

# The effect of shellfish, kelp and sea grass beds on flood risk and coastal erosion in Scotland

## Section 1: Project Overview

### Introduction

The Centre of Expertise for Waters (CREW) wishes to commission a capacity building project within the Hydrological Extremes Coasts and Risks theme, aligned to natural flood management (NFM) and the second drafting of opportunity maps for NFM in Scotland (2023).

### Aim & key questions

The overall aim of this project is to inform whether shellfish (oyster and/or blue mussel beds), kelp and sea grass should be incorporated into NFM in Scotland and whether (and which) existing features should be protected or restored for NFM and coastal erosion mitigation.

The project is split into 5 proposed work packages (see Appendix A) with key questions to address.

#### Work Package 1

1. What is the current state of knowledge and data availability? (in relation to the effectiveness of marine habitats to reduce flood and erosion risk to adjacent shorelines)
2. What additional information can be sourced from relevant stakeholders including experts and policy-makers, especially with regards to recent developments and unpublished data?

#### Work Package 2

3. What marine habitats could be considered in the Scottish context to reduce flood and erosion risk? (*Drawing on existing knowledge from comparable marine habitats*)
4. What does the literature suggest regarding the role of different marine habitats in flood and coastal erosion mitigation and potential benefits and limitations? (*to include consideration of how the efficacy in reduction of flood / erosion risk may vary according to the life cycle of these habitats*)
5. What is the historic and current distribution of native oyster beds, blue mussel beds, kelp and sea grass beds in Scotland?
6. How are these habitats subject to commercial fishing or harvesting practices in Scotland and are there future plans to expand commercial exploitation of these habitats?

#### Work Package 3

7. Which existing marine habitats are most likely to reduce flood risk and erosion to adjacent shorelines in Scotland?

#### **Work Package 4**

8. What plans currently exist and what are the costs for planned restoration of these features in Scotland? (to include consideration of *where there are future plans to expand fishing or harvesting of these features*)
9. Which areas/locations in Scotland could be targeted to reduce this risk, and/or are there sites where existing features could be protected or restored to reduce risk? (to include consideration of *current fishing or harvesting practices and how these could be modified to maximise flood risk benefit*)
10. How can this be represented in form of a simplified map to inform stakeholders?

#### **Work Package 5**

11. What are the clear opportunities for protection, regeneration, and/or restoration of these habitats in Scotland and what recommendations can be given about how to design these features for flood and coastal erosion management? (*to include: location, size, density, closeness to the coast, etc. and how these could be modified for the purpose of flood management*)

### **Background & knowledge gap**

The work has relevance to multiple policy areas, including those relating to flooding and coastal erosion, biodiversity, climate change, marine planning and ambitions for a blue economy (See Appendix B). Furthermore, the second drafting of opportunity maps for NFM (as required by the FRM Scotland Act 2009) will commence in January 2023. Relevant reports/studies are listed in Appendix C.

Marine features such as oyster, blue mussel, kelp and sea grass beds may provide some flood attenuation or coastal erosion benefit, but the mechanisms by which they perform this is little understood nor the extent to which they protect Scottish coastlines. The intention of the project is to fill gaps in knowledge around the role of shallow marine habitats in flood and coastal erosion mitigation in Scotland. It is not the purpose of the project to identify all marine habitats that provide such a function, as much is known about how other habitats can reduce flood and erosion risk, e.g. saltmarsh.

### **Anticipated impacts**

This project will enable us to optimise shallow marine features for flood risk and coastal erosion mitigation, thus helping to reduce flooding to coastal communities and increase resilience to future changes in risk. The primary beneficiaries of project outputs will be policy-makers and other public officials that lead or contribute to flood risk and coastal erosion management and/or shellfish and kelp/seagrass management and restoration in Scotland, e.g. SEPA, Local Authorities, Scottish Government, Marine Scotland, Naturescot, Scottish Association for Marine Science, academia and NGOs such as the Forth Estuary Forum. Longer-term benefits include the development of policy in relation to NFM that facilitates the management, restoration and protection of these marine features.

## **Deliverables**

### **Work Package 1**

- Stakeholder-specialist workshop
- Workshop report
- Work package 1 review discussion<sup>1</sup>

### **Work Package 2**

- Literature review (including grey literature; policy summaries)
- Data/evidence analysis (international, national, regional, and local scales)<sup>2</sup>
- Mapping visualisation
- Work package 2 review discussion

### **Work Package 3**

- Stakeholder-specialist workshop
- Work package 3 review discussion

### **Work Package 4**

- Mapping visualisation
- Work package 4 review discussion

### **Work Package 5**

- A final report of 20-30 pages, excluding annexes and the bibliography, that builds upon work packages 1-4 including:
  - A literature review
  - Brief summary of additional multiple benefits (e.g., carbon sequestration, water quality)
  - A concise set of recommendations
  - Cover image(s) with associated photo credits
- A plain English summary of aims and results (up to 1 page)
- Communications and impact plan – supported by CREW’s Impact Officer
- Website summary (200 words)
- Policy brief
- Work package 5 review discussion

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<sup>1</sup> Review discussions will include the CREW Project Manager and representatives of the project team and project steering group.

