

**PORCUPINE CONFERENCE**  
**March 14/15 2020**  
**Scottish Association for Marine Science**  
**DELEGATE INFORMATION**  
**SPEAKER ABSTRACTS**



**Day 1: Saturday 14<sup>th</sup> March**

**Marine Conservation in Scotland – an overview**

Calum Duncan  
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Calum Duncan is Head of Conservation Scotland for the Marine Conservation Society, establishing the Scotland conservation programme for MCS in Edinburgh in April 2000. For over 12 years, Calum has also steered the Save Scottish Seas coalition of Scottish Environment LINK Marine Group members that campaigned to secure the Marine (Scotland) Act 2010 and subsequently for its delivery, including new Scottish Marine Protected Areas, a National Marine Plan and Regional Marine Plans. The MPA process highlighted the overlap with fisheries management, an area of work that MCS in Scotland has also been involved with.

As we enter a new decade, despite some welcome progress made on developing the MPA network, protecting the most vulnerable inshore MPAs and introducing the National Marine Plan, deadlines in 2010, 2015, 2016 and 2020 will have been missed to halt the decline of biodiversity, establish ecologically coherent MPA networks and ensure our seas are in Good Environmental Status. A series of reports in 2019 highlighted that we are in the midst of inter-linked climate, nature and ocean emergencies and that doing business as usual has led us to this point. The next decade must have ecosystem, including ocean, restoration at the core of all decision-making and nothing short of transformative change in how we do business in and around the sea, from fisheries and aquaculture management to plastics manufacture and transport, is needed to deliver that at the scale necessary. This talk will provide a snapshot of marine conservation in Scotland through the prism of the ocean crisis and the need to meet the latest Sustainable Development Goals, to which Scotland was among the first nations in the world to commit.

**The direction of seabed protection – a case study from Gairloch**

Nick Underdown, Head of Communication and Campaigns, Open Seas  
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In 1886 a decision was taken to prohibit the new technology of "bottom trawling" within our coastal waters. In 1984, following overfishing in offshore waters, this ban

was removed and bottom-trawling was allowed across the vast majority of the coastal zone - with a few small exceptions. Gairloch is one of these, an area where bottom-trawling has never been legal and where protection from dredging has been in place since 1983. Commercial and investigatory dives have found it to contain still active herring spawning grounds. However, reports from the local community indicate that illegal fishing has continued to take place in Loch Gairloch. We present evidence of illegal damage to the seabed gathered via dive investigations following reports of illegal fishing. We compare areas which remain intact with areas that have been degraded with a view to understanding the true cost of illegal fishing activity. The Scottish Government is undertaking a national review of the impacts of bottom-towed fishing on priority marine feature habitats. We consider what additional protection the review could deliver and its benefits to biodiversity and fisheries policy.

### **Successes and challenges for community-led Marine Protected Areas around Arran**

Lucy Kay  
MPA Project Officer, COAST

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The Community of Arran Seabed Trust (COAST), founded by two local Arran divers, worked with the Arran community to successfully campaign for protection of areas of sea around the Isle of Arran in the southern Clyde region. Their sustained efforts over many years resulted in the protection of the Lamlash Bay No Take Zone (NTZ) in 2008 and, following this, the designation (2014) and subsequent legal protection from mobile bottom fishing (2016) of a larger area of nearly 300km<sup>2</sup> as the South Arran Marine Protected Area (MPA).

To promote awareness and understanding about the marine life around Arran, Scotland and the UK, COAST established a marine discovery visitor centre (the Octopus Centre) where displays, activities and events connect people of all ages with the marine world and empower them to become involved with its protection. COAST has recently initiated an MPA Project to establish and implement an effective model for a community-led management plan for the South Arran MPA to inform future policy direction, secure long-term protection of the MPA and support sustainable use of the area that benefits the community on Arran and further afield.

The NTZ and MPA are providing a special opportunity to study seabed habitats and species populations in the areas protected from bottom-towed fishing gear. COAST has long-standing partnerships with a range of research institutes through which a variety of survey, research and long-term monitoring of the protected areas has been established. Results demonstrate how effective marine area protection enables remarkable biodiversity recovery.

