

Exploring Scotland's marine biodiversity in the genomics era

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Molecular data has transformed our understanding of biodiversity by providing greater power for species discovery and delimitation and for identifying adaptive variation. In particular, the advent of next-generation sequencing and large genome-wide datasets provides new insight into biodiversity patterns and processes at the ecosystem, species and genetic level. Here, I demonstrate how genome-wide nuclear markers can i) improve phylogenetic resolution in taxonomically challenging groups and ii) along with machine learning can aid in detecting past and future climate-linked loss in economically vital species. I then discuss the future application of these methods for exploring Scottish marine biodiversity, with a focus on intertidal invertebrate communities that are especially vulnerable to climate change impacts. This work highlights the importance of 'big data' for improving fundamental biodiversity knowledge and it has important implications for combatting the global biodiversity crisis.

Twitter: @molluscular

Tweetable abstract: This year at #MASTSasm2020 you'll learn about how genome-wide data improves our understanding of biodiversity at the level of ecosystem, species and gene, and how these approaches will help us to conserve and protect Scotland's unique #marine #biodiversity.

Area being submitted to (delete as appropriate): *1. General Science Session*

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The Scottish Shelf Waters Reanalysis Service – a 25 year Scottish Shelf Model hindcast

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Area being submitted to (delete as appropriate): 1. General Science Session

Are you a student? (Delete as appropriate): No.

Twitter feed:

Come and hear about the new 25-year hindcast of the Scottish Shelf Model (SSM). We will describe the data product and give the audience insight into what the hindcast can be used for, enabling users to realise the full potential of the SSM and the available model outputs. #MASTSasm2020.

The Scottish Shelf Model (SSM) is a numerical hydrodynamic model covering the Scottish continental shelf waters. The highly complex Scottish coastline and bathymetry require the circulation in coastal and inshore areas to be modelled at a high-resolution. The SSM has an unstructured computational grid enabling Scottish coastal waters to be highly resolved where necessary.

One of the most recent SSM data products, to be released in November 2020, is the Scottish Shelf Waters Reanalysis Service (SSW-RS; <https://sites.google.com/view/ssw-rs/home>). The SSW-RS will provide a 25 year (1993-2017) hindcast model run, including variables such as hourly horizontal current velocities and water elevation fields as well as daily mean files of three-dimensional currents, temperature and salinity, all on the original unstructured model mesh. The reanalysis is forced using data from the Copernicus Marine Environmental Monitoring Service (CMEMS) and the output will be freely available for download by the UK marine science community and industry.

This presentation will demonstrate the data product and give the audience a brief insight into what the reanalysis can be used for (e.g. particle tracking, oil spill modelling, connectivity studies, forcing smaller local models, etc.). By showcasing the SSW-RS and how it can be used for a range of applications, we hope to inspire and/or educate fellow

scientists/researchers and industry, enabling users to realise the full potential of the SSM and the available model outputs.

References

J Wolf et al. (2016) The Scottish Shelf Model. Part 1: Shelf-Wide Domain. Scottish Marine and Freshwater Science Vol 7 No 3

10 years of the annual Shetland inshore fish survey: trends, insights, and implications for regional management

Shaun Fraser¹, Chevonne Angus¹, Connor Wood¹, and Kirsty Laurenson¹

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Area being submitted to (delete as appropriate): 3. *Governing Scottish Seas: theory, practice and future horizons*

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The annual Shetland inshore fish survey undertaken by @NAFCShetland has completed its 10th year, Shaun Fraser presents results and discusses implications for the regional management of fish stocks #MASTSasm2020 #NAFCResearch #UHIResearch

Inshore fisheries are an economically and culturally important part of many coastal communities. However, inshore fish stocks are often poorly understood and can be vulnerable to human impacts and environmental change. The establishment of Regional Inshore Fisheries Groups in Scotland is part of an increasing emphasis on the importance of local fisheries management. However, there is a lack of information on the abundance and distribution of fish species in the nearshore environment. To better understand inshore fish populations, sufficiently long timeseries at a suitable spatial resolution are required and are currently lacking in many areas.

The annual Shetland inshore fish survey was established during 2011 in response to information received from industry of particularly high numbers of juvenile cod on inshore fishing grounds. The survey has since been undertaken annually during August and September using the 12 m MFV *Atlantia II* (LK 502). This year marked the 10th consecutive year of the survey. Standardised scientific trawling gear and fishing methods have been used to target demersal fish species. In recent years the survey has been further enhanced by an extended survey design which targets potential nursery grounds in shallow areas to collect additional information on juvenile fish. Catch rate results are used to investigate the relative abundance of fish species by considering catch per unit effort. Length data are used to further interpret variations in population structure and recruitment of commercial species.

Trends are presented which provide an up-to-date and independent source of information on the present

relative abundance and recruitment of fish species in the nearshore waters around Shetland and contextualise these results within the inter-annual trends in catch rate and size composition from 10 continuous years of available survey data. Results are compared with local industry experience and also with larger-scale surveys such as the ICES International Bottom Trawl Survey. In some cases, trends from the Shetland inshore fish survey align closely with local industry perceptions and yet contradict international stock assessment data. The detailed data on inshore fish species provided additional opportunities, for example in investigating the diet and foraging behavior of other larger marine animals.