<sup>2</sup> Only Open Data sources should be used. If the only data available are subject to licencing restrictions, these should be clearly noted and discussed with the project steering group. Spatial data should be provided in shapefile format to INSPIRE metadata standards.

## Anticipated timescale

The project will commence in **February 2023** with the project deliverables signed off by the CREW Director by **February 2024**.

## Funding

The maximum amount of funding available inclusive of VAT (where applicable) is **£100,000**.

This includes an associated costs (excluding sub-contractor) budget of:

- £1000 for the start-up and end meeting project steering group room and equipment hire
- £2000 for the two project steering workshops room and equipment hire
- £1000 for travel and subsistence

## Section 2: Further information for applicants

### Project management

Day-to-day communication will be between the research/review team (the contractor) and a CREW Project Manager and is likely to involve short catchups as agreed.

### Project steering group

A CREW project steering group (PSG) generally include representatives of Scottish Government and its delivery partners plus a CREW representative. The PSG for CRW2022\_02 will include representatives of SEPA, NatureScot, Food Standards Scotland and CREW.

### Submitting a proposal

Please send a completed application form ([available here](#)) addressing the project requirements. A copy of expectations and the award criteria are provided below for reference.

Proposals need to be submitted to the Research Support Officer – Centres of Expertise ([Regan.Tammi@hutton.ac.uk](mailto:Regan.Tammi@hutton.ac.uk)) for evaluation **by noon on Wednesday 18<sup>th</sup> January 2023**. We aim to notify the successful bidder by **Friday 10<sup>th</sup> February 2023** and we may request a pre-contract meeting.

Please contact the Research Support Officer [Regan.Tammi@hutton.ac.uk](mailto:Regan.Tammi@hutton.ac.uk) if you would like any clarification on any of the above. You should highlight any potential conflicts of interest in your proposal. For queries about what may constitute a potential conflict of interest please contact the CREW Deputy Manager ([Nikki.Dodd@hutton.ac.uk](mailto:Nikki.Dodd@hutton.ac.uk)).

