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Evaluating the potential impacts of tidal power schemes on estuarine waterbirds

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As a means of reducing dependence on fossil fuels and thereby combating global climate change, tidal power offers a potentially valuable renewable energy source. The UK coastline has some of the highest tidal ranges in the world and proposals for tidal power schemes have thus been put forward for several estuaries where the tidal range is sufficiently large for energy to be harnessed, including the Severn, Mersey, Dee and Solway.

Although the energy supply at such sites is reliable and plentiful, the development of any tidal power scheme would have great implications for the ornithological interest of the site in question. The UK holds a significant proportion of Europe's estuarine resource and its estuaries and other wetlands are of considerable international importance for migrant and wintering waterbirds. A peak of 2 907 731 waterbirds, for example, was counted by the Wetland Bird Survey (WeBS) in the UK in winter 2008/09 (Calbrade *et al.* 2010). Many of these wetland sites are designated as Special Protection Areas (SPAs; under the EC 'Birds Directive' 2009/147/EC) as part of the Natura 2000 network, or as Wetlands of International Importance under the Ramsar Convention.

Here we describe the key issues that need to be evaluated as part of any assessment of the effects of a tidal power scheme on birds, as considered in the recent Strategic Environmental Assessment (SEA) undertaken as part of the Severn Tidal Power Feasibility Study. The Severn Estuary is designated as both an SPA – with 18 spring/autumn passage or over-wintering waterbird species listed as features – and a Ramsar site, and encompasses seven Sites of Special Scientific Interest (Burton *et al.* 2010). A mean annual peak of 72 909 waterbirds was recorded there by WeBS counts over the period 2004/05–2008/09 (Calbrade *et al.* 2010). Five different tidal power options – three barrage schemes and two lagoon schemes – have been considered by the feasibility study and SEA (Fig. 1)

A tidal power scheme would first affect waterbirds through disturbance, which would be at its greatest during construction and decommissioning but which would continue at a lower level throughout the scheme's operational lifetime. Disturbance would be potentially greater for lagoon schemes that intersect a greater area of intertidal habitat, than for barrage schemes, and could also be deemed significant should the line of the scheme run close to offshore seabird colonies.

The principal effects for waterbirds of any tidal power scheme relate to the changes to intertidal habitat that would follow its implementation (Clark 2006). The tidal range upstream of a tidal power scheme would be approximately halved following its implementation, leading to an immediate reduction in the intertidal area available for feeding birds. However, the effect of this for waterbirds would not be directly proportional to the amount of habitat lost due to variations in intertidal habitat quality across the estuary and subsequent changes in the nature of intertidal areas. Reduced turbidity upstream of schemes would lead to a considerable fall-out of

suspended sediments and, should this remain on the intertidal, this could benefit invertebrate communities and so potentially increase bird densities in remaining habitat. In contrast, delaying the ebb tide to maximize power generation would reduce the time available for waterbirds to feed. For some schemes, increased wave action (in conjunction with a reduction in accretion due to reductions in suspended sediments) may lead to further erosion of intertidal mudflats over the scheme's operational lifetime. Oystercatcher *Haematopus ostralegus* numbers on the Dutch Oosterschelde, for example, have declined steadily since a storm surge barrage was constructed there in the 1980s, and are predicted to continue to decline due to continuing erosion (Rappoldt *et al.* 2006, Duriez *et al.* 2009). Saltmarsh also may be affected by erosion exacerbated by the prolonged 'standing-head' of water, and experience less frequent inundation.