Volunteers from the Arran community and further afield are crucial to the success of COAST, helping deliver many aspects of COAST's work including survey and research, running the visitor centre, delivering events and activities and raising funds for all aspects of our work. COAST is one of 16 locally-focussed, community-led groups in Scotland that are all working to secure healthy, well-managed seas, sharing ideas, knowledge, expertise and enthusiasm through the Coastal Communities Network (CCN).

This talk will present some of the findings of the research in the NTZ and MPA and discuss some of the ongoing challenges and opportunities to build on what has been achieved so far, and continue efforts to secure a sustainable future for the seas around Arran and in the Clyde.

COAST <https://www.arrancoast.com/>  
Coastal Communities Network <https://www.communitiesforseas.scot/about-the-network/>

### **A tale of two worms: ecological research in Scottish sea lochs, 1990-2009**

David Hughes  
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The sea lochs of the Scottish west coast support a wide range of seabed habitats and communities. Their calm, sheltered waters allow divers to carry out long-term observations and *in situ* experiments that would be difficult or impossible in more exposed conditions. This talk gives an overview of field studies based at the Scottish Association for Marine Science, extending over almost two decades, and focusing on two sea loch specialities – the burrowing echiuran *Maxmuelleria lankesteri* and the reef-building serpulid *Serpula vermicularis*. These two worms have very different lifestyles but both can be regarded as “ecosystem engineers” in their respective habitats. Both studies involved continuous video observations of behaviour extending over periods of weeks, along with manipulative experiments to quantify rates of sediment turnover, tube extension and degradation of relict tube debris. Results are assessed against the objectives of the original projects and gaps in our understanding of the ecology of the two worm species are highlighted.

### **The status and distribution of eyelash worms (Annelida: Polychaeta: *Myxicola* spp.) in UK waters**

**Teresa Darbyshire**  
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Amgueddfa Cymru-National Museum Wales investigated the distribution and identification of two distinct forms of the eyelash worm (*Myxicola* sp.) around the UK. Currently, only two valid species of *Myxicola* are recorded from the UK, *Myxicola aesthetica* (Claparède, 1870), a small species inhabiting crevices and algal holdfasts, and *Myxicola infundibulum* (Montagu, 1808), a larger species inhabiting soft sediment environments, often seen and recorded by divers. *Myxicola infundibulum* has a convoluted taxonomic history with around 17 other names currently synonymised under it and is recorded worldwide. The aims of this project were to use both molecular and morphological techniques to investigate specimens of both forms from different UK populations, determine whether or not they are the same species and map their distribution using photographs submitted by divers. At the same time, an updated description of *Myxicola infundibulum*, using new specimens collected from the type locality in the Kingsbridge Estuary in Dorset, will be produced to aid accurate future identification of 'true' *Myxicola infundibulum* and sequences obtained from other '*M. infundibulum*' populations outside of the UK will be used to indicate how genetically distinct the UK populations really are.

### **A review of the European species of Magelonidae**

Kate Mortimer-Jones, Senior Curator: Marine Invertebrates, Amgueddfa Cymru – National Museum Wales

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The Magelonidae is a relatively small family of marine annelids, with approximately 72 described species, easily recognised by their spade-like flattened head regions, giving rise to the common name—the shovelhead worms. In general, they burrow in muds and sands primarily in coastal regions and on continental shelves, although deep-water species are known. At present, nine magelonids are known to occur in European waters, including five British species. Although a partial review of the group was carried out in 2000, several species were in need of re-description and the distributions of others not well known. This review of all European species highlights recent taxonomic work carried out, including that based on *Magelona equilamellae* under the Roger Bamber Grant awarded by the society. Several species are now known to extend from Europe to Western Africa and a guide to all European species is given.

