Tracking fishing activities in small scale fisheries

Tania Mendo[1*], Sophie Smout[12], Tommaso Russo[3], Lorenzo D'Andrea[3], Mark James[1]

1. *Scottish Oceans Institute, University of St. Andrews. East Sands, Fife UK, KY16 LB*
2. *Centre for Research into Environmental and Ecological Modelling, School of Mathematics and Statistics, University of St Andrews, The Observatory, Buchanan Gardens, St Andrews, Fife, UK, KY16 9LZ*
3. *Laboratory of Experimental Ecology and Aquaculture, University of Rome Tor Vergata, Rome, Italy*

**tm96@st-andrews.ac.uk; 0044 (0)1334 463457*

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Increased positional data of fishing vessels have allowed great progress in identification of fishing grounds, effort, and impact to habitats. Experiences with VMS and AIS systems fitted on large scale fishing vessels have shown that in order to identify when and where fishing activities are occurring, fisheries-specific approaches need to be developed based on the fishing practices of each fleet. In Small Scale Fisheries (SSFs), vessels have generally been exempted from these reporting requirements, but recent technological developments towards smaller low-cost systems that can easily be fitted on smaller fishing vessels have opened new possibilities in monitoring SSFs. Ideally, to identify fishing activities, positional records should be collected with a sufficiently high frequency to ensure all fishing behaviours can be detected. The objective of this study were to i) evaluate the optimal temporal resolution of positional data records in a small-scale fishery using pots and traps to identify fishing activities and ii) to determine the spatial distribution of fishing activities at scales relevant to management. However, because of the size of the SSF fleet (e.g. >70% of European Union's active vessels), emphasis is given in discussion to deliver the best compromise between the computational demands of processing large amounts of data and the identification of fishing activities. On-board observers recorded GPS position and concomitantly recorded which activity (hauling of creels, deployment and steaming to and from fishing grounds) was occurring during each trip. The original data points were then progressively 'thinned' to suggest an optimal range of polling interval, where computational requirements were tractable but also the inferences matched the original observer records in identifying the number and location of hauls, the distance covered during hauling, and a fishing pressure indicator for the distribution of fishing activities (Indicator 5 within the Data Collection Framework). Hidden Markov models (HMM) that take speed and turning angle into account were used to identify fishing activities and then generate fine spatial maps depicting the location of fishing activities. The models performed very well in identifying the location of fishing activities (<5% error rate compared to observer data). Our results show that the location of, extent, and potentially also the effort expended in fishing activities can be mapped at a fine spatial scale, offering real benefits for SSF management.

Use of otolith chemistry to understand the scaling of population processes

Thomas Régnier[1], Fiona M. Gibb[1] and Peter J. Wright[1]

[1] *Marine Scotland Science, Marine Laboratory, 375 Victoria Road, Aberdeen, AB11 9DB, UK* T.Regnier@marlab.ac.uk

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Understanding fish dispersal and connectivity is a prerequisite for the effective management of fish stocks by advising on the relevant spatial scale for assessment, and the implementation of fishing closures.

Otoliths can be a useful natural tag as they grow continuously throughout the life of a fish and their chemical composition is influenced by their habitat. When coupled with information on age from daily increments, changes in the otolith chemical fingerprint can be used to infer fish movements and connectivity within the lifetime of individual fish.

Connectivity is best estimated by comparing chemistry in equivalent parts of the otolith from the same year-class, thus allowing post dispersed individuals to be assigned to sampled sources. However, as marine fish larvae are subject to very high mortality, it is difficult to track all possible larval sources through to the juvenile stage using this approach. Consequently, an alternative approach has been developed that infers the number of contributing larval sources from a cluster analysis of the early otolith chemistry. The number of these natal clusters in different settlement grounds is then used to infer the spatial scale of larval dispersal. Using such an approach with Random Forest Clustering we have applied this method to a forage fish (the lesser sandeel, *Ammodytes marinus*), a commercially important gadoid (cod, *Gadus morhua*) and a deep-sea fish (the roundnose grenadier, *Coryphaenoides rupestris*).

