UNISDR
The United Nations Office for Disaster Risk Reduction

UNISDR Scientific and Technical Advisory Group Case Studies – 2014

Recognising Natural Coastal Protection and Risk Reduction by Intertidal Wetlands

The Problem

With scenarios of sea level rise and potential increases in storminess, greater environmental awareness and the escalating cost of maintaining ageing coastal embankments, more emphasis has been placed in the last decade on saltmarsh creation and restoration within more sustainable, ecologically sound coastal defence planning. Prior to the 1990s in the UK, the only comprehensive study about how, and to what degree, saltmarshes reduce wave heights and protect defences came from a hardware model experiment[1]. Hardware model results were incorporated into policy documents from the (then) National Rivers Authority, illustrating the relationships between saltmarsh width and the height (and cost per mile) of coastal defence embankments. This research formed the basis for subsequent discussions of the 'managed realignment' of sections of the UK coastline. The creation of new areas of intertidal wetland between old defence lines and new, lower (and hence less expensive) and more landward defences was promoted through the argument that dissipation of wave energy across, and increased flood water storage by, these created marshes would reduce flood risk to coastal populations and economies. The need to validate these wholly untested, yet economically important, 'design rules' led to the Cambridge Coastal Research Unit initiating the first direct measurements of wave energy dissipation across NW European saltmarshes[2].

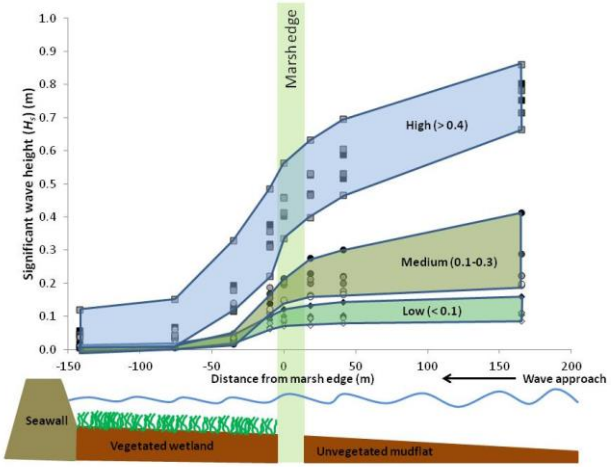

Figure 1 Spatial and temporal variability of wave attenuation over a UK East-coast salt marsh Möller, I., Spencer, T., and Rawson, J. 2002. Proceedings of the 38th International Conference on Coastal Engineering, Cardiff, July 2002.

Authors: Dr Thomas Spencer, Dr Iris Moller, Cambridge Coastal Research Unit, University of Cambridge

The Science

Measurements of wave activity along mudflat to saltmarsh cross-shore transects have been made using bespoke inundation-triggered arrays of pressure sensors, allied to new analytical procedures to extract summary wave characteristics from high resolution measurements of variations in wave height and wave period[3]. In autumn 2013, these field measurements were supplemented by a full-scale experiment in the longest wave flume in the world (the 330 m long 'Large Wave Flume' (GWK), Hannover, Germany) which obtained reliable data on wave damping and surface sediment dynamics across typical coastal marsh surfaces under realistic storm wave conditions[4].

At a range of macro-tidal and micro-tidal locations in NW Europe and in the flume, this research has shown how wave energy reduction over saltmarshes varies with the relations between water depth and wave height; marsh surface topography and vegetation canopy structure and the nature of the unvegetated mudflat / vegetated saltmarsh transition[5]. These findings have important implications for the repair of degraded marshes and the construction of new ones, in the context of reducing coastal flood risk.

As they cross the mudflat/saltmarsh boundary, wave heights and wave energy are substantially reduced, particularly for high waves. In this set of experiments, only 10% of the outer mudflat energy remained at the sea defence line[6].