Incorporating new data sources for successful regional management of fisheries requires a flexible approach and collaborative attitude from regulators. Support to industry initiatives and to inshore survey activity can provide timely and practical additional sources of information to help inform a more local approach to stock assessment. The continuation of fine-scale fish surveys is recommended and adds increasing value to existing datasets.

Acknowledgements

Thanks to the many contributors, both past and present, to survey work aboard the MFV *Atlantia II* and to data management at the NAFC Marine Centre. Financial support from the Shetland Islands Council and the Shetland Fish Producers Organisation is gratefully acknowledged.

Towards a holistic marine litter regime: Gaps and challenges in the current political framework

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An estimated amount of 4.8-12.7 million tonnes of marine plastic litter is introduced into the marine environment each year. Marine litter impacts many marine species from mammals to corals and commercial fish and shellfish. Moreover, marine litter is damaging marine industries, repels tourists, is costly for local authorities and a potential human health threat. Most marine litter is plastic and stems from land-based sources. On the international, regional, and national level, many voluntary and legally binding efforts have been conducted to prevent, reduce, and remove marine litter from the environment. However, the current political regime is fragmented and lacks a holistic approach that covers both land-based and sea-based sources strategically. Under this background, the implementation and extent of legal instruments to combat marine litter are being investigated in two case studies, Scotland, and South Korea. For both countries, estimations on the annual flux of marine litter exist, and the governments have developed strategies and measures to address marine litter. With the comparison of both approaches and a literature review, gaps in the current approach are revealed. Results show that limited and inconsistent monitoring methodologies, uncertainties in the pathways of litter in the environment, hidden mismanaged plastic waste through exports and a general failure to address plastic consumption and correct disposal hinder the successful prevention of marine litter. Recommendations to overcome existing gaps and challenges are proposed. A new Global Plastic Treaty is proposed that could achieve a transition towards a circular economy and a holistic marine litter regime.

Twitter abstract:

The implementation of legal instruments to combat marine litter is being investigated in two case studies. Results show uncertainties, gaps and a lacking connection to plastic consumptions hinder the prevention of marine litter. A new Global Plastic Treaty is proposed that could achieve a holistic marine litter regime.

Area being submitted to (delete as appropriate): *1. General Science Session / 3. Governing Scottish Seas: theory, practice and future horizons*

Are you a student? (Delete as appropriate): Yes (University of Edinburgh, MSc Marine Systems and Policies)

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This template is an example of how to prepare an abstract for the 2020 MASTS Annual Science Meeting, to be held online during the week of **5-9 October 2020**.

Please note that abstracts should be broad and applicable to a wide audience.

Please provide an additional tweetable abstract first (max. 280 characters) to assist online promotion. #MASTSasm2020.

If you are on twitter please provide your twitter handle @someone. Don't worry if you are not on twitter as you will still be named.

The full abstract should be submitted to masts@st-andrews.ac.uk, in an editable format, by 16:00 Friday 14th August 2020.

Abstract authors who are selected to give a 5-6 minute flash-talk at the ASM will also be asked to provide a 30-60 second pre-recorded video abstract of their talk for promotional purposes.

The title should be typed in font Arial 14 pt bold.

The Authors' names should be typed in Arial 9 pt, with the presenting Author underlined.

The Authors' affiliations should be typed in Arial 8 pt italics. The email address of the

presenting Author is requested, and he/she will be referred to also as the Corresponding Author.

The main text should be typed in Times New Roman 10 pt.

A brief paragraph with acknowledgements may be added at the end of the main text.

A limited number of citations in the text are allowed, and the relevant list of references should be added at the end of the abstract. The references should be typed in Times New Roman 9 pt.

For consistency, please do not exceed one page in this format.

Acknowledgements

All the Authors are kindly thanked for having submitted an abstract formatted according to this template.

References

Authors (Year). Title. Journal title, number (issue) and page numbers.

Detecting floating macroplastics in coastal waters using high resolution satellite data.

Lauren Biermann¹, Dan Clewley¹, Ben O'Driscoll², Victor Martinez-Vicente¹, Tim van Emmerik³, Davida Strett⁴, Yangrong Ling⁴, Ellen Ramirez⁴, Juan Velasco⁴, Mary Crowley⁵ and Nikolai Maximenko⁶

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Area being submitted to: 4. Multiple Marine Stressors;

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Global plastic production has increased exponentially in the last few decades, with 359 million metric tons manufactured in 2018 alone. Europe was responsible for nearly 20% of this production, but half of all plastics collected here for 'recycling' were exported to China and SE Asia instead. Each year, through complicated networks and land-based sources across the globe, millions of tons of plastic waste enter the ocean, adding pressure to our increasingly stressed marine systems.

