Impact of Typhoon Disturbance on Key Mangrove Macrobenthos in Can Gio Biosphere Reserve, Vietnam

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Area being submitted to 1) General science session

Preferred presentation medium (ii) Oral

Are you a student? No

Abstract

The intensity of tropical storms may increase due to climate change and coastal mangrove forests are particularly vulnerable due to their low structural diversity. Bioturbating crabs possibly accelerate the recovery of storm-damaged mangrove forests, yet the response of these ecosystem engineers to storm disturbance is largely unknown. Here we compare the ground-dwelling crab community of intact monocultural mangrove stands with that of typhoon gaps having experienced 100% tree mortality in two adjacent areas in Can Gio Biosphere Reserve, S-Vietnam. In each area, an 18-20 yr old *Rhizophora apiculata* stand served as control and was compared with typhoon gaps where downed stems had been removed or left on-site. The gaps were 14 and 20 months old when sampled in the dry and rainy season, respectively. Four people manually caught crabs during 30 min in each 100 m² plot (7 replicate plots per area, treatment and sampling) and abiotic and biotic measures were taken. Despite complete canopy loss, total crab abundance had not changed (in contrast to biomass) and all forest species were also found in the gaps. Gap-exclusive species existed and average species number and Shannon diversity were higher in the gaps. *Perisesarma eumolpe* was the most abundant crab, both in the forest and in the gaps and a shift from sesarmids (typical leaf litter feeders, omnivorous forest species) to ocypodids (microphytobenthos feeders, more prominent in sunny areas) had not occurred. The persistence of litter-feeding sesarmids is probably linked to woody debris in the gaps, fuelling a mangrove detritus based food web, rather than one based on microphytobenthos with deposit-feeding ocypodids. The continuous abundance of burrowing crabs in the gaps suggests that important ecosystem engineering activities are still performed; however, bioturbation was less pronounced since crab size/biomass was smaller in the gaps. Follow-up work is assessing the long-term dynamics of the gap fauna as well as the crabs' impact on storm gap recovery.

Keywords: Mangrove crabs, storm disturbance, hurricane, canopy gap, community structure, diversity

Acknowledgements

We are grateful to the German Research Foundation and The Marine Alliance for Science and Technology for Scotland for supporting this work.

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Simulating tides and waves in the East Coast of Scotland

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Area being submitted to: General science session.

Preferred presentation medium: oral.

Are you a student? Yes

North Sea is one of the most extensively studied shelf seas and its hydrodynamic behavior has been modeled by many investigators. However, most iof this effort has been devoted to the general circulation due to tide, wind and buoyancy inputs. There is a lack of modeling effort on wave activity, and especially on the interaction of waves and tidal effects.

Some previous works highlighted the presence of three amphidromic points for the main tidal harmonic component (M_2) in the North Sea, one near English Channel, one near Danish coast and one at Southern-West tip of the Norway coastline. Wave fields that may interact with this structure of tidal phase and amplitude arise from local wind stress within the North Sea, and long-range wave propagation from the Atlantic and Norwegian Sea.

As part of the EPSRC TeraWatt project on renewable energy resources, we concentrated on combined modeling of tides and waves off the east coast of Scotland using the MIKE 3 by DHI modelling software.

We focused on an area centred on Stonehaven bay which is the location of a Marine Scotland long term hydrographic and ecological monitoring site. The domain extended north into the Moray Firth, and south to the Farne Island.

Boundary data for the model were provided by sea level tidal oscillations derived from a satellite altimetry based global tidal model, and by output from a whole-Atlantic wave model. For calibration and validation, we used tide-gauge data from the UK sealevel recorder network, and wave data from buoys in the Moray Firth, Firth of Forth and Aberdeen Bay.

Our results show that the model was very successful at predicting the phase and amplitude of the major tidal harmonics in the region. The simulated wave fields were also a good representation of the observed data with respect to locally generated waves and waves propagating into the region from the Atlantic. However, the results show that there is a significant element of the eastern Scottish wave field which originates in the Arctic sector of the Norwegian Sea, that was not captured by our model boundary conditions.