Figure 2 Saltmarsh fronting sea defences at Tillingham, Dengie Peninsula, UK southern North Sea coast. Note earthen bank in front of wide saltmarsh (foreground) and the need for a re-inforced sea defence (background left) where coastal erosion has resulted in a narrow saltmarsh with fronting mudflat (photo: I Moller)

The application to policy and practice

The research findings were incorporated into 'best practice' design rules for saltmarsh creation and maintenance in manuals issued by i) the UK Environment Agency and ii) the Construction Industry Research and Information Association (CIRIA). '*Making Space for Nature: a review of England's wildlife sites and ecological network*' states that 'salt marsh and other coastal habitats play an economically critical role in coastal flood protection (… Möller *et al.* 1999;…)', leading to Recommendation 5: 'Authorities responsible for measures to reduce the risks from coastal erosion and flooding should do so in ways that enhance ecological networks where possible. This can be achieved by taking full account of the natural dynamism and functioning of the coast, thereby allowing wildlife and habitats to move and evolve[7].' The UK Government response to Lawton Recommendation 5 reads: 'We agree that authorities responsible for measures to reduce the risks from coastal erosion and flooding should do so in ways that enhance ecological networks where possible.' Government will promote a strategic approach to

flood and coastal erosion risk management, based on a sound understanding of coastal processes, catchment hydrology and the natural processes at play in rivers and at the coast, to inform local decision making[8].' The research outputs were also incorporated into the coastal chapter of the Government's Committee on Climate Change (Sub-committee on Adaptation) report on 'Managing the land in a changing climate' in July 2013[9].

Did it make a difference?

The research has 'had profound impacts on design of flood walls, not only in the UK but also the EU and USA[10].' More broadly, the recognition of significant wave energy dissipation by saltmarshes has aided recognition of the ecosystem service value of coastal wetlands (and contributed to the UK National Ecosystem Assessment); contributed to the Living With Environmental Change (LWEC) report card on the implications of climate change; for UK government policy advisors and ministers, local government authorities and those charged with assimilating evidence for the UK's 2nd Climate Change Risk Assessment (CCRA). The research has also provided advice to the UK Government's Environment Agency and nature conservation body, Natural England, on the importance of maintaining or restoring intertidal habitat. This has been particularly important in discussions with wider stakeholders such as community groups and landowners, such that they can better understand not only the benefits of conserving habitats but also, by carrying out managed realignment and the creation of new habitats, help with flood risk management[10].

1 Brampton, AH. Engineering significance of British saltmarshes. In: Allen JRL Pye K (Eds.) Saltmarshes. Morphodynamics, conservation and engineering significance. Cambridge: Cambridge University Press, Cambridge. 1992; pp. 115-122.

2 Moeller I, Spencer T, French JR. Wind wave attenuation over saltmarsh surfaces, Preliminary results from Norfolk, England. Journal of Coastal Research. 1996; 12(4): 1009-1016.

3 Möller I, Spencer T, French JR, Leggett DJ, Dixon M. Wave transformation over salt marshes, A field and numerical modelling study from North Norfolk, England. Estuarine, Coastal and Shelf Science. 1999; 49: 411-426.

4 Saltmarshes under extreme waves. 2013. Available at: http://thesaltmarshexperiment.wordpress.com/ [accessed 27 July 2014].

5 Möller I. Quantifying saltmarsh vegetation and its effect on wave height dissipation, results from a UK East coast saltmarsh. Journal of Estuarine, Coastal, and Shelf Sciences. 2006; 69(3-4): 337-351.

6 Möller I, Spencer T. Wave dissipation over macro-tidal saltmarshes: Effects of marsh edge typology and vegetation change. 2002; Journal of Coastal Research, Special Issue 36: 506-521.

7 Lawton JH, Brotherton PNM, Brown VK, Elphick C, Fitter AH, Forshaw J, Haddow RW, Hilborne S, Leafe RN, Mace GM, Southgate MP, Sutherland WA, Tew TE, Varley J, Wynne GR. Making Space for Nature: a review of England's wildlife sites and ecological network. London: DEFRA. 2010. .Available at: http://archive.defra.gov.uk/environment/biodiversity/documents/201009space-for-nature.pdf [accessed 27 July 2014].

8 DEFRA PB13537: Government response to 'Making Space for Nature' Review. London: DEFRA. 2011. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69272/pb13537-lawton-response-110607.pdf [accessed 27 July 2014].

9 Adaptation Sub-Committee on Climate Change Progress Report 2013. Managing the land in a changing climate. London: Committee on Climate Change, 2013. Available at: http://www.theccc.org.uk/wp-content/uploads/2013/07/ASC-2013-Book-singles_2.pdf [accessed 27 July 2014].

10 Dixon AM. Pers. Comm. September 2013. UK National Ecosystem Assessment. 2011. Available at: http://uknea.unep-wcmc.org/ [accessed 27 July 2014] and Rees SM Pers. Comm. October 2013.

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