### **A celebration of 25 years of marine mammal research on the west coast of Scotland**

Pippa Garrard, Education Manager, Hebridean Whale and Dolphin Trust  
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The Hebridean Whale and Dolphin Trust (HWDT) is a marine conservation charity that has been leading the way for the conservation of cetaceans on the west coast of Scotland through robust long-term monitoring programmes for the last 25 years.

Through our community sightings network, HWDT has collated over 28,000 sightings records from 3,284 individual contributors. The launch of the Whale Track smartphone application and website in 2017 capitalised on technological advances in citizen science, providing a quick and convenient way for users to report sightings, doubling the rate of reports. Our research vessel, Silurian, has been monitoring cetaceans through dedicated visual and acoustic surveys using standard line transect methodology (Buckland et al., 2001), as well as photo-identification techniques, since 2003, generating one of the largest databases of its kind in UK waters. Silurian has travelled 112,707 kilometres, recording 33,514 animals during 14,337 sightings of 16 different species and collected over 6,000 hours of underwater recordings. Since January 2019, dedicated surveys have been conducted during the winter months, providing crucial year-round monitoring for the first time in our history. Our research has critically advanced the understanding of resident and migratory species in Hebridean seas, and has established the west coast of Scotland as one of the most important areas for harbour porpoise (*Phocoena phocoena*) in Europe (Embling et al., 2010; Booth et al., 2013). It has helped identify important areas contributing to the identification of Marine Protected Areas (MPAs) for harbour porpoises, minke whales and basking sharks and is being used to detect trends and changes in the marine environment, such as the increase in underwater noise pollution (Findlay et al. 2018) and monitoring emerging threats like entanglement. Long-term monitoring of this nature remains our priority, ensuring we can continue to provide the evidence needed to inform effective conservation measures.

### **Shallow shores and deeper depths: the challenges for citizen science data collection using SCUBA.**

Natalie Hirst, Seasearch Scotland and North East Coordinator  
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Seasearch works with volunteer divers to gather species and habitat data from around the UK. Utilising recreationally trained divers means Seasearch activities are limited to standard recreational diving depths down to 30m. However even depths of 20-30m towards the deeper extent of recreational levels can be challenging with additional factors such as reduced bottom time, gas mixes, and potential extra safety stops to think about whilst trying to record at the same time. This presentation looks at the challenges associated with data collection in deeper water and differences in the data collected at shallower depths down to 30m, and what explanation there may be for this and how we might improve our data collection from deeper waters.

### **Population trends for spiny lobster – how useful are occupancy models for benthic species?**

Angus Jackson  
Seasearch Data Officer

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Growing evidence makes it clear that distributions of species and patterns of diversity respond to natural conditions, stochastic processes, climatic change and exploitation by humans. These can have ecological or economic consequences. What is less clear is the consistency in response by different taxa e.g. whether ranges or abundance are changing in similar ways. Predictability of such changes and the broader implications are, as yet, poorly understood. Robust interpretations about population trends are needed to disentangle anthropogenic influences from natural processes and to inform appropriate management and conservation. Such interpretations require long-term data, collected in a consistent manner. In the UK, we are blessed with many dedicated volunteer naturalists that contribute to the collection of such datasets. Such datasets have a long history of use for terrestrial taxa, but less so for marine organisms. Seasearch is a project for volunteer scuba divers who have recorded and mapped distributions of benthic marine species and habitats around the British Isles and adjacent seas since the 1980s. This extensive, longterm dataset now exceeds 750,000 spatial records for benthic species. It may provide a powerful tool to assess changes in species' distributions. Using the most recent and powerful statistical tools (Bayesian occupancy models), I demonstrate that Seasearch records can identify robust population trends on a national scale. For large crustacea of economic importance, these trends differ among species and from country to country. Statistical tools, such as occupancy models, should become a valuable tool for those involved in management and conservation.

