PLYMOUTH MARINE SCIENCE & EDUCATION FOUNDATION (PlyMSEF) ANNUAL STUDENT CONFERENCE
12th February 2015

Showcasing Early-Career Scientists

Plymouth Marine Laboratory (PML)
PLYMOUTH

PLyMSEF Conference Schedule

8:30 – 9:00  Registration - PML Marine Matters Centre
9:00 – 9:10  Kieran Curran - Welcome address and House keeping
9:10 – 9:45  Opening talk Professor Martin Attrill
"What has happened to our seas?"

Session 1: Biogeochemistry
Session chairs – Kieran Curran /Urvashi Danookdharree

<table>
<thead>
<tr>
<th>Time slot</th>
<th>Presenter</th>
<th>General Topic</th>
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<td>8:30 – 9:00</td>
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<th>Time slot</th>
<th>Presenter</th>
<th>General Topic</th>
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<tr>
<td>9:50 - 10:05</td>
<td>Matthew Fishwick</td>
<td>Dissolution of aerosol trace metals</td>
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<td>10:05 - 10:20</td>
<td>Madeleine Vickers</td>
<td>Palaeoclimate and stratigraphy</td>
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<td>10:20 - 10:35</td>
<td>Richard Sims</td>
<td>Near-surface gradients of gases</td>
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<td>10:35 – 10:50</td>
<td>Charlotte Walker</td>
<td>Calcification mechanisms of coccolithophores</td>
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10:50 - 11:05  Tea/Coffee break in Marine Matters Centre (MMC)

Session 2 Modelling and observing the oceans:
Session Chairs – Richard Sims/ Kiruthika Natesan

<table>
<thead>
<tr>
<th>Time slot</th>
<th>Presenter</th>
<th>General Topic</th>
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<tbody>
<tr>
<td>11:10 – 11:25</td>
<td>Dr Hayley Evers-King</td>
<td>Applications of in-water optics to ocean colour</td>
</tr>
<tr>
<td>11:25 – 11:40</td>
<td>Dr Ben Loveday</td>
<td>Remote sensing and modelling of the Agulhas system</td>
</tr>
<tr>
<td>11:50 – 11:55</td>
<td>Kieran Curran</td>
<td>Size-fractionated primary production of shelf seas</td>
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<td>11:55 – 12:10</td>
<td>Martin Osborne</td>
<td>Modelling the optics of suspended particles</td>
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12:10 – 13:10  Lunch and Networking /Poster session Marine Matters Centre (MMC)

Session 3: Ecosystems and policy interface
Session Chairs – Dr Nicholas Higgs /Harry Teagle

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<thead>
<tr>
<th>Time slot</th>
<th>Presenter</th>
<th>General Topic</th>
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<tbody>
<tr>
<td>13:15 – 13:30</td>
<td>Laura Friedrich</td>
<td>Ecosystem services and stakeholder engagement</td>
</tr>
<tr>
<td>13:30 – 13:45</td>
<td>Sarah Gall</td>
<td>Q methodology: Application for MPAs</td>
</tr>
<tr>
<td>13:45 – 14:00</td>
<td>Jennifer Skinner</td>
<td>What value does taxonomy have in modern science, policy?</td>
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</table>
Session 4: Ecology and climate change effects
Session Chairs: Charlotte Walker /Dr Awantha Dissanayake /Harry Teagle

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<thead>
<tr>
<th>Time slot</th>
<th>Presenter</th>
<th>General Topic</th>
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<tbody>
<tr>
<td>14:00 – 14:15</td>
<td>Samantha Simpson</td>
<td>Understanding movement patterns of skates</td>
</tr>
<tr>
<td>14:15 - 14:30</td>
<td>Leoni Adams</td>
<td>Multi-stressor climate impacts on bi-valves</td>
</tr>
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<td>14:30 – 14:45</td>
<td>Kristian McKonvile</td>
<td>Gelatinous zooplankton ecophysiology</td>
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14:45 – 15:00   Tea/Coffee break in Marine Matters Centre (MMC)

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<tr>
<th>Time slot</th>
<th>Presenter</th>
<th>General Topic</th>
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<tr>
<td>15:05 – 15:20</td>
<td>Jacqueline Maud</td>
<td>Calanus ecology and climate : 25yr time series</td>
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<td>15:20 – 15:35</td>
<td>Sara Mynott</td>
<td>Climate change impacts of crab camouflage</td>
</tr>
<tr>
<td>15:35 – 15:50</td>
<td>Dr Awantha Dissanayake</td>
<td>Ecophysiological impacts of climate change on crustaceans</td>
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15:50 – 16:30 Closing remarks and prize giving
16:20- 16:55 Networking
17:00 Plymsef Lecture: Professor David Sims

“Here or there? Search behaviour of marine animals and the evolution of optimality”
18:00 - 19:00 Wine Reception
PlyMSEF Talk:

“Here or there? Search behaviour of marine animals and the evolution of optimality”

Professor David Sims

David Sims is an MBA Senior Research Fellow and Leader of the Sims Lab at the Marine Biological Association. As Deputy Director for Research he co-ordinates the Ecosystems and Environmental Change research theme. David holds a joint academic appointment with the University of Southampton where he is Professor of Marine Ecology in the Ocean and Earth Science school at the National Oceanography Centre and in the Centre for Biological Sciences.

