

# Science for Environment Policy

## Rising sea levels will cause irreversible changes to plant communities in a Welsh wetland

**As global temperatures continue to warm, sea-levels are expected to rise, increasing the risk of saltwater inundating wetlands in low-lying coastal areas. A study in Wales, UK, describes how rising sea levels will result in a shift from a wetland rich in plant diversity to one dominated by saltwater and mud in 200 years' time.**

**Coastal wetlands provide important ecosystem services for people and the environment, including food, clean [water](#), and habitats that support a variety of wildlife.** As increasing temperatures cause ice caps to melt and water to expand, sea levels will rise. Rising sea levels will inevitably result in some changes to coastal wetland ecosystems, as saltwater intrudes further inland. Consequently, wetland habitats will be altered, affecting biodiversity and the ecosystem services provided by the wetlands.

This study, partly funded by the [European Regional Development Fund](#), explored how sea-level rise might affect a tidal wetland in west Wales, UK. The wetland consists of two marsh areas situated next to a river estuary where saltwater from the sea mixes with freshwater from the river. The marshes experience some tidal flooding, creating a gradient of saline (salty) and wet environments across the area.

Sea-level rises might affect the wetland via changes to the frequency and duration of flooding. To understand how this will alter existing wetland areas and, therefore, how it will likely affect marsh plants and invertebrate communities living in the riverbank sediments (benthic communities), the researchers modelled the predicted extent of flooding from sea-level rises over the next 200 years, starting in 2010.

They did this by modelling changes in land elevations, accounting for changes in surface levels from possible peat formation to compensate for rising sea levels. Peat is primarily formed in the marshes from the reed *Phragmites australis*. The ranges of flood levels resulting from the intrusion of saltwater were represented by the average heights of the high waters of neap (lowest) and spring (highest) tides.

To characterise the existing plant communities in the wetland, the researchers surveyed the plants, in 50 wetland plots, representing a range of saline and wet environments. Water levels and soil data from the sample plots, together with the plant survey, were used to describe different groups of plant communities found across the wetland. For example, wet woodland and meadows were found in freshwater areas, which are the least wet and least salt tolerant, and mixed herb and reed marshes, dominated by *P. australis* reeds, which are tolerant of wet conditions and brackish (salty) water, were found along the river bank.

In addition, the researchers took sediment samples from five intertidal sites, ranging from saline to freshwater, along the river shoreline to determine the composition of the benthic invertebrate community in the marshes.

The modelling revealed that over the next 200 years the marshes will be progressively and more frequently flooded as the sea level rises, with the intrusion of saltwater affecting the ecology of the wetland. The researchers suggest that under low estimates, sea levels might penetrate 250 m inland in 200 years' time, and under high estimates, the same extent of intrusion could happen after 175 years.

*Continued on next page.*



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The extent and frequency of saltwater intrusion from flooding is expected to be gradual, but between 2135 and 2185 a tipping point could be reached where the low slope of the wetland would allow extensive areas of the wetland to be inundated every flood tide. In around 175 years (under high estimates of sea-level rise), two-thirds of the wetland could always be inundated with salty water during flood tides.

Plant communities are predicted to change along a gradient of salt and moisture tolerance, driven by the depth and frequency of saltwater inundation during flood tides. Plants that are intolerant of saltwater could be replaced by plants that are more salt tolerant. Eventually, the wetland may become dominated by salt marshes, or if the depth of water during flood tides becomes too deep, by tidal mudflats (a type of wetland that forms when mud is deposited by tides).

Saltwater intrusion into freshwater areas of the wetlands, which currently support a large diversity and abundance of plants, will lead to less plant [diversity](#) (as fewer plants will be able to survive under these conditions).

The expansion of tidal mudflats would also change the biodiversity of the area, such as causing benthic species that occur in brackish areas to penetrate further into the existing freshwater areas of the wetland.

Mudflats also provide rich feeding grounds for a variety of wading birds and act as nurseries for fish species. For example, larvae of the primitive lamprey fish were found in the mudflat samples, suggesting that lampreys, which are protected under the [Habitats Directive](#), breed in the area. The wetlands may, therefore, still be important in the future, no longer for their plant diversity and the wildlife that rely on them, but for the bird and fish species the mudflats could support.

This study has helped to identify some of the changes that this particular wetland might expect over the coming 200 years and is valuable as some of the effects are not likely to be visible during the first 100 years. The formation of peat, primarily from *P. australis* reeds, is likely to continue during this time, however, implying that one ecosystem function of the wetland — carbon storage — will increase over this period.