### **An observational comparison of Marine life on the exposed cliffs of the west coast of Orkney with that found on the wrecks in the Scapa Flow.**

Penny Martin, Amateur diver and citizen scientist  
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### **The occurrence and behaviour of harbour porpoises around Scottish salmon farms**

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The nature and extent of interactions between cetaceans and aquaculture are largely unexplored. Individuals may face a trade-off between potential benefits, such

as foraging opportunities, and the possibly negative consequences of exposure to industry activities. In Scotland, the expanding Atlantic salmon (*Salmo salar*) farming industry is mainly on the west coast, northern and western islands, waters that also host some of the highest densities of harbour porpoise (*Phocoena phocoena*) in Europe. The region's importance to the species was recognised by the designation of the Inner Hebrides and Minches Special Area of Conservation (SAC) in 2016.

The aim of this study was to determine when and how often porpoises approach fish farms within the SAC. Passive Acoustic Monitoring (PAM) for porpoise echolocation clicks was undertaken at seven fish farms between May 2018 and March 2020. Recordings were further examined to describe the fish farm soundscape by characterising sounds and signals emitted by industry activities. Fine scale movements of echolocating porpoises around farms were visualised using hydrophone arrays, and for the first time in Scottish waters, Baited Remote Underwater Vehicle (BRUV) and sonar techniques were used to survey wild fish aggregations around farms. Results indicate porpoises were frequently detected around salmon farms, and their presence may be dependent on both environmental and anthropogenic factors. Soundscape analysis revealed distinctive acoustic characteristics of activities such as fish feeding, electricity generators, acoustic deterrent devices (ADDs), and net cleaning.

The study ultimately presents multiple small-scale and site-specific examinations into the relevance of salmon aquaculture to harbour porpoises in Scotland, with an aim to inform management of the SAC and industry practices.

### **A very particular sea loch: 50 years (and more) research on Loch Creran, Argyll.**

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Loch Creran is a medium sized sea loch situated some 15 km north of Oban, where marine research has been conducted intensively since the 1960s by Heriot-Watt University, alongside SAMS and other Universities. L. Creran is particularly suited to scientific study, as it is a "Goldilocks" loch - not too big, not too small, not too deep, not too shallow, not too far North, not too far South. It encapsulates all the key features of a fjordic sea loch at a manageable scale, which is also accessible almost all the way round by road. In addition it supports or has previously supported many key human activities relevant to understanding human influences on fjordic systems, including fishing, recreational boating, commercial shipping, salmon aquaculture, shellfish aquaculture and an industrial plant, whilst its surrounds support commercial forestry and pastoral farming. Biological studies have included all levels of ecology, and have been enhanced by the presence of several different species which form biogenic reefs, including polychaetes and bivalves. The moderate depth range has facilitated studies using SCUBA diving from an early stage. This talk will aim to overview the development of our scientific understanding of this fascinating

loch, and then look at some recent research highlights before considering remaining questions and future issues.

### **Green turtle diet is dominated by seagrass in the Western Indian Ocean except amongst gravid females**

Stokes, H.J.<sup>1</sup>, Mortimer, J.A.<sup>2,3</sup>, Hays, G.C.<sup>4</sup>, Unsworth, R.K.F.<sup>1</sup>, Laloë, J-O.<sup>4</sup>, Esteban, N.<sup>1</sup>. Green turtle diet is dominated by seagrass in the Western Indian Ocean except amongst gravid females. *Mar Biol* **166**, 135 (2019).

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provide many important services