David’s research focuses on the movement ecology of marine predators. David has been awarded a Royal Institution ‘Scientist for the New Century’ Lecture (2001), Life Membership of the Royal Institution, the FSBI Medal of the Fisheries Society of the British Isles (2007) for “exceptional advances in fish biology and/or fisheries”, and the Stanley Gray Silver Medal from the Institute of Marine Engineering, Science and Technology (2008). He has served as series editor for Advances in Marine Biology and associate editor of the Journal of Animal Ecology and is currently an Associate Editor of Animal Biotelemetry.

After graduating with a First Class degree in Biological Sciences in 1991 David was awarded a personal Ph.D studentship from the Natural Environment Research Council (NERC) leading to a Ph.D in the behavioural ecology of fish, based in part at the Marine Biological Association (MBA) Laboratory in Plymouth. In 2000, after being Lecturer in zoology at Aberdeen University, David returned to the MBA Laboratory as a NERC-funded Research Fellow and formed the Sims Lab.

SELECTED PUBLICATIONS

ABSTRACTS
Session 1: Biogeochemistry

9:50-10:05  Matthew Fishwick - University of Plymouth

Dissolution of aerosol trace metals into surface waters: influence of aerosol source, seawater temperature and seawater pH

A number of trace metals are required by phytoplankton for a range of important biochemical functions. A major pathway supplying trace metals to the open ocean is atmospheric deposition of aerosols. The proportion of total trace metal contained within aerosols that dissolves in seawater, known as the fractional solubility, varies greatly and is dependent on aerosol composition and the physicochemical conditions of the seawater.

In this study, the effects of key physicochemical factors on aerosol trace metal dissolution into seawater were investigated. These factors were seawater temperature and seawater pH. Aerosol samples were collected from the Tudor Hill atmospheric observatory in Bermuda over four different seasonal time periods (ca. 1 – 2 month) over 2009 and 2010 and replicate subsamples of these were used in aerosol leach experiments along with filtered low trace metal seawater collected from the Bermuda Atlantic Time-series Study region. Filtration of seawater leachate through 0.4 µm and 0.02 µm pore size filters allowed colloidal (> 0.02 µm – < 0.4 µm) and soluble (< 0.02 µm) size fractions of the dissolved (< 0.4 µm) trace metal pool to be determined.

Initial results for iron showed that seawater temperature (4 – 25 °C) and pH (7.7 – 8.1), had no significant effect on the dissolution of aerosol iron within the range of values tested. However, the source and composition of aerosols affected the fractional solubility of iron by up to one order of magnitude, with the most anthropogenically influenced samples having the highest fractional solubility. Supporting data showing the influence of aerosol source, seawater temperature and seawater pH on a suite of biologically important trace metals (e.g. Co, Cu, Mo) will also be presented.

10:05 - 10:20  Madeleine Vickers - University of Plymouth

The Early Cretaceous sequence in Spitsbergen: the Festningen profile

During the Early Cretaceous, Spitsbergen, Svalbard, was located at a palaeolatitude of ~60°N. Abundant fossil wood derived from conifer forests, dinosaur trackways, enigmatic deposits such as glendonite horizons and rare outsized clasts, and stable isotope data from the Early Cretaceous formations of Spitsbergen suggest that the climate at that time was much more dynamic than the traditional view of “invariant greenhouse” conditions on Earth. The purpose of this study is to test the veracity of using such proxies as climate indicators, and to evaluate the climatic character of Arctic Svalbard during the Early Cretaceous. To this end, the sedimentological and sequence stratigraphic context of glendonites (pseudomorphs after the cold-water mineral ikaite) and outsized clasts (possibly ice-rafted) within the coastal to marine shelf sedimentary deposits of the Early Cretaceous of Spitsbergen are being documented. This is being achieved through high resolution conventional sedimentary logging (bed-scale) of the successions (documentation of glendonites, outsized clasts, together with sampling every < 0.5m for stable isotope analysis) in order to constrain and elucidate the nature of environmental and possible climatic variations during this time. Preliminary results from a key targeted section at a location known as Festningen will be presented.
10:20 - 10:35 Richard Sims - PML – University of Exeter