Acknowledgements

The project is funded by the EPSRC TeraWAtt project

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Comparative toxicity of Nano- and Microscale Copper Oxide Particles in Two Marine Mussels

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Area being submitted to *General* science session.

Preferred presentation medium: Oral presentation

Are you a student? Yes

Copper oxide nanoparticles (CuO NPs) are one type of NP used in a wide variety of applications, for example, batteries, semiconductors, electronic chips, inks and heat transfer nanofluids. The growing use of CuO NPs has given rise to worldwide concerns regarding their environmental release, particularly to the marine environment.

The toxicity of CuO NPs on organisms and human health is poorly studied compared to other metal oxides such as ZnO or TiO2. Hence, it is essential to investigate CuO NP exposure, uptake and effects on key marine organisms, such as benthic filter feeders and compare their effects with those of CuO microparticles (MPs).

Very few studies have determined the effect of CuO NPs on mussels, and these have concentrated solely on oxidative stress and lipid peroxidation, but have not investigated DNA damage or cell viability. As CuO NPs are likely to agglomerate in seawater comparative toxicity data for copper oxide microparticles are lacking as well as their respective effects on filter-feeding marine mussels.

Two species of marine mussel (*Mytilus edilus* and *Modiolus modiolus*) were exposed to CuO NPs and CuO MPs at the following concentrations 5, 10, 15 and 20μgL^{-1} along with the control; for 72 hours. Endpoints studied included DNA stand breaks (Comet assay), cell viability (flow cytometry) and oxidative stress (superoxide dismutase (SOD) activity). The blue mussel, *M. edulis* was selected due to its wide distribution and sensitivity. The horse mussel, *M. modiolus*, was selected as a comparison, because of its ecological role in establishing biogenic reefs, which are increasing being classified as special marine features and require protection.

Results showed that both forms of CuO (NPs and MPs) can cause DNA damage in both types of cells (haemolymph and gill) for both mussel species in a concentration-dependent manner. Similarly, both forms of particulate CuO displayed the potential to decrease the cell viability in haemolymph cells for both mussel species. Both forms of CuO (NPs and MPs) have the potential to increase SOD activity, indication an induction of oxidative stress.

M. edulis is more sensitive to both CuO forms (especially MPs) than *M. modiolus*. These effects are influenced by many factors such as particle size, the length of the exposure, the soluble Cu in the medium and the accumulation of CuO particles in the species. Finally, these initial findings indicate that filter-feeding mussels are potential targets for nanoparticle exposure and suitable biomarker organisms in the marine environment.

Keywords: Copper oxide, nanoparticles, marine systems, marine mussel

Acknowledgment

I acknowledge supervisors Teresa Fernandes and Mark Hartl for the huge support. Also my funder for this project Jazan University, Jazan, Saudi Arabia.

Optimising holding conditions for lobsters to exploit a seasonal market

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Area being submitted to: 1) General science session
Preferred presentation medium: (i) oral
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The Scottish lobster fishery is an important part of the Scottish fishing industry, with the value of catches amounting £12 M in 2012 (Marine Scotland, 2013). They are caught for live sale using creel capture methods, which can be weather- and season-dependent. Although live lobsters (*Homarus gammarus*) are a high value product, the price fluctuates seasonally dependent on availability and demand (Figure 1). Therefore many fishers and merchants hold on to livestock to compensate for market fluctuations and typically hold them from the period of their greatest availability (mid-summer) to the time of greatest demand (around Christmas), when the product also attracts the highest price (Beard & McGregor, 2004).

