

Project Proposal Form – 2022 entry

Project Title	OU4 - Predicting the resilience of coastal habitats to climate change
University (where student will register)	The Open University
Which institution will the student be based at?	As above
If other	
Theme (Max. 2 selections)	Climate & Environmental Sustainability <input checked="" type="checkbox"/> Organisms & Ecosystems <input type="checkbox"/> Dynamic Earth <input type="checkbox"/>
Key words	Hydrology, biodiversity, vegetation, climate-change, water-regime, nature conservation
Supervisory team (including institution & email address)	PI: Prof D Gowing, Open University, d.j.gowing@open.ac.uk Co-I: Dr J Millett, Loughborough University, j.millett@lboro.ac.uk Dr Clare Lawson, Open University, clare.lawson@open.ac.uk Dr Stewart Clarke, National Trust, Stewart.Clarke@nationaltrust.org.uk
Is the project co-designed by a student?	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
Is the PhD suitable for part time study?	Yes <input checked="" type="checkbox"/> This is a requirement of NERC

Project Highlights:

- **Collaboration:** inform the long-term conservation strategy of the National Trust and work with a variety of other conservation organisations.
- **Fieldwork:** undertake fieldwork in some of the UK's most valuable conservation sites at coastal locations around the UK
- **Global issues:** address adaptation to future environmental change

Overview:

Freshwater coastal wetlands (such as dune 'slacks') are highly biodiverse and support many rare UK plant, invertebrate and vertebrate species. Their diversity is due to the key influence of groundwater and the hydrological regime of the soil. They are, however, severely threatened by human activities, in particular climate change and resulting sea-level rise. The extent of these habitats has declined by 30% at key sites, over 20 years. As a result, there is an urgent need to understand the potential impacts of future environmental change on these conservation-priority habitats.

Sea level is rising at 3 mm per year and the rate is accelerating. Future predictions have considerable uncertainty, but experts now believe the rise could exceed 1 m by 2100 (Bamber *et al.*, 2019.) In terms of coastal ecology, such a rise would have a huge impact on the coastline, and would extend inland due to groundwater dynamics being perturbed. This project aims to consider the impact of future sea-level rise on vegetation in freshwater coastal wetlands. freshwater coastal wetlands.



Organisations, such as the National Trust who would partner this project, need to take long-term decisions about the conservation management of habitats on their land. For the decision to be properly informed, the impacts of different sea-level-rise scenarios need to be considered. There is currently a lack of information about the water-regime requirements of some vegetation types that grow in groundwater-dependent terrestrial ecosystems and of the hydrological continuity of coastal groundwater systems. This project would build on a large data set of water-regime requirement information held by the Open University (www.floodplainmeadows.org) and upon the results of current PhD students who have investigated the hydrological regimes of sand-dune slacks (Loughborough University) and turloughs (Open University.)

The outputs of the study would directly inform the nature-conservation policies of the National Trust, who own over 750 miles of UK coastline including some of our most important areas for biodiversity.

Figure 1: *The fen orchid (Liparis loeselli); a rare species whose habitats include on coastal groundwater dependent systems. © Karen Wilkinson*

Alt text: *A photo of a flowering spike of the fen orchid within a dune-slack system, illustrating what may be lost by habitat change*

Methodology:

The main investigation will be fieldwork-based. It will involve multiple sites around the UK where both the botanical composition of the vegetation and the groundwater dynamics will be monitored. This will be supplemented by archival work to identify other appropriate sites that have existing botanical and/or hydrological information suitable for analysis. The third strand will be a controlled experiment looking at the effect of anoxia and salinity upon the interspecific competitive abilities of individual species that are key to the habitats under investigation.

Training and skills:

Students will be awarded CENTA2 Training Credits (CTCs) for participation in CENTA2-provided and 'free choice' external training. One CTC equates to ½ day session and students must accrue 100 CTCs across the three years of their PhD.

Some familiarity with the native flora would be an advantage, but full training will be given in botanical survey. Training in hydrological instrumentation, differential GPS and laboratory methods for nutrient and salinity determination will also be provided. The successful candidate should be numerate, but the Open University will offer assistance in using "R" for data analysis. The student will be located within a team of conservation ecologists, who will provide support with respect to accessing the literature and developing presentation skills. They will also attend regular internal forums to discuss initiatives in conservation science.

We are looking for an ecology, environmental science or geography graduate who is willing to travel around the UK to work on some of the most valuable coastal ecosystems in Europe. The student will work with the National Trust and other nature conservation organisations to produce high quality science that will have real, applied impact beyond academia

Partners and collaboration:

The studentship will be collaborative between Open and Loughborough universities. The key external partner will be the National Trust, who conceived the idea and have stressed its importance. The project will be guided by members of the Trust's technical advisory staff (Phil Dyke, Stewart Clarke) who will attend project meetings. As a CASE partner, the Trust will offer the successful candidate an opportunity to work with them for defined periods to develop their industry-relevant skills. The project will also collaborate with the British Geological Society (BGS) who have expertise and allied interests in groundwater systems.

COVID-19 Resilience of the Project:

The fieldwork aspects involve lone working in remote areas and therefore incur little risk of infection. Laboratory analysis would be largely solitary. Supervisions, training, and liaison with external organisations will be predominantly online. Some training will need to be face-to-face, but the work will be risk-assessed and account for vaccinations status, testing and PPE. Providing lone travel is permitted, this project should be little affected by future outbreaks. If travel were affected, existing data could be analysed during the restricted period. In worst case scenario (no travel, no face-to-face,) the thesis could be based entirely on secondary data.

Possible timeline:

Year 1: Literature review and consultation with stakeholders to determine the most appropriate sea-level-rise scenarios to consider and to identify the habitats of greatest concern. Study-site selection in collaboration with the National Trust, BGS, statutory conservation agencies and Wildlife Trusts. Installation of hydrometric equipment as required. Training and field experience of botanical survey.

Year 2: Detailed botanical and topographic surveys of chosen habitats at selected sites. Establishment of controlled-environment mesocosms for competition studies. Processing of extant hydrological data to elucidate groundwater dependencies. Work experience with NT.

Year 3: Further botanical survey where required. Downloading of all field instrumentation. Final harvests of controlled mesocosms. Analysis of field data. Submission of a journal article and presentation of results at an international meeting. Thesis planning

Year 4: Funding is available for 3.5 years and it is expected that the thesis can be completed within that period.

Further reading:

Bamber, J.L., Oppenheimer, M., Kopp, R.E., Aspinall, W.P. and Cooke, R.M. (2019) Ice sheet contributions to future sea-level rise from structured expert judgment PNAS, 116, 11195-11200; doi: 10.1073/pnas.1817205116

Esteves, L.S., 2013. Is managed realignment a sustainable long-term coastal management approach? J. of Coastal Research, 65, 933-938. doi: 10.2112/SI65-158.1

Silvertown, J., Araya, Y. N. & Gowing, D. J. (2015) Hydrological niches in terrestrial plant communities: a review. *Journal of Ecology*, 103, 93–108

Further details:

Please contact **Prof. David Gowing** (david.gowing@open.ac.uk) for further details.

Applications should include:

- an academic CV containing contact details of three academic references
- a CENTA application form, downloadable from: [CENTA application](#)
- and an Open University application form, downloadable from: [Home OU application form](#) (if you are resident in the UK) or an [Overseas OU application form](#) (if you are an international applicant).

Applications must be sent to STEM-EEES-PHD@open.ac.uk by Friday 7th January 2022 (12 pm, noon)