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Seagrasses are widely distributed marine flowering plants that provide many important services in habitats across tropical and temperate systems, including carbon sequestration, creation of nursery habitat, and sediment stabilisation. In tropical and subtropical regions one vital role of seagrasses is providing a food source for endangered sea turtles. Green turtles (*Chelonia mydas*) are marine megaherbivores and play a critical role in structuring seagrass meadows. Through their foraging activities, green turtles can increase seagrass complexity and resilience or conversely, reduce species composition and production rates. Green turtle diet has been well-documented across most ocean regions. In the Mediterranean, their diet is mainly seagrass-based but large amounts of macroalgae and animal matter have been recorded. To date, no detailed assessment of green turtle diet in the Western Indian Ocean has been published. Here we address this knowledge gap through the analysis of 54 immature and adult green turtle gut contents from the Republic of Seychelles, collected between 1982-1983 from Cosmoledo and Farquhar, between 2016-2018 from Desroches, and later examined at Swansea University in 2017-2018. To understand green turtle habitat requirements, we compared the amount and relative importance of diet items consumed and assessed the habitat at known green turtle foraging locations in the Western Indian Ocean. This was the first diet comparison of gravid females, males and non-breeding females from sites that provided both breeding and foraging habitat. Seagrass dominated male and non-breeding female diet, accounting for 95% of the mean gut content biomass, but only 58% for gravid females, along with relatively large amounts of substrate and macroalgae. Satellite tracking of post-nesting green turtles from Chagos Archipelago in 2016 located foraging sites at Farquhar Atoll that coincided with capture locations of adult turtles sampled there in 1983. In situ surveys of those sites in 2018 revealed extensive nearly monospecific beds of *Thalassodendron ciliatum*. The prominence of seagrass in the diet of green turtles and connectivity between foraging and nesting

habitats throughout the region illustrate the need to conserve and monitor seagrass habitats of the Western Indian Ocean especially in the context of changing green turtle population densities.

### **Limpet Studies**

Alison Nimmo and Fiona Sanderson

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We began a simple enquiry into rockpools almost two years ago. We wanted to look at the behaviour of some common rockpool dwellers and thought it would be fun to begin an enquiry based only on our own close looking at a small area of shore below the kirkyard at Warebeth, near Stromness, in Orkney, where both of us were living, at the time.

This very open enquiry considered periwinkles, whelks, limpets, anemones, barnacles and seaweeds in association. We investigated ways to safely mark the shells of some of these subjects for study, and various ways to record movement patterns. There was plenty for us to learn. For instance, over the course of the study so far, we have seen the disappearance and return patterns of whelks to a congregation site, and learned a little about the territorial behaviour of anemones, but we soon identified that limpet movements were giving us the most to think about.

Having settled on limpets, we investigated ways to mark and monitor limpet activity, particularly to see if they did always return to the same 'home scars'. At first we used photos and sketches for this. In the first week of monitoring, we saw considerable switcharounds in limpet positions within a cluster, and wished that we could see what was happening underwater, during the tide, as well as after it.

We invested in a 'gopro' camera which could film underwater. We then experimented with ways to fix the camera on to the rock bed of the shore, so that we could build up a film archive of a particular cluster of common limpets.

We now have many of these films! We've shown them locally to the Orkney Field Club, to family groups during the Nature Festival, and taken the films to other islands too, as well as sharing them with Co-Coast.

These events convinced us that a wide range of audiences can be engaged to think more about rockpool life, and more generally, the intertidal zone, tides, and climate affect.

The Field Club funded some sound recording equipment, including hydrophones, so that we could listen in to the rock pools too.

Hearing limpets grazing, on the move, is a very distinctive sound, and has been a great sensory addition to the limpet talks we've given.

Alison is now based in the Scilly Isles, and perhaps the next phase of the project is to try filming limpet behaviour there. It appears that limpet activity is quite varied, perhaps geographically, or perhaps local factors, like predation, play a part in this. There's still plenty for us to find out!

## **Day 2: Sunday 15<sup>th</sup> March**

### **The GRAB Trust: Beaches & Marine Litter Project**

Kerry Mackay, Beaches and Marine Litter Project Officer, The GRAB Trust

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The GRAB Trust is the Group for Recycling in Argyll & Bute. We have been working hard for over 20 years as a charitable social enterprise, to educate and promote waste reduction and responsible waste management.

The Beaches and Marine Litter Project was established to tackle the degrading and harmful issue of coastal and marine litter. Argyll & Bute has an extensive coastline, numerous islands and almost 80% of the population live within one kilometre of the coast. Marine Litter is unsightly and can cause extreme problems in and out of the water, for both people and wildlife. There are shocking stories of animals dying due to entanglement and ingestion, such as the stag on Jura.