Near Surface Ocean Profiler for trace gas measurements

Surface ocean trace gas measurements are routinely made using water collected via the ship’s intake (~5-7 m depth) but it is unclear how representative this water is of the concentration at the sea surface microlayer. Accurate estimates of surface gas concentrations are essential when calculating air/sea fluxes. We have developed a Near Surface Ocean Profiler (NSOP): a deployable sampling platform from which finely resolved vertical profiles of trace gases can be made in the upper 10 m of the ocean. NSOP is a free-floating buoy consisting of a waterproof, remote-controlled winch that raises and lowers a small cage containing a microCTD and inlet tubing. Disturbance of the water column is minimized by deploying the NSOP approximately 10m away from the ship. NSOP rides the swell and, unlike ship-based sampling, does not suffer from large depth fluctuations due to ship motion. This results in an improved vertical resolution: +/- 20 cm in a 1-2 m swell. Water is pumped through the inlet tubing to the ship and through a membrane equilibrator. The membrane equilibrator has a much shorter system response time than traditional showerhead or percolating equilibrators, which enables high resolution measurements. Equilibrated gas exits the equilibrator and can be analysed by multiple instruments. Preliminary pCO2 and DMS profiles from the Western Channel Observatory (WCO) L4 site are presented, with further pCO2 measurements planned during the Shelf Sea Biogeochemistry research cruises and at the WCO site. We aim to characterise the environmental conditions when near surface gradients are significant and to quantify their impact upon air-sea CO2 flux estimates.

10:35 – 10:50 Charlotte Walker - MBA – University of Southampton

Do all coccolithophores calcify by the same mechanisms?

Coccolithophores are globally distributed, unicellular marine algae belonging to the phylum Haptophyta. Characterised by internally produced, intricate calcite laths that form a casing on the outside of the cell, they are crucial in the transfer of carbon from the upper waters to depth. Emiliania huxleyi is the most globally abundant species, with the ability to form vast blooms that can be seen from space. The majority of research has focused on this species, but how and why calcification occurs is still largely unknown. As research has progressed, it is becoming clear that coccolithophores may exhibit important physiological differences between species. For example, differences in coccolith-associated polysaccharides may contribute to the diversity in coccolith morphology. With this starting point the project aims to dig deeper into the mechanisms of calcification, comparing other important ecological species to E. huxleyi to begin to answer the question: Do all coccolithophores calcify by the same mechanisms?
Session 2: Observing and modelling the ocean

11:10 – 11:25     Dr Hayley Evers-King - PML

From sea to space: understanding in-water optics to develop applications of satellite ocean colour

Measurements of the light environment within the ocean, and leaving its surface, contain a wealth of information. Satellite ocean colour data can provide highly temporally and spatially resolved data pertinent to many important marine issues, from water quality, to primary ecosystem variability and its influence on fisheries and aquaculture. My recently completed PhD research focused on taking an in-water understanding of optics, investigating the sensitivity of the ocean colour signal through to the study of Harmful Algal Blooms in the southern Benguela from satellite imagery. Particle and radiative transfer models were used in a sensitivity study and the development of a semi-analytical inversion algorithm to derive phytoplankton community characteristics including chlorophyll a concentration and cell size. I will share some insights from this process, and discuss how I will be using this experience to begin new research investigating the role of optics in understanding variability in ocean heat flux.

11:25 – 11:40     Dr Ben Loveday - PML

The Greater Agulhas system: new perspectives from model and earth observation data

The greater Agulhas system, which contains the Southern Hemisphere's strongest western boundary current, is, in the mesoscale, one of the most energetic regions of the world's oceans. Determining the eddy structure of this system, and identifying the mechanisms that control its behaviour, is essential if we are to understand and quantify the Agulhas leakage: the thermohaline: "warm-water" link between the Indian Ocean thermocline and its Atlantic counterpart.

Due to the sporadic nature of the leakage, which partially occurs through the ejection of large rings, and sparse in situ data, it is common to employ numerical ocean models to investigate the region. However, the variety of numerical schemes employed in these models can lead to different interpretations of system behaviour. To address this concern, my PhD research involved investigating the response of the greater Agulhas system to idealised wind fields using a suite of different numerical models of varying resolution. Within the context of this framework, the response of the Agulhas Current and leakage under pseudo-palaeoclimatic conditions may be more accurately inferred.

Coupled to this multi model approach, remote sensing techniques such as eddy tracking were extensively used as validation tools and, in tandem with model output, to shed light on the sub-surface structure of the Agulhas leakage. My recent appointment in the Remote Sensing Group at Plymouth Marine Laboratory will adapt these techniques to monitor slope currents and frontal systems on the European continental shelf.