In sandeel, the otoliths chemistry of settled juveniles sampled across 8 grounds included within 3 management areas revealed that recruitment within each management area relied upon distinct larval sources. In cod sampled across the whole North Sea, Northern, Central and Southern larval sources were identified showing limited mixing between the Northern and Southern components. Finally, in the roundnose grenadier sampled on the Western shelf edge and the Rockall trough, the results suggest that the population present around the Rosemary bank seamount is isolated from the two other sites sampled.

The relevance and the need to reform current spatial management measures for these species is discussed in the light of the information obtained from otolith chemistry.

Clustering "port production footprints" to inform fisheries management: A case-study of the UK shellfish sector

Helen Cross[1], Mike Bell[2], Dimitris Christopoulos[3]

[1] *Edinburgh Business School (EBS), Heriot Watt University, Edinburgh* – Helen.Cross@ebs.hw.ac.uk
[2] *International Centre for Island Technology (ICIT), Heriot Watt University, Orkney*
[3] *Edinburgh Business School (EBS), Heriot Watt University, Edinburgh*

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Can UK 'port production footprints' (landing portfolios) be used to inform fisheries management plans? This paper explores a new approach to managing fisheries which looks beyond grouping UK ports by regional affiliations, to instead grouping ports according to catch composition.

The proposed British exit from Europe affords an opportunity to re-design our fishing systems for effective and flexible governance[1]. With current aspirations to ground decision making at a local-levels (in terms of controlling allowed species, catch-quotas and entry into fishing grounds) our aim in this paper, is to consider how fisheries management might benefit if landing portfolios rather than regional spatial geographies were driving fisheries dialogue and decision making. The paper uses the UK shellfish sector as a case-study.

UK shellfisheries comprise smaller local inshore vessels (operating typically within six nautical miles) and offshore trawl or dredge activities, undertaken by larger (sometimes nomadic) fleets. Most shellfish species are not currently subject to a quota system. But change is expected as local engagement with research into spatial stock structure is likely to inform future quota management and the scales at which it may be applied. Aspirations to control fishing ground access are also evident, as is a movement to extend a definition of 'the inshore' to twelve nautical miles.

This work draws upon existing 'UK sea fisheries landing statistics' updated annually by the Marine Management Organisation (MMO) [4]. Shellfish landings are isolated from pelagic and demersal data, with events attributed to more than five-hundred ports along the UK coast. Each port is located within one of twenty-five fishing areas. These include RIFGs in Scotland (n=5); IFCAs in England (n=10), regional groups in Wales (n=3); the Crown Dependencies (n=2) comprising the Channel Islands (Jersey, Guernsey, Isle of White, Sark) and the Isle of Man; and Northern Ireland (n=1). Landings are attributed to either small or larger- scale fleets; mobile or active gears.

Shellfish catch is differentiated into groups comprising clams, cockles, crabs, cuttlefish, lobsters, mussels, Nephrops, octopus, oysters, periwinkles, razors, scallops, shrimps (prawns), squid and whelks.

The analysis uses clustering, devised from 'port production footprints' of shellfish catch. Coupling clustering with information derived from existing regional management plans, inferences are made concerning future trajectories for key ports sharing similar 'production footprints'. This exploratory research seeks to identify a typology of UK shellfish production ports, which might develop management strategies tailored to their landing portfolios.

Powers to manage inshore fisheries are recognized as being disparate across the UK[2, 3]. England's 'Inshore Fisheries and Conservation Authorities' (IFCAs) retain significant statutory and legislative authority compared with the advisory position of Scotland's 'Regional Inshore Fisheries Groups' (RIFGs). This paper explores methods of traversing the 'management barriers' which regional governance currently upholds and seeks to identify: i) strategies through which the UK shellfish sector might develop greater autonomy and ii) scales at which these strategies would be most beneficial.

References

[1] Phillipson, J. & D. Symes (2018). 'A sea of troubles': Brexit and the fisheries question. Marine Policy, 90: 168-173.

[2] Msomphora, M.R. (2016) Conflict resolution and the delegation of authority in fisheries management: The case of the Outer Hebrides Inshore Fisheries Group. Marine Policy 73: 263-275

[3] Pieraccini, M. & E. Cardwell (2016) Towards deliberative and pragmatic co-management: a comparison between inshore fisheries authorities in England and Scotland. Environmental Politics 25 (4): 729-748.

