhance the overall productivity of all target species and to reduce the environmental footprint through improved nitrogen removal.

Offshore aquaculture of finfish and bivalves are receiving much attention world-wide as a way of meeting increasing demands for marine products. However, implications associated with aquaculture include the enrichment of dissolved inorganic and suspended organic particles, which can cause eutrophication and ultimately alteration of the ecology of natural ecosystems. Macroalgae acts as biological filters as they convert dissolved inorganic particles to organic matter which in turn can be harvested and thereby removed from the environment.

The project will focus on two of New Zealand's major aquaculture species (mussels and salmon) and will examine benefits of co-culture with macroalgae species that produce valuable halogenated metabolites. In addition to exploring the environmental benefits, the potential to increase yields of the desired metabolites will be simultaneously examined.

|| Development of a data-poor stock assessment model for New Zealand by-catch species

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The concept of Ecosystem-Based Fishery Management (EBFM) has emerged from understanding the impacts fishing activities can have on marine biodiversity. An important aspect of EBFM is the assessment and management of impacts that selective fisheries can have on non-target (by-catch) species. Despite their low economic value or potential, these species may play a key role in the structure and functioning of marine ecosystems. Attempts to quantify the status and trends of these species by fisheries scientists and managers are often hindered by data-limitation. There is great potential to explore the development and application of various data-poor methods in New Zealand, with an estimated 80% of NZ fish stocks lacking an assessment under the Quota Management System (QMS). Sustainability Assessment for Fishing Effects (SAFE) is a quantitative assessment framework devised by CSIRO (Australia), and is applicable to certain NZ fishery stocks (e.g. chondrichthyan species such as ghost sharks, skates, or dogfish). The current study explores one of the key components of this approach, the estimation of catchability (probability of fish capture within an area affected by gear) under varying gear and population distribution scenarios, using Bayesian hierarchical methods.

|| Bigeyes or bigears? Vocalisations as a contact call to mediate group cohesion in a New Zealand reef fish

Lucinda van Oosterom

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Rising levels of ocean anthropogenic noise may impact acoustic communication in fishes particularly at night where the absence of visual cues makes sound communication even more important. Bigeyes (*Pempheris adspersa*) are nocturnal planktivorous reef fish that feed in loose shoals and are soniferous. Bigeye vocalisations have been suggested to be contact calls to maintain group cohesion, however despite the fact that many other vertebrates use contact calls, for fish direct evidence for group cohesion is restricted to the use of visual and hydrodynamic cues. Our laboratory experiments show that bigeyes significantly increased group cohesion when exposed to recordings of ambient reef sound at higher sound levels while also decreasing vocalisations. These patterns of behaviour are consistent with acoustic masking. When exposed to playback of conspecific vocalisations, the group cohesion and vocalisation rates of bigeyes both significantly increased. These results provide the first direct experimental support for the hypotheses that vocalisations are used as contact calls to maintain group cohesion in fishes, making fish the evolutionarily oldest vertebrate group in which this phenomenon has been observed. Providing a new behavioural context for the considerations of signal, noise, and interference avoidance in fish communities.

|| Future estuarine carbonate weather: role of benthic microphytes

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Current effort to evaluate the effects of atmospheric carbon dioxide on estuarine ecosystems is grounded in a conceptual framework that distinguishes between carbonate weather–the short-term variability in the seawater pH-pCO2 system—and carbonate climate, the longer-term shift in the baseline pH-pCO2 system due to increased absorption of carbon dioxide by the ocean.

Many dynamic estuarine processes drive carbonate weather, one of which is benthic photosynthesis: microphytes remove dissolved inorganic carbon (DIC) from the pore water of surface sediment during day but add DIC at night. In cohesive sediment, these activities cause variations in the concentration of hydrogen ions that can exceed the predicted long-term change in the open ocean by orders of magnitude.

Microphytes' photosynthesis and respiration are not the only drivers of pH in surface sediment. The bacterial degradation of organic matter with oxygen and the re-oxidation of reduced solutes, for example, decrease pore water pH, whereas nitrate assimilation, metal oxide reduction and carbonate dissolution increase pH. However, the strength of the effect on pH of these sedimentary processes is a function of pH.

Here, we ask how interactions between benthic photosynthesis and other sedimentary processes will affect the distribution and flux of hydrogen ions in estuarine sediment under conditions of the future seawater buffer capacity. We present and discuss a series of sediment pH microprofiles measured in daylight and darkness at current (pH 8.1) and future (pH 7.7) carbonate climate.

|| Sulfide speciation in subtidal Hauraki Gulf sediment

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In 2012, we showed how sediment profile imagery (SPI) could be used to derive the sediment content of sulfide, a product of the anaerobic microbial degradation of organic matter. We then proposed using SPI to assess the sulfide footprint of marine mussel farms, in particular, to detect temporal changes in the extent of the seafloor area of elevated sediment sulfide content. To do so, in 2014, we developed a rapid field technique to locate the boundary of such footprint with a series of sediment profile images taken along a transect leading from inside to outside a mussel farm.

Analysis of our sediment profile images was based on a previously established strong correlation between image color intensity and the sediment sulfide content extracted with 1 M HCl (acid volatile sulfide, AVS). AVS include dissolved pore water sulfide (H2S), mackinawite (FeS, the largest fraction) and greigite (Fe3S4). Dissolved H2S, however, does not contribute to sediment color; greigite contributes to color but is only partially extracted, and pyrite (FeS2), which also contributes to sediment color, is not extracted.