To raise awareness and tackle this issue we provide fun educational workshops for groups and schools. Encouraging them to appreciate and take ownership of their local beaches, while learning how to reduce the amount of waste they create and recycle as much as possible. All litter is preventable, with Reduce, Reuse and Recycle an important part of this.

We also support community beach cleans with equipment that is free to borrow and have grant funding for groups for doing beach cleans. Participating in a local clean-up will help prevent litter from finding its way back or into the Marine environment. Join us on Sunday to learn more about our work and what you can do to get involved.

### **Differential Scanning Calorimeter as an assessment tool for estimating degradation rates of plastics in marine and freshwater environments**

Winter Dotto, MSc, Swansea University

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There is global concern over plastic pollution and its detrimental effects on wildlife as well as potential risks to human health. Specific monitoring protocols should be developed to monitor plastics in a range of environments. The differential scanning calorimeter (DSC) was used to test degradation of plastics. Polymers such as low-density polyethylene (LDPE), high impact polystyrene (HIPS) and polyethylene terephthalate (PET) were left to degrade for 6 months in freshwater and seawater

mesocosms; the same polymers were also left to degrade in real world conditions at Swansea Marina. The onset oxidative temperature (OOT) of these polymers was determined with the DSC and compared to control samples to investigate the rate of degradation. Depth, polymer type and conditions were significant factors affecting degradation. OOT of LDPE and HIPS polymers were significantly different in comparison to control samples with a plausible model to determine rate of degradation and “ageing” of plastics.

### **Trans-Atlantic rafting – American bivalves on British shores**

Anna Holmes, Bivalve curator  
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Non-native bivalves are washing ashore in Britain and Ireland attached to plastic waste items.

These invading tropical molluscs are riding the Gulf Stream from the warm Caribbean and are thrown onto our beaches after rough weather. Of the species found so far there is a known invasive species among them and so they need to be monitored.

Most records of rafting bivalves are from the SW and W coasts of Ireland and the SW of England and there are a few records from Scotland but here is a distinct gap in the data for Wales. I am setting out to rectify this and encourage as many people who already go out on surveys, walks, tours and beachcleans to look at the larger plastics on the beaches to see if these west Atlantic invaders are attached and how they can identify and record them.

### **Macroalgal Blooms: Is the Sustainable Harvesting of Opportunistic Macroalgae a Solution For Associated Ecological, Social and Economic Problems?**

Catherine Oliver<sup>1</sup>, Pippa Moore<sup>1</sup>, Andrew Woolmer<sup>2</sup>, Jessica Adams<sup>1</sup>

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Eutrophication, coupled with the reduction of herbivorous grazers from marine, coastal and estuarine ecosystems can cause unwanted macroalgal blooms globally. Opportunistic macroalgal blooms (predominately *Ulva* spp.) are increasingly becoming a problem in Milford Haven Estuary, southern Wales, UK, where the waterbody has recently been classified as ‘unfavourable status’ in the European Union Water Framework Directive. This project aims to assess: A) the biomass in the

estuary; B) affected habitats and species; C) nutrient sequestration; D) macroalgal species composition and E) socio-economic costs related to public goods and services. The project is working alongside GreenSeas Resources, a company who intend on sustainably harvesting macroalgal blooming species in the estuary. The methods include satellite and aerial mapping of biomass hotspots; bird ethogram surveys; crustacean surveys; infauna sampling and macroalgal clearance experiments which will be coupled with socio-economic surveys to create a mixed-methods approach. Preliminary data from Unmanned Aerial Vehicles (UAVs) have been used to create models of macroalgal bloom hotspots which can be used to calculate the biomass available for sustainable harvesting. It is hoped that removal of macroalgae via harvesting may be able to translate into a local nutrient trading scheme due to *Ulva* spp. having the capacity to sequester excess nutrients and heavy metals. Furthermore, findings from this project will be globally relevant.