[4] Accessed-Online: https://www.gov.uk/government/collections/uk-sea-fisheries-annual-statistics

Modelling changes in Functional Maturity of Scottish European Lobsters (*Homarus gammarus* L.) stocks from 20 years of commercial catch data

M T Coleman[1,2], M C Bell[1]

[1] *International Centre for Island technology, Heriot-Watt University, Orkney– mtc2@hw.ac.uk*
[2] *Orkney Sustainable Fisheries Ltd., Orkney*

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Within Scotland, European lobster *H.gammarus* is the target of a high value, socioeconomically important fishery to remote coastal communities with ~1,200 tonnes landed annually, with a value of ~ £11 million at first sale (Scottish Government, 2017). Stocks of *H.gammarus* are assessed by Marine Scotland Science for twelve stock assessment areas. Of these, four stocks are classed as being overexploited, three as partially/fully exploited and four as stock statues unknown (Mesquita *et al*, 2017). However the robustness of these assessments depends on our understanding of stock dynamics and biological parameters at appropriate geographical and temporal scales. Key knowledge gaps relating to fundamental biological characteristics of *H.gammarus* still exist, most importantly in relation to size at maturity (SM). With SM being the size at which individuals begin to reproduce and hence contribute to future recruitment prospects, this size also has a strong bearing on the size at which individuals can be harvested without damaging spawning potential. Marine Scotland Science have collected data on size frequency in catches of *H.gammarus* over the last 20 years within each stock assessment area, recording also the presence of and seasonality of gravid (egg bearing) females. Such information can be used to indicate functional maturity SM in data-poor fisheries, based on the linkage between mature gonads and the presence of gravid females in the population (Waddy and Aiken, 2005). Recent studies on American lobster *Homarus americanus* have identified declines in SM in both American (Le Bris *et al.*, 2017) and Canadian (Haar *et al*., 2017) stocks over a similar time period, with both fishing and temperature being identified as the primary drivers. The potential for similar declines to have occurred in Scottish stocks is therefore high and if unaccounted for could potentially lead to erroneous perception of stock status.

This study is the first to provide SM estimates for many of Scotland's *H.gammarus* stocks through modelling the presence of ovigerous of females in catch samples using a maximum likelihood approach that considers the influence of both functional maturity and spawning frequency at size. We also investigate whether changes in SM have occurred over the last 20 years, potentially driven by fishing pressure and increases in temperature.

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References

HAARR, M. L., SAINTE-MARIE, B., COMEAU, M., TREMBLAY, M. J. & ROCHETTE, R. (2017). Female American lobster (Homarus americanus) size-at-maturity declined in Canada during the 20th and early 21st centuries. Canadian Journal of Fisheries and Aquatic Sciences, 75, 908-924.

LE BRIS, A., PERSHING, A. J., GAUDETTE, J., PUGH, T. L. & REARDON, K. M. (2017). Multi-scale quantification of the effects of temperature on size at maturity in the American lobster (Homarus americanus). Fisheries Research, 186, 397-406.

MESQUITA, C., DOBBY, H. & MCLAY, A. (2016). Crab and lobster fisheries in Scotland:-results of stock assessments 2000-2012. Scottish Marine and Freshwater Science, 7, 76.

SCOTTISH GOVERNMENT. (2017). Scottish Sea Fisheries Statistics 2016. Pp 114.

WADDY, S. L. & AIKEN, D. E. (2005). Impact of Invalid Biological Assumptions and Misapplication of Maturity Criteria on Size-at-Maturity Estimates for American Lobster. *Transactions of the American Fisheries Society*, 134**,** 1075-1090.