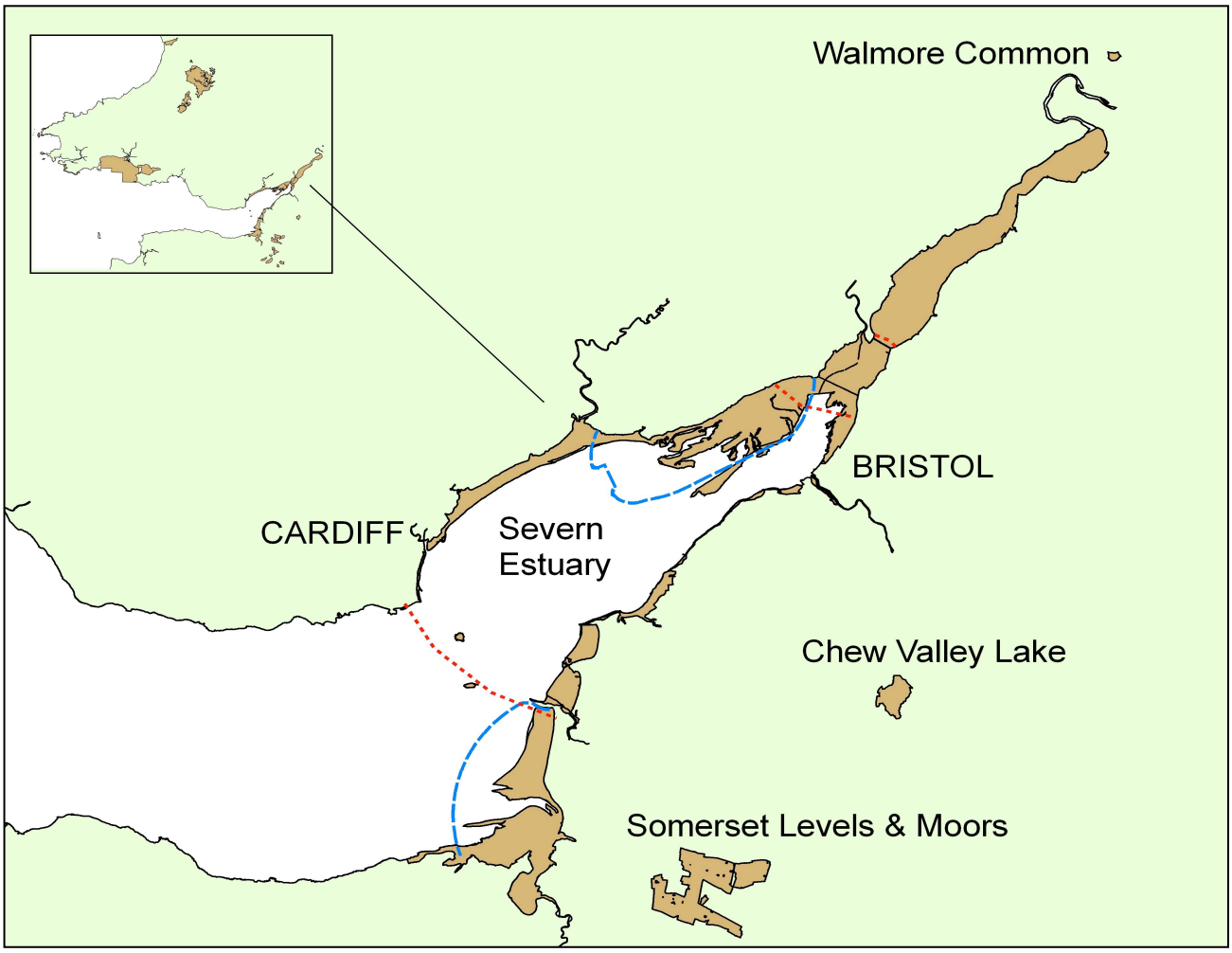

Figure 1. The Severn Estuary and neighbouring Special Protection Areas (SPAs). Tidal power barrage options are shown by red dotted lines and lagoon options by blue dashed lines.

Breeding seabirds might be affected by tidal power schemes, not only due to disturbance, but potentially because the construction of schemes could permit the colonization of breeding islands by rats. Piscivores also might be affected by changes in fish populations and their availability.

Waterbirds in the floodplain surrounding the estuary might be affected by direct habitat loss where the barrage or lagoon schemes make landfall, or due to changes in the water table. Increases in water tables due to less efficient drainage in low-lying areas would potentially benefit both breeding and wintering waterbirds (depending

on whether groundwater might be affected by increased salinity), though if uncontrolled could threaten nests or young. However, positive effects would likely be counteracted by improved management of water levels to alleviate flood risks.

Effects on protected areas even further afield also should be considered. The immediate loss of intertidal habitat would displace birds and cause them to redistribute either within the estuary or to neighbouring sites. This in turn might affect the birds at those sites through competition and density-dependent mortality. Redshank *Tringa totanus* displaced following the construction of an amenity barrage at Cardiff Bay, South Wales, for example, had a lower survival rate after they moved (Burton *et al.* 2006). Large tidal power schemes also have the potential to affect tidal levels and thus lead to further loss of intertidal habitat at other protected sites remote from that where the scheme is constructed (Burrows *et al.* 2009).

Any effects on waterbirds within the estuary where the tidal power scheme is constructed (should this be an SPA) would in themselves affect the integrity of the Natura 2000 network. However, it is lastly important to note that any effects on the site in question (if not mitigated or compensated for) would potentially also cause knock-on effects for other sites in this network. This is because waterbirds also pass through many other sites on migration between their wintering and breeding grounds.

In summary, therefore, whilst a tidal power scheme would principally affect waterbirds through the loss of and changes to intertidal habitat, a number of additional issues should be considered as part of any assessment. Importantly, birds might be affected at sites distant to that where the scheme is constructed.

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References

Burrows, R., Walkington, I.A., Yates, N.C., Hedges, T.S., Wolf, J. & Holt, J. 2009. The tidal range energy potential of the west coast of the United Kingdom. *Appl. Ocean Res.* 31: 229-238.

Burton, N.H.K., Musgrove, A.J., Rehfisch, M.M. & Clark, N.A. 2010. Birds of the Severn Estuary and Bristol Channel: their current status and key environmental issues. *Mar. Poll. Bull.* 61: 115–123.

Burton, N.H.K., Rehfisch, M.M., Clark, N.A. & Dodd, S.G. 2006. Impacts of sudden winter habitat loss on the body condition and survival of redshank *Tringa totanus*. *J. Appl. Ecol.* 43: 464–473.

Calbrade, N.A., Holt, C.A., Austin, G.E., Mellan, H., Mitchell, C., Stroud, D.A., Wotton, S.R. & Musgrove, A.J. 2010. *Waterbirds in the UK 2008/09: The Wetland Bird Survey*. Thetford: BTO/WWT/RSPB/JNCC.

Clark, N.A. 2006. Tidal barrages and birds. *Ibis* 148: 152–157.

Duriez, O., Saether, S.A., Ens, B.J., Choquet, R., Pradel, R., Lambeck, R.H.D. & Klaassen, M. 2009. Estimating survival and movements using both live and dead recoveries: a case study of oystercatchers confronted with habitat change. *J. Appl. Ecol.* 46: 144–153.

Rappoldt, C., Kersten, M. & Ens, B.J. 2006. *Scholeksters en de droogvalduur van kokkels in de Oosterschelde; Modelberekeningen voor de periode 1990-2045 aan het effect van zandhonger en zeespiegelstijging op het aantal scholeksters*. Ecocurves Rapport 2 / SOVON-Onderzoeksrapport 2006/12. Haren/Beek-Ubbergen, Holland: EcoCurves/SOVON Vogelonderzoek.

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