Despite these shortfalls, applying the AVS/color intensity correlation for our purpose becomes problematic only if the composition of sedimentary sulfides changes horizontally, that is, from site to site or as a function of sediment age, that is, depth below the sediment surface. Here we report on the latter issue. We found that, in iron-rich subtidal sediment of the Hauraki Gulf, vertical gradients in the concentrations of dissolved sulfides are negligible. Vertical gradients in the sediment pyrite concentration, however, can introduce uncertainty and therefore need to be considered when using SPI to derive the vertical distribution of sedimentary AVS.

|| Working with commercial partners: Helping to strengthen marine science and conservation

Laura Wakelin

Department of Conservation

The Department of Conservation (DOC) has been working with a range of commercial partners to help grow conservation in New Zealand. In 2013, Air New Zealand announced an extension of their existing partnership with DOC, to focus on marine protection, with a view to benefitting both conservation and tourism. Air New Zealand is a major partner in DOC's development of a national marine reserve monitoring and reporting programme, which will allow DOC to monitor and report on the state of New Zealand's marine protected areas. Air New Zealand is also a sole major sponsor of DOC's marine experiences network, promoting 10 iconic Coastal Gems as holiday destinations, highlighting the important role that marine environments play in quintessential kiwi life. This poster will provide an overview of DOC's approach to working with commercial partners such as Air New Zealand and highlight some of the key ways in which they have helped strengthen marine conservation science and awareness of marine protection in New Zealand.

|| Depth zonation within necrophagous amphipod *Hirondellea dubia* populations in the Tonga Trench

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Necrophagous amphipods play an important role in hadal trench community food webs; they dominate the scavenging community and are key prey species. Food availability and hydrostatic pressure vary greatly throughout hadal depths; each species has a range of tolerances to these which influence their distribution within the trench. Previous studies have also detected stratification of sexes and life stages between depths in the scavenging amphipod *Hirondellea gigas*; mature life stages dominated the greater depths while juveniles were abundant in shallow depths. The primary aim of the present research is to investigate whether this pattern occurs in the Tongan Trench for the scavenging amphipod *Hirondellea dubia*. Amphipod samples were collected during the JAMSTEC voyage YOK1310 to the Tonga Trench in 2013 from depths of 6,253m and 10,807m. Individuals have been morphometrically analysed to compare depth stratification within the *H. dubia* population. Although all amphipod species were sexed and measured, only *H. dubia* was present at the 10,800 m site, which meant depth zonation of other species could not be measured using these data. In addition, we compare the demographics and population distribution of amphipods in the Tonga Trench with other trenches in the South-West Pacific Ocean.

|| Mapping *Macrocystis pyrifera* beds in New Zealand from satellite images

Sanky Meng, **Vincent Zintzen**, Helen Curtis & Shane Geange

Department of Conservation

Giant kelp *Macrocystis pyrifera* (known in New Zealand as bladder kelp) is a large perennial kelp that forms dense beds with layers of floating surface canopies. These beds are at the base of many temperate coastal food webs, provisioning highly structured three-dimensional habitat for associated invertebrate, fish and algal species. The provisioning of biogenic habitat by giant kelp is influenced by local and regional pressures such as sedimentation, nutrient supply and water temperature. Because giant kelp is a foundation species that responds to a range of pressures, it is a potentially good indicator species for monitoring the ecological integrity of the New Zealand marine environment. Although there is anecdotal evidence that the extent of some of New Zealand's *Macrocystis* beds are declining, there has to date been little quantitative evidence to assess the extent and rate of this decline. Recent advances in the resolution of images provided by satellites means it is now possible to cost-effectively map *Macrocystis* beds remotely, which allows for the analysis of time-series data. We present time-series analysis using Near Infrared bands and normalized difference vegetation index (NDVI) from QuickBird satellite imagery to map *Macrocystis* beds in the Marlborough Sounds and discuss the potential of this technique for large-scale monitoring.

|| Quantifying uncertainties in estimating temperate mangrove forest cover and cover stocks

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Temperate mangroves attract attention due to their rapid expansion and potential to mitigate climate change through carbon sequestration. Mangrove mapping and carbon stock estimation are often accomplished through remote sensing. This inevitably involves uncertainty due to positional errors, water column effects, miss-classification, tree measurement, and model parameterisation (allometric equations). We used Landsat and common remote sensing techniques to estimate mangrove areas in the Motu Manawa (Pollen Island) Marine Reserve, New Zealand. Forest inventory data, various allometric equations, and Monte Carlo simulation were used to quantify uncertainties in carbon stock estimations. Tall mangrove area was estimated at 71.9 ± 0.97 ha and dwarf mangroves covered 81.3 ± 1.10 ha with an accuracy level of 96% and 92%, respectively. Of the potential error sources, water column correction had the largest effect, accounting for 14%, followed by image classification (7%) and geo-rectification (6%).

The total above-ground carbon stock was estimated at 34 t C ha-1 with an uncertainty of 5.8%. The biggest individual uncertainty was sampling error (11 t C ha-1), followed by allometric equations (5.8 t C ha-1). Measurement errors exerted only a minor effect. These results indicate that adequate water column corrections and model parameterisation are required for improving carbon stock estimations in temperate mangroves.

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