Ship Noise Playbacks Impact Norway Lobster Development

Bolger, E. L.[1], Briers, R.[1], Hartl, M. G. J.[2] and Diele, K.[1,3]

[1] *School of Applied Sciences, Edinburgh Napier University, Edinburgh, UK – edward.bolger@napier.ac.uk*
[2] *Centre for Marine Biodiversity & Biotechnology, Institute of Life & Earth Sciences, School of Energy, Geoscience, Infrastructure & Society, Heriot-Watt University, Edinburgh*
[3] *St Abbs Marine Station, St Abbs, UK*

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Low-frequency sound levels (10 - 500Hz) in the oceans have increased by at least 100-fold globally over the last century, predominantly caused by growth in commercial shipping. This has lead to concern over potential impacts on marine fauna and international legislation, e.g. the Marine Strategy Framework Directive which requires EU member states to ensure that anthropogenic noise levels in the oceans do not adversely affect the environment.

The effects of underwater noise on marine invertebrate larvae, often regarded as population bottlenecks, are unknown for most species.

In 2017, we conducted a controlled laboratory experiment to investigate whether and how ship noise, played back throughout the larval development the commercially important Norway Lobster *Nephrops norvegicus* (L.) affects its development (zoea stages I, II and III). Three sound treatment groups (n=82 each), emulating different levels of shipping activity were compared:

* T1 'Busy' treatment: frequent ship noise playback with regular timings
* T2 'Occasional' treatment: less frequent ship noise playback at randomized intervals
* T3 'Ambient' treatment: constant ambient sound exclusive of any ship noise (Control)

At ZI stage, neither T1 nor T2 affected development time to the next stage in comparison to the control. However, the duration of ZII was significantly longer ($p < 0.05$) in the 'Busy' treatment than the other two treatments. The duration of ZIII was significantly longer in the 'Occasional' group than in the other two treatments ($p < 0.01$). We also observed carry-over effects of noise impacted larvae: First stage juveniles of both 'Busy' and 'Occasional' treatment groups showed significant reductions in escape response stamina compared to the control (33% and 46% reduced tail flicking stamina respectively, $p < 0.05$).

Our results are the first to our knowledge to demonstrate that anthropogenic noise has can both prolong the zoea larval phase *and* reduce anti-predator escape response stamina of decapod crustaceans. In the wild this would likely increase the risk of predation and could lead to reduced recruitment to the commercially important adult population.

To further explore the link between ship noise and developmental impacts, we are now assessing whether an acute exposure to a ship noise playback increases the respiration rate and oxidative stress levels of *N. norvegicus* larvae and decreases larval quality. The response parameters are O_2 consumption (metabolic rate proxy) and SOD, TBARS, GPx, GSH (oxidative stress indicators). As a proxy for larval 'quality', we are conducting elemental combustion analysis to compare the molecular carbon and nitrogen content of ship noise exposed larvae with a control group.

We are further investigating whether any changes in these responses are mediated by pre-exposure to chronic ship noise over the course of the larval development. Evidence of tolerance build-up would indicate that this species could be more resilient to noise pollution than suggested by short-term experiments.

Our findings so far underline the need to investigate the responses of invertebrate larvae to noise to allow predictions of the effects of the effects of this stressor on respective populations. A wider range of ecologically/commercially important invertebrate species since it is unlikely that results can be reliably extrapolated between species.

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Restoration of a keystone species: Understanding the settlement behaviour of the European oyster *Ostrea edulis*

Ana Rodriguez-Perez[1,2,3,4], Mark James[2], David Donnan[4], Theodore B. Henry[1], Lene Friis Møller[5] and William G. Sanderson[1,3,4]

[1] *Centre for Marine Biodiversity & Biotechnology, EGIS, Heriot-Watt University, Edinburgh, UK – ar62@hw.ac.uk*
[2] *Scottish Oceans Institute, University of St. Andrews, East Sands Fife, UK*
[3] *St Abbs Marine Station, St Abbs, Scottish Borders, UK*
[4] *Scottish Natural Heritage, Perth, UK*
[5] *Danish Shellfish Centre, DTU Aqua, Technical University of Denmark, Denmark*

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The European native oyster *Ostrea edulis* once formed extensive beds that constituted a central resource. Ecologically, they were biodiversity hotspots that mediated effective coastal ecosystem functioning, while harvesting of *O. edulis* contributed to food security and spurred local economies. Yet, intense overfishing in the 19th century, combined with more recent stressors such as coastal development and disease outbreaks, led to these beds being functionally extinct[1]. Today, several European countries are trying to restore *O. edulis* to recover the ecological functions which, as a keystone species, it once provided in our marine environment. Its beds have therefore become the focus of conservation and restoration efforts in the North-East Atlantic.