Methods for detecting and monitoring plastic litter by satellite are new, but well placed to fill gaps between limited in situ observations and global models. We demonstrate how optical data acquired by the European Space Agency (ESA) Sentinel-2 satellites were used to detect aggregations likely to include floating macroplastics across four coastal sites, including the east coast of Scotland (Biermann et al., 2020). Aggregated materials were detectable and identifiable on sub-pixel scales using a Floating Debris Index (FDI) and spectral signatures, respectively. A Naïve Bayes machine learning approach then allowed for automated discrimination of detected macroplastics from natural sources of floating debris, including seaweed, driftwood, pumice, and sea foam. Across study sites, suspected ocean plastics were classified as such with an overall accuracy of 86%.

Next steps include extending our libraries and algorithms for plastic detection and monitoring in rivers, highly turbid coastal waters, and the open waters of the Great Pacific Garbage Patch (GPGP). Importantly, we will be trialing a new data driven approach to atmospheric correction for Sentinel-2 and other high resolution sensors, including Worldview 3. We will present some of our early, promising results.

Each year, millions of tons of #plastic waste enter our marine ecosystems. We show that floating plastics can now be detected using high-res optical data collected by the @CopernicusEU #Sentinel2 satellites & discriminated from natural debris using machine learning. #MASTSasm2020

@LaurenBiermann

The full abstract should be submitted to masts@st-andrews.ac.uk, in an editable format, by **16:00 Friday 14th August 2020**.

Abstract authors who are selected to give a 5-6 minute flash-talk at the ASM will also be asked to provide a 30-60 second pre-recorded video abstract of their talk for promotional purposes.

Acknowledgements

We acknowledge and thank the European Space Agency for funding and supporting our present and future work, as well as all members of the GIANT Ocean team for their contributions to the work ongoing over the North Pacific Gyre.

References

Biermann, L., Clewley, D., Martinez-Vicente, V. et al. Finding Plastic Patches in Coastal Waters using Optical Satellite Data. *Sci Rep* 10, 5364 (2020). <https://doi.org/10.1038/s41598-020-62298-z>

Masks on the beach: The impact of COVID-19 on marine plastic pollution

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Area being submitted to (delete as appropriate): 1. *General Science Session*;

Are you a student? (Delete as appropriate): No.

The production and use of personal protective equipment (PPE) like masks and gloves has skyrocketed around the world as a result of the COVID-19 pandemic. While PPE is important for protecting people from the virus, the incorrect disposal of single-use plastic PPE has led to a noticeable surge in plastic pollution, most notably in our oceans and waterways. This paper explores this phenomenon. It begins with a review of recent literature on sources, the scale, and impact of marine plastic pollution in general. It then focuses on the increased use of PPE resulting from the pandemic and calculates estimates of the number (and weight) of single-use plastic face masks that have likely entered our oceans as a result. The paper concludes by surveying a number of recent innovative technological and design solutions to addressing the issue, as well as offering policy recommendations that can be adopted at both the individual and state level.

Tweetable Abstract:

Masks on the beach: The impact of COVID-19 on #MarinePlasticPollution



Billions of #SingleUsePlastic face masks will enter our #Oceans as a result of #COVID19 and they are already washing up on our beaches.

Paper by @OceansAsia1 @tealepb + Sam Cooke for #MASTSasm2020 @mastscot

People Ocean Planet

Leakey, Chris D.B.¹, Ladd-Jones, H.², McConnell, B.J.³, James, M.⁴

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Area being submitted to (delete as appropriate): 1. *General Science Session*

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Abstract for the 2020 MASTS Annual Science Meeting, to be held online during the week of **5-9 October 2020**.

Tweetable abstract: (max. 280 characters) to assist online promotion.

Our People-Ocean-Planet Initiative @OceanBehaviours shines a light on their approach to positive outcomes for the marine environment through behavioural insights. Motivate, socialise and ease the change with diverse collaborations. #MASTSasm2020 #MarSocSci #BehaviourChange

The full abstract should be submitted to masts@st-andrews.ac.uk, in an editable format, by 16:00 Friday 14th August 2020.

When we consider major challenges for the ocean environment, it's clear that the pace and magnitude of negative change often continues to outstrip the response of society. Scientists and environmental practitioners continue to improve impact on policy and industry. However, there is another major lever of change that remains relatively untapped: people.

MASTS new behavioural change initiative is not only complementary to policy and industry levers for change but interwoven with democratic processes of governance and the systems of business and supply chains.

This talk will shine a light on the how marine science and conservation can work through the lens of behavioural psychology and sociology, moving society towards positive tipping points that helps unlock wider, more systemic change.

The People Ocean Planet (POP) Initiative is seeking to develop new projects and welcomes approaches for collaboration. POP also provides a framework and

philosophy that others may use to extend their research or practice for behavioural change outcomes. We will also celebrate other relevant work within and beyond the MASTS membership, building a community for interdisciplinary action.

Acknowledgements

MASTS thanks its funding and supporting partners for their assistance in initiating People Ocean Planet. See www.peopleoceanplanet.com for details.