Are existing size-fractionated primary production models appropriate for UK shelf Seas?

Shelf seas are 4-6 times more productive than the open ocean, supporting high biomasses of phytoplankton despite accounting for only 5% of global ocean surface area. By fixing carbon via photosynthesis and subsequently sinking or being grazed upon, phytoplankton export carbon to deep waters and sediments, storing it for hundreds to millions of years. This “biological pump” of carbon is a key component of Earth’s climate system as phytoplankton...
account for ~50% of global net primary productivity. However, the export efficiency of phytoplankton and their ecological roles are strongly determined by their sizes, which range over 9 orders of magnitude by volume. Therefore, methods of estimating the primary production of different phytoplankton size classes are of great benefit to our understanding of the biogeochemistry and ecology of shelf seas and their influence on the wider oceans and Earth’s climate. By combining extensive in situ data of phytoplankton photo-physiology and phytoplankton pigments, Uitz et al, 2008 produced a method of estimating primary production for three size classes of phytoplankton. However, this model is calibrated and validated with tropical, open-ocean samples and uses pigments to apportion size class. Here we test the performance of this model against in situ, size-fractionated data collected from the Western Channel Observatory, a dynamic coastal-shelf site.

11:55 – 12:10  Martin Osborne – MRes Student - University of Plymouth
Modelling the optical properties of suspended particles in coastal waters

Mie theory is routinely used to model the interaction of suspended particles in sea water with incident light and to predict the resulting scattering and absorption. Here predictions from a model employing classic Mie code are compared to in-situ data to investigate the refractive index of a mixed particle population off the coast of Plymouth as a test case. Parameter values for refractive index, angle resolution and maximum and minimum particle size classes were obtained from the literature. Size data were collected using a prototype digital in-line holographic imaging system capable of resolution down to 20µm, and optical data were collected using Wetlabs AC 9 and BB 9 instruments. Measurements are from station L4 in the Western Channel Observatory (WCO) in April. The size distribution is described by a Junge type power law with the exponent ξ ranging from 2.1 to 3.8. The model allows both the real and imaginary parts of the refractive index to vary with incident wavelength. Closure results were often within 10% of the measured values for scattering and absorption, and calculated refractive indices ranged from 1.2 + i0.05 to 1.04 + i0.00008. We conclude that, given appropriate parameterization, the approximations of Mie theory do not prevent the extraction of realistic values for refractive index and size distribution from the optical data set used, even with distinctly non-spherical flocculated particles in the scattering population.
Session 3 Ecosystem services and marine policy

13:15 – 13:30        Laura Friedrich – University of Plymouth

Ecosystem services and stakeholder engagement in marine governance
The ecosystem services concept reveals the benefits that humans receive from ecosystems as well as the effects those different activities have on the ability of ecosystems to support wellbeing. A growing body of literature shows that ecosystem service assessment can contribute to the evidence base for policy making and management, inform trade-off decisions or support the design of financial instruments. It also has the potential to raise understanding of the need for management to secure healthy, resilient and functioning ecosystems and could be a powerful tool for engaging stakeholders in marine governance. Engagement plays an increasingly important role in sustainable marine governance as a mechanism to ensure that all relevant interests and sources of knowledge are integrated in decision making, to reduce conflicts and to increase buy in by affected stakeholders. How ecosystem services could support stakeholder engagement is a key research question in VALMER, an EU Interreg funded project involving French and UK partners. VALMER is exploring the application of ecosystem service assessment in marine governance at six sites in the English Channel. At each site, a stakeholder led process has identified ecosystem services and applied assessment in combination with scenario building to explore different management options. These stakeholder processes have been evaluated to identify how the ecosystem service assessment has contributed to stakeholder engagement. Interviews have been conducted with stakeholders to establish whether their understanding of the role of marine ecosystems and the need for management had improved, whether ecosystem service assessment fostered better understanding among stakeholders with different interests and whether it supported a constructive dialogue. A comparison of results from the six case studies will reveal how this differed between stakeholder groups and management contexts. Preliminary results from Poole Harbour, the first completed case study, will be presented.