### **Seagrass restoration – the next chapter**

Sam Rees, Seagrass Research Technician, Swansea University  
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In March 2019 funding was set in place for a two year project so restore 2Ha of seagrass, with a focus on community engagement. The site of Dale Bay, Pembrokeshire was selected, using a novel approach to seed planting using biodegradable materials (Unsworth et al, 2019). This talk will outline the trials and tribulations experienced by the project in its first year from initial start up to the planting of the first hectare of seagrass

### **Scotland's blue carbon: the contribution from seaweed detritus**

Alasdair O'Dell, PhD student at the Scottish Association for Marine Science  
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The term blue carbon refers to the carbon stored by coastal marine vegetation such as mangrove forests, seagrass beds and salt marsh systems. Until recently, seaweed has been omitted from blue carbon reports mainly because in-habitat burial of carbon is precluded in rocky areas. Seaweed beds in Scotland are areas of high productivity and provide a large number of ecosystem services. While carbon storage within seaweed beds is minimal, the potential for long-term carbon storage comes from the production and fate of seaweed detritus. This project aims to monitor and estimate detrital production in Scotland, produce decomposition rates for important species in Scotland and use biomarkers to estimate sediment contribution from seaweed. Overall, the project seeks to better understand the role that seaweed plays in long term carbon storage. This talk gives an overview of seaweed as the 'elephant in the blue carbon room' and showcases the experiments conducted so far in this PhD.

## **The copepod *Calanus finmarchicus* in a changing world**

Kim Last, SAMS  
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Biological clocks are biochemical and molecular oscillators that cycle with solar time and are adaptive at orchestrating future activities. Such biological (circadian) clocks are also present in the marine copepod *Calanus finmarchicus*, where they underpin daily and seasonal behavioural/physiological rhythms associated with diel vertical migrations. However, with climate change, these copepods are extending their habitat ranges northwards tracking isotherms into different light environments, thereby potentially altering clock function and phenology. Behavioural, physiological and genetic data collected along latitudinal gradients, from Loch Etive to north of Svalbard, has revealed unexpected variability in behaviour and circadian clock gene expression suggesting adaptation potential. Ultimately, understanding zooplankton responses to climate change is required in order to predict future changes in ecosystem function and biogeochemical cycling.

## **Fish-jellyfish interactions: The good, the bad and the overlooked.**

Donal Griffin, Queen's University, Belfast Bsc (Hons), MSc & PhD Researcher  
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Fish and jellyfish interact in a range of ways, many of which contribute to fish stock success. Yet, historically the ecological relevance of jellyfish has often been neglected beyond their role as stressors to the marine environment.

This commonly resulted in a gross over-simplification whereby jellyfish were included in ecosystem and fisheries models as a single functional group, feeding at the same trophic level over time. However, this issue is becoming less common as more and more studies have accounted for jellyfish complexity, yet many data gaps persist as to their true trophic role within marine food webs.

Using a multidisciplinary approach, we investigated the net impact of jellyfish on fish communities in the Irish Sea, and the potential for researchers to do the same in marine systems all around the world.

## ***Population viability and resilience of bottlenose dolphins (*Tursiops truncatus*) on the east coast of Scotland***

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The small, demographically-isolated population on the east coast of Scotland is subject to a number of anthropogenic pressures and is protected by the Moray Firth Special Area of Conservation. Long-term, high-quality photo-identification data have been collected for three decades that allow detailed analysis to estimate population dynamics parameters. Sighting histories of well-marked individuals were analysed using mark-recapture models to estimate survival rate and annual abundance of the east coast population. Survival rates remain high and the population was shown to be increasing over time (by nearly 5% per year). A population viability analysis (PVA) was developed using general life history parameters published for the species and vital rates derived for the population in question. This predicted an growth rate of 1.7% (SD = 0.021) and a final population size of 1256 individuals (SD = 178) after 100 years. A sensitivity analysis of model input parameters identified sex ratio at birth, fecundity, mortality of adult females, calf mortality across the first three years of life and age of first offspring in females to all strongly affect population growth rate. By modelling catastrophic events on the simulated population, a resilience framework was constructed to demonstrate the relative effects of frequency, mortality and reproductive success on population growth rate, likelihood of decline and probability of extinction. Results suggested that the timeframe of reoccurrence of disasters may be more influential than the magnitude of effects on survival or reproduction. Various anthropogenic pressures were shown to depress growth rate, the most severe of which (-350% change; 36% probability of extinction) was caused by a succession of simulated harmful algal blooms. This work updates key population parameters in light of new data and provides the most up-to-date PVA for this population, examining population dynamics under different scenario.