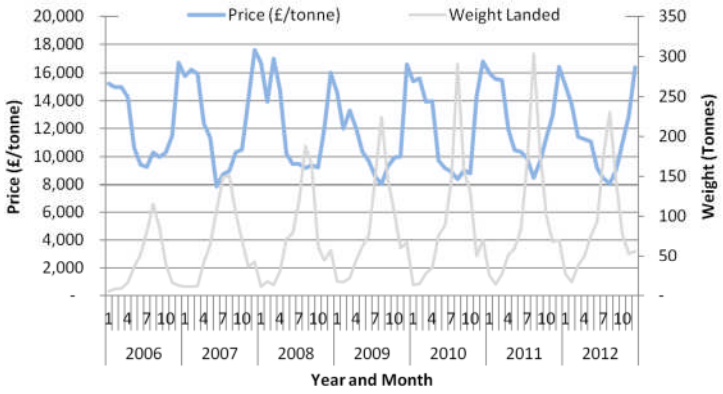

Figure 1: Monthly price and weight of lobsters (*Homarus gammarus*) landed into Scotland by Scottish vessels over the period 2006-2012. Source: Marine Analytical Unit, Marine Scotland.

There are no statutory regulations regarding the storage or transport of live lobsters and so fishers and merchants are not restricted by parameters such as water quality, stocking density or storage times during the holding period. This results in immense variation in holding conditions between facilities, the effects of which can be compounded by the relatively long times (up to 6 months) for which the lobsters are held. In the present study, the effects of holding temperature and feeding on the survivability, body condition and product quality of *H. gammarus* have been assessed over a 6 month holding period at St Abbs Marine Station. Locally creel-captured lobsters were held at 4, 8 and 12 ^{o}C (n=72) in flow-through systems, reflecting the length of time that lobsters are routinely held in the live trade. Half of the lobsters at each temperature were fed a maintenance diet of cooked mussel (*Mytilus edulis*) and the remaining half had feeding withheld, according to industry holding practices. Periodically throughout the holding period biometric measures were made and body condition was assessed from a range of haemolymph assays (Watts *et al*., 2014). At the end of the trial the animals were sacrificed humanely and tissue samples were taken to determine metabolite reserves and muscle composition, using both proximate analysis and proteomic methods. The results from this research will identify the optimal holding conditions for maximising survival, reducing the likelihood of bacterial diseases such as Gaffkemia and maintaining good product quality that can be used as a code of practice for the industry.

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Changing growth and maturation schedules of demersal fish in the Firth of Clyde

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Area: 1) General science session

Preferred presentation medium: (i) oral

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The abundance of large demersal fish in the Firth of Clyde has declined since commercial trawl fishing began in 1962. Two factors that may be partially responsible for this decline are changing growth rates and maturation schedules. These physiological traits are plastic, fluctuating with environmental conditions like food availability and temperature. They are also heritable, so can evolve in response to selective pressures. We use bottom trawl survey length-age-maturity data to calculate time series of von Bertalanffy growth parameters and PMRN maturity indices. These estimates are modelled against time and environmental variables to determine the amount of change that is ascribable to plastic responses and that which may be due to evolution. For haddock and whiting we find that – since 1980 – mean length at age has decreased substantially, with the older age groups being more strongly affected. There are also steep declines in the expected length at maturation for one year old fish. These trends are much steeper in the Clyde than elsewhere in the Scottish west coast. Temperature and population biomass fluctuations are not responsible for temporal trends in growth rates and maturation, so it appears as though these traits have evolved during the last few decades, contributing to the decline in the abundance of large fish.

Assessing cumulative pressures on priority marine features

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Area being submitted to General science session

Preferred presentation medium (i) oral

Are you a student? No

Marine environmental policy is an important aspect of the current European, UK and Scottish environmental agenda. The development of the Shetland Islands' Marine Spatial Plan (SMSP) was initiated by the Scottish Government in 2006. It has been utilised successfully as a tool to guide developers and others in putting their proposals for changes to existing uses (such as aquaculture and fishing) and introduction of new uses (such as expansion of ports, renewable energy and oil and gas infrastructure). Through policy, it provides suggestions, proposes directions and highlights opportunity for development. This paper explores the challenges of assessing cumulative pressure areas around the Shetland Islands, and spatial overlap with the Scottish Governments 'priority mean features'. Understanding cumulative pressures and their impacts is important consideration for both marine managers and developers, and is currently poorly addressed through policy. Cumulative pressure assessments can be used to targeted marine policies and help to achieve environmental targets such as 'Good Environmental Status' under the Marine Strategy Framework Directive.

Acknowledgements

We would like to acknowledge Marine Scotland for funding this work.