13:30 – 13:45        Sarah Gall - University of Plymouth

Q methodology: a novel approach to assessing stakeholder acceptance and social impacts of MPAs
The importance of social impact assessment for MPAs has been widely recognised in national and international policy, but research has been limited. Recognition that social factors may be the primary driver of MPA success highlights that understanding the social context is essential to effective planning and management. The initial stages of the UK Marine Conservation Zones project successfully engaged stakeholders in the planning of 127 MPAs in England. Stakeholders have, however, been excluded from subsequent discussions on management and implementation and initial research suggests they have become disenfranchised and uncertain of the future. Q methodology provides a novel, quantitative approach to reveal stakeholder perspectives and was used to assess current perceptions and acceptance of MPAs in the Devon & Severn region. Interviews were conducted with stakeholders that were actively involved in, or knowledgeable about the MCZ process. By sorting a set of statements about the topic of interest into a forced frequency distribution ranging from statements that are ‘least like they think’ to those that are ‘most like they think’, stakeholders reveal their viewpoints. They then provide explanations for the statements that were most and least like they think to aid interpretation. Factor analysis is conducted to identify stakeholders who have produced similar sorts and therefore have similar opinions. These groupings are termed ‘factors’, and are characterised by statements that are common
across sorts. Social discourses are then developed for each factor via interpretation of the characteristic statements. The talk will outline the methodology required to conduct a survey using Q methodology. It will describe how the method has been applied to assessing stakeholder opinion on MPAs in Devon and outline how the method may be useful in marine policy and conservation research.

13:45 – 14:00      Jennifer Skinner – SAHFOS

What value does taxonomy have in modern science and policy?

The Marine Strategy Framework Directive takes an ecosystem approach in promoting a sustainable and healthy marine environment, and relies on indicators to help set useful, practical and attainable targets in its bid to achieve Good Environmental Status in European Seas by 2020. Developing ecological indicators is a challenging process, but is an essential factor in setting realistic targets that allow for climate change, but will trigger management action if a manageable anthropogenic pressure is detected. Indicators for biodiversity and food webs require a level of specificity to detect changes in community composition, that despite technological advancements, bulk indicators cannot provide. Taxonomic studies, however, enable specific and responsive indicators to be selected and monitored over time to assess the impacts of drivers on the environment at the species level. Long term taxonomic data sets, such as the Continuous Plankton Recorder survey and MarCLIM, have enabled the detection of significant changes in biodiversity, and help disentangle natural variation in species composition from changes caused by particular drivers, manageable or otherwise. Bulk indicators lack the necessary level of detail required to accurately develop and inform indicators representing such complex facets of the ecosystem. Consequently, indicators derived from taxonomic data, such as those informing pelagic and benthic ecosystem components, are crucial to the success of directives including the MSFD, and provide essential information to accurately help inform policy in implementing effective and cost efficient management programmes.
Session 4 Ecology and climate change effects

14:00 – 14:15    Samantha Simpson- MBA – University of Southampton
Understanding movement patterns of skates
Recent studies in the Northeast Atlantic have documented marked declines in the abundance of commercially important skate (Rajidae) species within the past few decades as a consequence of fishing. Observed declines are at least in part due to rays having k-selected life-history traits of slow growth, late age at maturity and relatively low fecundity, which makes them particularly susceptible to high levels of fishing exploitation. However, although rays appear to be heavily impacted by fishing a detailed understanding of the underlying population distribution changes – for gaining better insight about future changes – is hampered by a very limited knowledge of the spatio-temporal dynamics of individuals within a population. Improved quantitative estimates of spatial dynamics such as dispersal, migrations, and movements linked to preferred habitats is an extremely important but neglected aspect of marine animal ecology. How is it that we know so little and what directions can future research take to improve our current knowledge?

14:15 - 14:30    Leoni Adams – MBA – University of Southampton
Impacts of multiple stressors: how climate change, ocean acidification and microplastics affect performance and productivity in marine bivalves
Microplastics in the marine environment pose a growing concern for marine conservation and biodiversity. Whilst the scientific evidence relating to impacts of microplastics on wildlife is fast growing, there is still relatively little known about the subject. Deposit and filter feeding organisms are known to be at particular risk from microplastic pollution, and trophic transfer up the food chain has been evidenced. A filter-feeder, (Mytilus spp.) and a natural predator (Carcinus maenas) were kept under laboratory conditions to elicit responses to microplastic pollution, combined with two other current important marine stressors; increased temperature and increased carbon dioxide levels. Increased stress levels from climate change and ocean acidification in the natural environment may increase susceptibility to plastic ingestion and associated impacts. This study aimed to understand how these three stressors interact over two trophic levels.

Both species were treated directly with temperature and CO2. Mytilus spp. were intermittently exposed to fluorescent dyed microplastics during feeding. Immediately following this exposure Carcinus maenas were allowed to consume Mytilus spp. for 20 minutes, allowing natural trophic transfer.

Physiological responses to stressors were recorded and analysed to describe the interacting effects of microplastics, temperature and CO2 on two common intertidal marine species.