To maximise the success of current restoration efforts it is crucial to understand the settlement behaviour of *O. edulis* larvae. This can inform selection of settlement substrates that will maximise recruitment of young *O. edulis* spat from newly restored oyster beds. In addition, it enables fine-tuning of larval dispersal models, aimed at designing networks of restoration sites which can promote larval recruitment and connectivity between restored beds. This is because larvae can prolong their planktonic duration, and thus influence their overall dispersal, if suitable settlement sites are absent[2]. Although there have been several studies in the past investigating settlement of *O. edulis* larvae, their prime aim was to improve settlement in hatchery conditions, i.e. producing individually settled oysters sold for commercial consumption. Yet, to inform restoration efforts, there is a need to further our understanding of the settlement behaviour of this species under natural scenarios.

In the present study, mature *O. edulis* larvae were presented with a range of settlement substrates which could be either expected under natural scenarios or laid into the sea to encourage larval settlement if adequate substrate is missing. The hypothesis was that these substrates would differ in their potential to induce settlement. Larval behaviour was subsequently monitored over a 74h time period. We show marked differences in the proportion of larvae settling, but crucially also in the time it took larvae to start metamorphosing. We discuss the implications of these results for planned restoration efforts and propose future research directions that settlement experiments could take to further our understanding of the settlement inducers and preferences in this species, therefore improving the prospective success of *O. edulis* restoration efforts in the North-East Atlantic.

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References

[1]Beck, M.W., Brumbaugh, R.D., Airoldi, L., Carranza, A., Coen, L.D., Crawford, C. *et al.* (2009). Shellfish reefs at risk: a global analysis of problems and solutions. Nature Conservancy.

[2]Coon, S., Fitt, W. & Bonar, D. (1990). Competence and delay of metamorphosis in the Pacific oyster Crassostrea gigas. Marine Biology, 106, 379-387.

Distribution, density and size of deep-sea sponge morphotypes in the Faroe-Shetland Channel (FSC) Sponge Belt Nature Conservation Marine Protected Area (NCMPA)

Georgios Kazanidis[1], Johanne Vad[1,2], Lea-Anne Henry[1], Francis Neat[3], Bee Berx[4], Konstantinos Georgoulas[1], J Murray Roberts[1]

[1] *Grant Institute, School of Geosciences, University of Edinburgh, UK- georgios.kazanidis@ed.ac.uk*
[2] *Centre for Marine Biodiversity and Biotechnology, Heriot-Watt University, UK*
[3] *Marine Stewardship Council, UK*
[4] *Marine Scotland Science, UK*

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Sponges are common members of several marine benthic communities. When found in high densities, they play a very important role in the functioning of shallow-water ecosystems e.g. in the elemental cycling (de Goeij et al. 2013). However, available information about the distribution of sponge aggregations in the deep sea, their role in the structure and functioning of deep-sea ecosystems as well as the role of environmental parameters in shaping the population dynamics of sponge aggregations, is very limited (Beazley et al. 2015; Cathalot et al. 2015; Kazanidis et al. 2016, 2018). The Faroe-Shetland Channel (FSC) Sponge Belt Nature Conservation Marine Protected Area (NCMPA) constitutes a biologically-diverse area in the deep North Atlantic and it covers an area of 5,278 km^2. In the present study we examined 465 images from 13 video transects within and outside the NCMPA. Image analysis included the characterization of the substrate, grouping of sponge morphotypes in five categories (encrusting/excavating, arborescent, massive/spherical/papillate, flabellate/ caliculate and stipitate/clavate), and measurements of sponge size. Distribution of sponge morphotypes was also examined in relation to environmental parameters like depth, type of substratum, temperature and salinity. The sponge aggregations were mainly composed from massive and flabellate sponges. The density of sponges had its maximum values within a relatively narrow zone between approx. 480 and 530 m. Preliminary modelling work (redundancy analysis, RDA) has also provided important information about the role of water mass properties in the distribution of sponge aggregations in the NCMPA. This study has improved our understanding about the distribution of sponge aggregations in the deep North Atlantic in relation to environmental variability contributing to the implementation of efficient management strategies for these fragile aggregations.