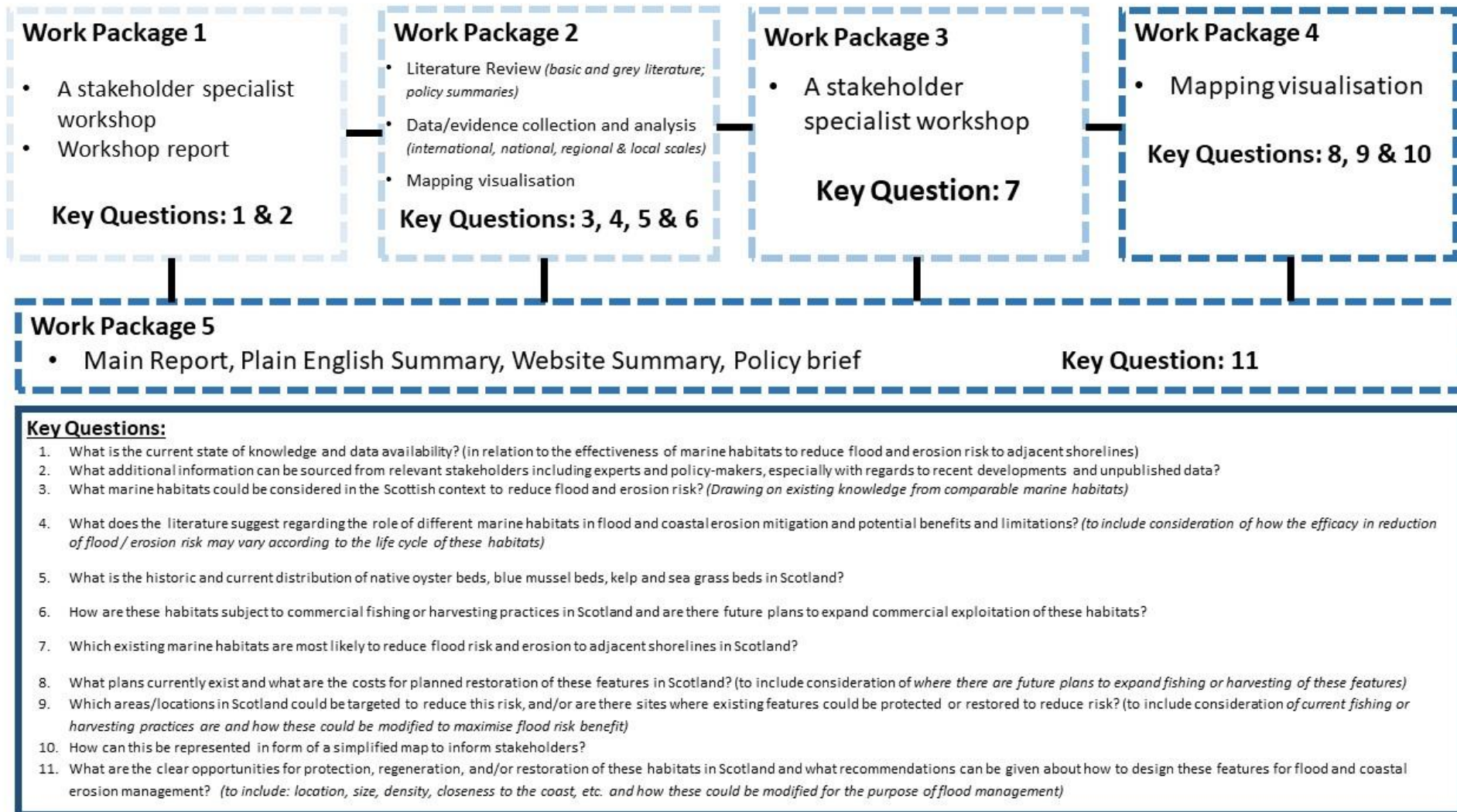
## Expectations

No.	Criteria	Descriptor
1	Duration	The proposed duration will align closely to the details provided in the anticipated timescales section of the specification.
2	Staff time and effort	The proposed allocation of staff time and effort is appropriate and includes all deliverables. The proposal must also provide a commitment that named staff members will be available to work on the contract if the bid is successful.
3	Project costs	The estimated breakdown of project costs is realistic and inclusive of all deliverables.

## Award criteria

No.	Criteria	Descriptor
1	Understanding the project ask and policy background	The proposal should include an introduction which demonstrates a clear understanding of the project requirements. This should include an understanding of the policy background and the supporting role of this project; the need for this research; the project aim; and how the proposal will address this aim.
2	Proposed methodology	The proposal should demonstrate a high quality and workable methodology, including: how the evidence will be identified, reviewed and assessed; consulting relevant stakeholders and/or experts where appropriate to address the key questions and produce the deliverables in the timescales required. It should explain the suitability, robustness and limitations of the proposed methodology.
3	Milestones	The project milestones are logical, practical and include all deliverables.
4	Project Management	The staff, resources and expertise are appropriate for conducting the proposed project. The proposal should name the project lead and outline their project management experience.
5	General and specific topic expertise and experience	The proposal should provide details of individual staff members who will work on this project and demonstrate how they will meet the project requirements, specifically: <ul style="list-style-type: none"> <li>- general research experience and expertise;</li> <li>- specific experience and expertise on the topic of marine habitats &amp; NFM.</li> </ul>
6	General communication and deliverables	The proposal should describe the approach to producing the deliverables, which will be published on the CREW website. It should detail who will take lead responsibility for report-writing and overall report quality. It should provide examples of previous literature reviews, reports, mapping visualisation and workshops in which they have been involved.
7	Quality assurance	The proposal should provide details of quality assurance procedures to demonstrate how the contract will be continuously delivered to a high standard. It should specifically address issues of quality control at different stages of the project, including evidence gathering, analysis and report writing. It should include a timetable for delivery of tasks, project milestones and allocation of staff and staff time against each task, covering the duration of the contract.
8	Risk	The proposal should provide a risk assessment matrix detailing any risks identified in relation to the delivery of this contract, and proposed mitigation measures to minimise their probability and impact, focused particularly on risk to completion on time.

## Appendix A. Work packages 1-5 and their associated deliverables and key questions



## Appendix B. Relevant policy areas

**Flooding and coastal erosion:** The [Flood Risk Management Scotland Act 2009](#) and supporting guidance place a requirement on responsible authorities to identify opportunities to protect or restore natural features to help mitigate flood risk. SEPA's soon to be published flooding strategy, further reinforces the importance of this approach while the [Dynamic Coast CREW project](#) has highlighted the growing importance of managing coastal erosion enhanced flooding. Research suggests that kelp, sea grass, blue mussel and native oyster habitats can help reduce flood risk and coastal erosion and could be an important tool in this regard. Flooding is likely to become more common place in coastal regions of Scotland due to more frequent and more intense storms. Scotland's west coast and low-lying islands are at particular risk from this storm related flooding, and it is here that these features may have the greatest benefit.