14:30 – 14:45    Kristian McConville – PML – University of Plymouth
Do the physiological implications of increased water content explain growth and population dynamics observed in zooplankton?
Gelatinous zooplankton are an ecological group that are united by their low C mass to volume ratio. The ecophysiological implications of being gelatinous are beginning to be understood, and include increased C specific feeding rate and growth. However, to this point gelatinousness has been treated as a categorical variable, not recognising the considerable variation in C to volume ratio that exists in the zooplankton. This study treats gelatinousness
as a continuous variable and through a combination of meta-analysis and time series analysis; investigates how gelatinousness affects the growth, population dynamics and population variability of all zooplankton. Preliminary analyses suggest that there is a strong relationship between gelatinousness and somatic growth rate and significant relationships between gelatinousness and both population variability and increase rate. These results suggest that the trait of gelatinousness could have considerable ecological and evolutionary implications for all zooplankton.

15:05 – 15:20    Jacqueline Maud – PML – Queen Mary University
**Calanus helgolandicus and a changing climate: analysis of a 25-year time series from the English Channel – an update**

Calanus helgolandicus is a dominant copepod species occurring in warm, temperate European waters. Commensurate with the recent warming of the North Sea, *C. helgolandicus* distribution has undergone a northward expansion with subsequent replacement of the colder-water *Calanus finmarchicus*. The subsequent modification of the zooplankton ecosystem may have significant implications at higher trophic levels. This work provides an update to the analysis of *C. helgolandicus* adult abundance (1988-2012) and egg production rate data (1992-2012) from the English Channel Station L4 time-series. This 25-year time series of weekly measurements, supported by data on temperature, stratification and food quantity and quality, allows a unique opportunity to tease apart the multiple factors that control the abundance of this species. There is evidence of a long-term warming trend in the Western English Channel, however *Calanus helgolandicus* dynamics appear surprisingly robust, despite the great inter-annual variability in timing and extent of the stratification and bloom cycle that is observed at this site during the summer. Their “bet hedging” reproductive strategy partially compensates for phenological mismatches with food; however there is evidence of an increasing winter population. In this presentation we explore the alternative hypotheses related to population control at this L4 site, namely that the success of the annual population is linked to the egg production rate and egg-hatching success; that seasonal temperature changes and food quality effect reproduction; and the timing of summer stratification strongly influences egg survival and hatching.

15:20 – 15:35     Sara Mynott – University of Exeter
**How will climate change affect shore crab camouflage and vulnerability to predation?**

Predator-prey relationships are major forces in shaping marine ecosystems, so finding out how they will be affected by changes in ocean properties (warming, acidification and hypoxia) is key to understanding and predicting how these ecosystems will respond to future climate change. However, much research to date has focused on how individual species will be affected by climate change, with little consideration for species interactions and trophic dependencies. This project aims to assess how relationships between predators and their prey will be affected by looking at the impact of climate change on prey camouflage.

Camouflage is one of the most widespread ways of avoiding predators and many animals change colour in order to match their surroundings. However, environmental stress can have a major influence on animal colour and potentially therefore the effectiveness of predator avoidance. This study investigates how climate-related stressors (seawater carbon dioxide
and oxygen levels, and seawater temperature) influence colour change, and hence camouflage, in the green shore crab (*Carcinus maenas*).

Previous work has shown shore crabs are capable of redistributing pigment in their carapace over a period of hours. By placing individuals on either a black or a white background in the laboratory and photographing them at regular intervals, their colour change can be quantified across a range of seawater conditions. These photographs, when analysed using a model of predator vision, reveal how changes in carapace colour influence their detectability. Preliminary results indicate how green shore crabs may respond to temperature over the range 5-20°C, and how temperature may influence camouflage in this species.

**15:35 – 15:50**  
**Dr Awantha Dissanayake – University of Plymouth**  
*Ecophysiological impacts of climate change: a crustacean perspective*

Continuous increasing carbon dioxide (CO₂) emissions are elevating atmospheric concentrations of CO₂, which in turn are increasing simultaneously the CO₂ concentrations and acidity of the world’s oceans (ocean acidification; OA). Elucidating the impacts of OA-associated climate change (OA-CC) upon the biota is of paramount importance as the human population increases, and thus the dependency upon global fisheries as a source of nutrition. Predicting OA-CC impacts on marine ecosystems and fisheries is difficult due to the current lack of knowledge of the ability of individual species and key functional groups to adapt to climatic change. Data presented addresses physiological impacts of increased CO₂ and ocean warming in decapod crustaceans occupying various ecosystems (shallow-water coastal and open ocean). Possible impacts upon fisheries will be discussed using two important crustacean groups used in global fisheries, from shallow-water (Penaeid prawns) and marine open waters (Antarctic krill). Physiological impacts described in the decapod species will be placed into context in two marine ecosystems [The East China Sea (ECS) and Antarctic waters] that both serve as major fishing grounds and are currently impacted by other climate change related effects (e.g. hypoxia). In the advent of OA, information from current global models (temperature, CO₂ concentrations, calcite and aragonite saturation level predictions) lacks greater spatial resolution for these regions (especially the ECS). In order to predict effects on global fisheries, laboratory-derived empirical evidence must be tied into species population models and oceanographic models (including varying sea-ice patterns) if we are to predict the status of global fisheries and ocean productivity.
POSTER ABSTRACTS
Alfred Alademomi – University of Plymouth