References

Beazley, L., Kenchington, E, Yashayaev, I. and Murillo, F.J.2015. Drivers of epibenthic megafaunal composition in the sponge grounds of the Sackville Spur, northwest Atlantic. Deep-Sea Research I, 98, 102-114.

Cathalot, C., van Oevelen, D., Cox, T.J.S., Kutti, T., Lavaleye, M., Duineveld, G. and Meysman, F.J.R. 2015. Cold water coral reefs and adjacent sponge grounds: hot spots of benthic respiration and organic carbon cycling in the deep sea. Frontiers in Marine Science, 2, doi: 10.3389/fmars.2015.00037.

De Goeij, J.M., van Oevelen, D., Vermeij, M.J.A., Osinga, R., Middelburg, J.J., de Goeij, A.F.P.M. and Admiraal, W. 2013. Surviving in a Marine Desert: The Sponge Loop Retains Resources Within Coral Reefs. Science 342, 108-110.

Kazanidis, G., Henry, L-A., Roberts, J.M. and Witte, U.F.M. 2016. Biodiversity of *Spongosorites coralliophaga* (Stephens, 1915) on coral rubble at two contrasting cold-water coral reef settings. Coral Reefs, 35, 193-208.

Kazanidis, G., van Oevelen, Veuger, B. and Witte, U.F.M. (in press). Unravelling the versatile feeding and metabolic strategies of the cold-water ecosystem engineer *Spongosorites coralliophaga* (Stephens, 1915). Deep-Sea Research I, https://doi.org/10.1016/j.dsr.2018.07.009

The UK MPA network: a check on progress and priorities moving forward

Emma Novak[1]

[1] *Joint Nature Conservation Committee*, *Inverdee House, Baxter Street, Aberdeen, AB11 9QA,* emma.novak@jncc.gov.uk

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Marine Protected Areas (MPAs) are a tool used worldwide to protect a variety of marine species and habitats including those which are particularly rare or important from damaging human impacts. The designation of MPAs in UK waters over the last few decades works towards the achievement of national and international obligations such as Aichi target 11 under the Convention on Biological Diversity and OSPAR commitments to implementing an ecologically coherent and well managed network of MPAs in the North East Atlantic. The ultimate aim of the UK MPA network is to promote 'clean, healthy, safe, productive and biologically diverse oceans and seas' for future generations. So how are we doing and are we achieving these goals?

The UK seas are home to diverse marine habitats such as beautiful cold-water coral reefs which thrive at depths of over 2000m and shallow-water sandbanks which provide a foraging habitat for bird and marine mammal species. Currently there are 299 UK MPAs covering approximately 24% of the UK marine environment. Designation of these is just one step in the progress towards an ecologically coherent and well managed network.

Assessments such as management status reports to OSPAR can help to ascertain how effective management is within MPAs and further work is ongoing on how management effectiveness can be achieved. Questions arising around the management of MPAs include the inclusion of these in wider management and planning such as regional Marine Spatial Planning. Moving forward we need to seek opportunities for cost-effective monitoring to better inform our management decisions and to better understand the effects of human activities on marine ecosystems. We will also take the opportunity to reflect upon the priorities and outcomes which came out of the JNCC Beyond the Coast conference as identified by experts across the field. Other priorities are beginning to be explored such as better quantifying the benefits MPAs serve to society and capturing these within natural capital frameworks.

Collaboration across a range of stakeholders is crucial in the provision of conservation advice and development of effective management within these areas to ensure that they deliver the desired conservation objectives. In order to advance UK knowledge and understanding of marine ecosystems, their function, condition, interactions with human activities and to meet the conservation challenges, collaborations with MASTS world-class academics and researchers will be key in the next steps towards achieving effectively managed MPAs for the conservation of the UK's marine environment.

This presentation will aim to provide an update on the current UK MPA network progress, priorities when looking to the future and to explore opportunities for us to better achieve a coherent and effectively managed MPA network across the UK marine environment.

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