Modelling the effect of predicted sea-level rise on coastal conservation habitats using GIS.

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Global average temperatures have increased by about 0.6°C (± 0.2°C) during the 20th century, and are projected to increase by 1.4 - 5.8°C by 2100 (IPCC, 2001a). The relationship between atmospheric warming and sea-level rise (SLR) is well understood, and this change is predicted to lead to SLR of up to 1m by 2100, creating consequences for coastal communities and environments worldwide (IPCC, 2001b).

Ireland is characterised by a dominance of settlement in coastal areas, with approximately 30% of the population living within 1-2 km of the coast (Devoy, 2000). Population in these areas is predicted to grow by at least 20% by 2020 (Stationery Office, 2002). The likely consequences of population increase are being planned for in the context of National Development initiatives, and the significance of rising sea levels as an additional pressure on coastal land resources is receiving increasing attention (Shannon Development, 2002). However, SLR exerts pressure on natural environments also. International studies such as the Millennium Ecosystem Assessment identify Climate change as a principal driver in the loss of biodiversity worldwide (Millennium Ecosystem Assessment, 2005).

The conservation of Biodiversity has become an integral part of development legislation globally. Natura 2000 forms the centrepiece of nature & biodiversity policy in the EU (EU, 1979 & 1992), setting a framework for an EU-wide network of nature protection areas. Member states are legally obliged to protect biodiversity in these areas, and are subject to monetary penalties if they fail to do so. The total area of the Natura network sites in Ireland is 9,344km^2, representing almost 14% of the total land surface. Additional areas that are deemed to be worthy of conservation are covered by other national designations, and by regional plans such as the county Clare Biodiversity Action Plan (BAP) (Clare

County Council, 2003). The Clare BAP has necessitated a broad inventory of all aspects of natural heritage in County Clare. This has included inventories of Natura 2000 sites and Nature Reserves, and has recently been extended to detailed surveys across extensive areas along the coast of the Shannon river estuary. Protected habitats in these areas will be subject to SLR influence up to 2100.

The Shannon is the largest river, and the largest river estuary in Ireland. Since estuaries are predominantly sedimentary environments, characterised by shallow horizontal gradients, they are particularly sensitive to changes in sea-level. When topographical sensitivity, the existence of conservation designations and increasing coastal development pressure are considered together, the Shannon estuary can be considered as one of Ireland's more sensitive coastal locations to future SLR.

This study focuses specifically on the development of methods for modelling the impact of future Climate changes on selected habitats along the Shannon estuary up to 2100. Coastal inundation models are being established using Geographic Information Systems (GIS). Predictions for a range of SLR scenarios are being based on Intergovernmental Panel on Climate Change (IPCC) predictions for best case, best guess and worst case SLR up to 2100. The additive influences of natural isostatic change (Devoy, 2000) and coastal storm surges are also being considered.

The generation of meaningful inundation prediction maps presupposes the existence of reliable Digital Terrain Model (DTM) data. Ordnance Survey Ireland (OSi) 1:50,000-scale local coverage raw contour and spot-heights data is available for use on this project. Errors in the OSI dataset are quoted at ±5m. These errors are typically largest in mountainous regions, but the range of possible error at the coast may still be sufficient to make viable inundation prediction mapping a difficulty.

Real time Kinematic (RTK) Global Positioning Systems (GPS) is capable of measuring elevation accurately to 1 – 2cm. RTK GPS will be used to assess the error range in the DTM for areas covered by detailed habitat surveys. The results of the GPS survey will be compared with the national coverage DTM to quantify the error ranges encountered within it, and to provide confidence ranges for SLR predictions within the GPS survey area, and to infer likely inundation and habitat risk across the wider estuary area.

The geographical range of protected habitats such as salt marsh is dependent on a range of other geophysical factors (Fuller, 1911, Tansley, 1941). The extent to which a range of geophysical variables might serve as predictors for salt marsh occurrence will be used to test predictability of present-day habitats, and to predict future SLR-driven habitat expansion zones.

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