#### **Films during breakout sessions:**

##### **Dynamic Earth – ATLAS project**

<https://www.dynamicearth.co.uk/learning/atlas>

ATLAS is a trans-Atlantic research project funded by the EU under the Horizon 2020 Blue Growth call. It aims to increase our understanding of deep Atlantic marine ecosystems and their connections with other areas. ATLAS will also improve our ability to predict how changing environmental conditions might affect them. The information gathered will allow ATLAS to inform scientists, governments and businesses on the best ways to protect these ecosystems from issues such as climate change, pollution and certain fishing techniques. This knowledge will support sustainable growth in the marine and maritime sectors.

Engaging the public with the outcomes of ATLAS is a key part of the project and with this in mind, Dynamic Earth, an Earth and Environmental Science educational charity based in Edinburgh, worked with the ATLAS researchers to create an Outreach Educational Portfolio. The portfolio was designed to increase ocean literacy and covers many ideas and concepts related to deep sea ecosystems and exploration, including ROV technology, taxonomy, pressure in the deep, biodiversity, threats to coral reefs and ocean acidification. This programme of activities formed the basis for

Dynamic Earth's 2019 public engagement programme in Edinburgh, at regional science festivals across Scotland and events across Europe, directly engaging over 32,000 members of the public in ATLAS-related deep-sea activities. All of the resources are freely available for use through the ATLAS website and each activity comes with an explanation of the background science, full instructions, kit lists and curriculum links.

For more information please go to <https://www.eu-atlas.org/>, follow @eu\_atlas on twitter or contact [Natalie.walls@dynamicearth.co.uk](mailto:Natalie.walls@dynamicearth.co.uk).

The team from ATLAS were unable to attend, but we will be showing a film of some of the ROV research which will be playing during the breakout sessions.

They have provided us with some 3-D headsets for delegates to use to see some of the videos of the research cruises that are available on YouTube.

Delegates should use the YouTube app on their phones and there will be a table of headsets with instructions on their use for anyone who would like a go!

#### **Argyll Hope Spot – information from the website:**



Thanks to coastal communities around the Argyll coast who care passionately about the marine environment, we are able to celebrate the recognition of the first Mission Blue Hope Spot in Scotland and mainland UK. This new Hope Spot joins an impressive and growing number around the world.

Collectively, Hope Spots can help to protect and restore marine biodiversity on a local, regional, national and international scale.

The Hope Spot is a community-led initiative. Its designation is a celebration and recognition of the world-class natural riches of this part of Scotland's coast. For generations these have sustained the coastal communities scattered across this beautiful and diverse landscape. Let's make sure they continue to do so far into the future.

Mission Blue Hope Spots are a catalyst to greater understanding, appreciation and protection of our marine environment, and they have a global reach. By highlighting Argyll's world-class marine life, Scotland's first Hope Spot will increase the area's appeal to visitors, benefiting local businesses, including sustainable fishermen.

The Hope spot is championed by 4 of the members of the Coastal Communities Network – namely:

CAOLAS  
CROMACH

Save Seil Sound  
Friends of the Sound of Jura

Further details about the work they are doing can be found on the Coastal Communities Network website - <https://www.communitiesforseas.scot/network-membership/>

### **Kelp, kelp, glorious kelp**

#### **Andy Jackson**

As a mark of respect for the late film-maker Andy Jackson, we wanted to show at least one of his pieces. And what could be more suitable than a short sequence he created, in his own words “on behalf of our kelp forests and all the animals that depend on them”. He wanted this to be used in social media in opposition to the proposals to harvest kelp by dredging.

#### **HISAC**

A local dive club showcasing some of their activities in the local area.

One of their members will be at the conference to provide more information.