Hypsometric analysis of Lagos Lagoon watersheds using ASTER (DEM) data and GIS

Lagos Lagoon watershed is situated in a low-lying terrain where topography is almost the same over a wider range of landscape. After the independence in 1960, Lagos started witnessing huge progression in her population increase; this has brought about an enormous change in the rich large wetland habitation that surrounds the Lagoon. Hypsometric analysis of the watershed describes the elevation distribution across an area of land surface. It also compares the terrain evolution of various landforms irrespective of the factor that may be responsible for it. This study takes into consideration the watersheds developed over partly flooded and partly inundated area. The hypsometric analysis has been used as hypsometric integral and hypsometric curve to deduce its relationship with the area of the watersheds. With exact integration of \( f(x) \) between the limits of the unit square as -1.017 for the entire watershed and between the ranges of 0.05 to 0.27 for the sub-watersheds, hypsometric integral was calculated. Hypsometric curve of the whole watershed indicates that 49% of the area is above the centroid of the watershed.

Bethany Clark – University of Exeter

3D tracking of gannet foraging trips and how they relate to oceanography

Miniaturised bio-loggers have facilitated huge leaps forward in understanding how animals interact with their environment, but the availability of technology and analytical tools has largely limited studies to two dimensions. A key goal is to reconstruct three-dimensional movement, which is particularly important for animals that use both aquatic and aerial habitats. Northern gannets \((Morus bassanus)\) are large piscivorous seabirds that able to safely carry bio-logging devices and use aerial dives to exploit marine prey, making them ideal for studying three-dimensional space-use. Here we report planned methods for the combined deployment of GPS loggers, barometric altimeters, tri-axial accelerometers and time-depth recorders to capture behaviours not identified by GPS alone. We will relate these behaviours to remotely-sensed ocean temperature and chlorophyll levels, with a focus on composite ocean front maps, providing new insights into the use of ocean fronts by foraging gannets. Our results will have relevance for marine spatial planning, particular in reference to collision risk at offshore wind farms, and address pure ecological questions about marine predator and oceanographic interactions.

Samantha Cox – University of Plymouth

3D movements of gannets alter in areas of frequent frontal activity

Fronts, marking the interface between differing water masses, have been linked to a taxonomically diverse range of marine predators globally. Increased productivity alongside the mechanical redistribution of biomass at these features mean prey may be both in higher densities and pushed to the surface. However, to date there is little evidence of this. In this novel study we use the Northern gannet \(Morus bassanus\) as a model medium ranging marine predator to demonstrate a change in foraging strategy, indicative of a change in prey fields, around fronts in the Celtic Sea. Two dive strategies were identified. V-shaped dives were
those with little active swim phase relying mainly on momentum from the plunge dive and were generally short and shallow. In contrast, U- shaped dives contained a substantial swim phase, where gannets used wing beats to pursue prey. These tended to be longer and reach greater depths. We found the prevalence of U-shaped dives was reduced around frontal features. We suggest this behavioural response results from a change in the availability and type of prey at fronts, and that these prey are most successfully exploited through the use of short shallow dives at high speeds.

Dr Hayley Evers-King – PML

*Sensitivity in reflectance attributed to phytoplankton cell size: Forward and inverse approaches and application to Harmful Algal Blooms*

Much research has been conducted to link variability in optical signals with phytoplankton community characteristics. Detection of individual species, functional types or size classes has been approached with varying degrees of success through a spectrum of empirical to analytical approaches. A key step in developing these techniques for global application is quantifying the sensitivity in reflectance, which can be attributed to phytoplankton characteristics (e.g. cell size) under different optical regimes. Further, it is important to understand the ambiguity that this variability imparts on the inverse ocean colour problem. A forward and inverse approach is presented, coupling phytoplankton absorption and backscattering from a phytoplankton particle population model with EcoLight-S and a non-linear optimisation inversion scheme. Simulated data is generated to establish how much variability in reflectance can be expected from changes in phytoplankton cell size under different bio-optical water types. This data is inverted to investigate ambiguity and minimum likely errors. The inverse approach is then applied to in situ data to provide context. Results indicate that size related sensitivity in reflectance is highly dependent on phytoplankton biomass, as determined by the relative phytoplankton contribution to the Inherent Optical Property budget. Suggestions are made to improve radiative transfer assumptions in lieu of applying full radiative transfer and a simplified version of the approach is applied to the MERIS level 2 archive for the southern Benguela. Finally, a time series of biomass and cell size associated with Harmful Algal Blooms is presented to demonstrate the utility of this approach for assessing interannual variability.