**Biodiversity and climate change:** There is clearly a role for protecting and/or restoring these shallow water habitats in addressing the twin crises of biodiversity loss and climate change. The value of these habitats is acknowledged in their multiple levels of protection as Priority Marine Features in [Annex I Habitats](#) and as [OSPAR Threatened and Declining Habitats](#). Marine features such as kelp can also help efforts to address the impacts of climate change by both sequestering carbon, increasing the resilience of our coastlines and providing ecosystem based adaptation. This work therefore has links to the various climate policies and strategies including [Scotland's Climate Change Adaptation Framework and Programme](#).

**Planning:** This work also has relevance to [Scotland's Marine Plan](#) which requires that development should be resilient to coastal change and flooding and protect the marine area.

**Economy:** The work also has relevance to emerging seaweed sector policy, where there is growing interest in [seaweed-based industries](#) and the ambitions set out in the [Blue Economy Vision for Scotland](#).

## Appendix C. Relevant reports and studies

Andersen, K. H., Mork, M., & Nilsen, J. E. Ø. (1996). Measurement of the velocity-profile in and above a forest of *Laminaria hyperborea*. *Sarsia*, 81(3), 193-196.

Angus, S. (2017). Modern seaweed harvesting and gathering in Scotland: the legal and ecological context. *Scottish Geographical Journal*, 133(2), 101-114. DOI: 10.1080/14702541.2017.1293839

Angus, S., & Rennie, A. (2014). An Ataireachd Aird: the storm of January 2005 in the Uists, Scotland. *Ocean & coastal management*, 94, 22-29.

- Brandon, C. M., Woodruff, J. D., Orton, P. M., & Donnelly, J. P. (2016). Evidence for elevated coastal vulnerability following large-scale historical oyster bed harvesting. *Earth surface processes and landforms*, 41(8), 1136-1143.
- Burrows, M. T. (2012). Influences of wave fetch, tidal flow and ocean colour on subtidal rocky communities. *Marine Ecology Progress Series*, 445, 193-207. DOI: 10.3354/meps09422
- Burrows, M., Fox, C., Moore, P., Smale, D., Greenhill, L., & Martino, S. (2018). Wild seaweed harvesting as a diversification opportunity for fishermen. [https://eprints.whiterose.ac.uk/137123/1/02376\\_WildWeed\\_Report\\_Clean\\_Issue.pdf](https://eprints.whiterose.ac.uk/137123/1/02376_WildWeed_Report_Clean_Issue.pdf) (Use Burrows, M et al., for distribution maps – they are (or were when published) some of the best available for kelp but still not altogether representative. The viewpoint about sustainability of the industry in Scotland is questionable.)
- Cefas contract report FC002I, Seaweed in the UK and abroad – status, products, limitations, gaps and Cefas role
- Christie, H., Kraufvelin, P., Kraufvelin, L., Niemi, N., & Rinde, E. (2020). Disappearing blue mussels– can mesopredators be blamed?. *Frontiers in Marine Science*, 550.
- Hamana, M., & Komatsu, T. (2016). Real-time classification of seagrass meadows on flat bottom with bathymetric data measured by a narrow multibeam sonar system. *Remote sensing*, 8(2), 96.
- Kelp Harvesting:  
<https://digitalpublications.parliament.scot/ResearchBriefings/Report/2018/11/12/Kelp-harvesting>
- Mork, M. (1996). The effect of kelp in wave damping. *Sarsia*, 80(4), 323-327.
- Native Oyster Restoration Projects: <https://nativeoysternetwork.org/restoration-projects-partnerships/>
- OSPAR Case report for kelp forest habitat, <https://www.ospar.org/documents?v=46871> and references therein.
- Proceedings of the 11th European Conference on Underwater Acoustics - Acoustic properties of macrophytes: comparison of single-beam and multi-beam imaging with modelling results. (PDF) [Acoustic properties of macrophytes: Comparison of single-beam and multibeam imaging with modeling results \(researchgate.net\)](#)
- Project Seagrass: <https://www.projectseagrass.org/>
- Seagrass restoration handbook: [https://catchmentbasedapproach.org/wp-content/uploads/2021/10/ZSL00168-Seagrass-Restoration-Handbook\\_20211108.pdf](https://catchmentbasedapproach.org/wp-content/uploads/2021/10/ZSL00168-Seagrass-Restoration-Handbook_20211108.pdf)
- Wild Seaweed Harvesting Strategic Environmental Assessment. Environmental Report November 2016. [ABPMER Wild Seaweed Harvesting: Strategic Environmental Assessment Environmental Report \(www.gov.scot\)](#) – see section 7.5 in particular
- Yesson, C., Bush, L. E., Davies, A. J., Maggs, C. A., & Brodie, J. (2015). Large brown seaweeds of the British Isles: evidence of changes in abundance over four decades. *Estuarine, coastal and shelf science*, 155, 167-175.