Daniel Heggie – PML – University of Bristol

*Alcohols in seawater and their exchange with the atmosphere*

Reactive alcohol species alter both hydroxyl radical and ozone concentrations in the atmosphere, and thus influence its’ oxidising capacity. Trace amounts of these alcohols (methanol, ethanol and propanol) have been found dissolved in seawater. What is not known is what role the ocean plays in the cycling of these trace gases, due to a lack of data. This project will investigate both coastal & oceanic environments, using several different analytical techniques (PTR-MS, GC-ECD & derivitisation) to quantify alcohol concentrations in air and seawater. An investigation of what controls concentrations of these alcohols in seawater will also be carried out, looking at variability with depth and time, and correlation with ancillary parameters measured by other researchers. Lastly results will be used in conjunction with atmospheric concentrations, to give estimates of alcohol flux across the air-sea interface, to identify if the ocean is a sink and/or a source for these gases.
Anaëlle Lemasson – University of Plymouth

Investigations into the reproductive biology and larval ecology of two non-native ascidians in UK waters

*Asterocarpa humilis* and *Corella eumyota* are two ascidians native from the southern hemisphere identified on UK shores in recent years. They are atypical species that although being solitary brood their larvae. Little is known regarding their reproductive behaviour in their introduced range and how their reproductive and larval traits facilitate the populations’ establishment. Here, three experiments were conducted to assess their reproductive seasonality, fecundity and larval ecology; additionally comparisons were made with another solitary brooding species, *Dendrodoa grossularia*, three typical solitary broadcast-spawning species, *Ciona intestinalis*, *Molgula socialis* and *Ascidiella aspersa*, and three colonial brooding species, *Botrylloides violaceus*, *Botryllus schlosseri* and *Diplosoma listerianum*. *A. humilis* brooded larvae throughout the year. *A. humilis* and *C. eumyota* released larvae for the entire duration of the experiment (February to July). Throughout the season, the average fecundity for *C. eumyota* was 398.22 offspring.g⁻¹, and 221.96 offspring.g⁻¹ for *A. humilis*. They displayed high fecundities more similar to broadcast-spawning species than brooding species. Larval dispersal and settlement behaviours were linked to the species’ reproductive strategy. Solitary brooders, including *A. humilis* and *C. eumyota*, showed short dispersal distances and preferences for shaded and sheltered substrates, this behaviour potentially reduces post-settlement mortality and promotes population build-up. The ability of *C. eumyota* and *A. humilis* to reproduce over a long period of the year, added to their high fecundity and larval behaviour promoting aggregation, allows for a facilitated process of population build-up. This study demonstrates that *C. eumyota* and *A. humilis* are efficient invaders whose reproductive traits enable their success.

Richard Sims – PML – University of Exeter

Near Surface Ocean Profiler for trace gas measurements

Surface ocean trace gas measurements are routinely made using water collected via the ship’s intake (~5-7 m depth) but it is unclear how representative this water is of the concentration at the sea surface microlayer. Accurate estimates of surface gas concentrations are essential when calculating air/sea fluxes. We have developed a Near Surface Ocean Profiler (NSOP): a deployable sampling platform from which finely resolved vertical profiles of trace gases can be made in the upper 10 m of the ocean. NSOP is a free-floating buoy consisting of a waterproof, remote-controlled winch that raises and lowers a small cage containing a microCTD and inlet tubing. Disturbance of the water column is minimized by deploying the NSOP approximately 10m away from the ship. NSOP rides the swell and, unlike ship-based sampling, does not suffer from large depth fluctuations due to ship motion. This results in an improved vertical resolution: +/- 20 cm in a 1-2 m swell. Water is pumped through the inlet tubing to the ship and through a membrane equilibrator. The membrane equilibrator has a much shorter system response time than traditional showerhead or percolating equilibrators, which enables high resolution measurements. Equilibrated gas exits the equilibrator and can be analysed by multiple instruments. Preliminary pCO2 and DMS profiles from the Western Channel Observatory (WCO) L4 site are presented, with further pCO2 measurements planned during the Shelf Sea Biogeochemistry research cruises and at the WCO site. We aim to characterise the environmental conditions when near surface gradients are significant and to quantify their impact upon air-sea CO2 flux estimates.
PlyMSEF February 2015 Organising Committee

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