Briefing Paper

The Importance of Freshwater Wetland Habitats

Freshwater wetlands are vegetated areas covered by permanent or temporary shallow water. They act as transitional links between the water and the land, providing habitat for both terrestrial and aquatic wildlife. Freshwater wetlands occur where the water table is at or near the surface of the land, and include habitats such as fens, peatlands, swamps, bogs and riparian river and lake marshes.

In the past, people have regarded wetlands as wastelands; yet they are amongst the world's most productive environments, comparable to coral reefs and tropical rainforests. However, despite this, wetlands are one of the world's most threatened ecosystems, owing mainly to drainage for agriculture or urban development and pollution pressures (Finlayson and Davidson, 1999: Zedler and Kercher, 2005).

In the past three centuries, England has devastated its wetlands; draining fens, ploughing grazing marshes, polluting reedbeds, straightening riverbeds, and exhausting peat from lowland bogs. It is estimated, for example, that 3,400 km^2 of fen were present in England in 1637, yet today only 10 km^2 remains (Natural England, 2008). It is also estimated between 1840 and 1880 approximately 100,000 hectares of wetland were drained every year (Baldock, 1984). Anthropogenic modifications to river discharges have also reduced the river-floodplain connection (Junk *et al*., 1989: Acreman *et al*., 2003), which is critical for maintaining wetland ecosystems (Poff *et al*., 1997: Michener and Haeuber, 1998).

We are now beginning to realise the value of wetlands for biodiversity and a wide range of other ecosystem services. The challenge is now to preserve what little natural wetlands we have remaining, and to begin compensating for previous destruction.

However, the future of wetlands looks uncertain in light of climate change, which is likely to affect their spatial distribution, expanse and function. Results of research by Acreman *et al* (2008) suggests that reduced summer rainfall and increased summer evaporation will put stress on wetland plant communities in late summer and autumn, with greater impacts in the south and east of England. In addition, impacts on rain-fed wetlands will be greater than on those dominated by river inflows.

Value of Freshwater Wetlands

Wetlands are important areas for biodiversity, supporting large genetic diversity, as well as endemic and migratory species. In the UK alone, 3500 species of invertebrates, 150 species of aquatic plant, 22 species of duck and 33 species of wader have been identified as living in wetlands (Merritt, 1994). Wetlands also supply vital rearing and breeding habitats for many species, including recreational and commercially important fish, by providing nutrient-rich feeding areas and refugia from predators and environmental variations (Welcomme, 1979: Maitland and Morgan, 1997).

Research has shown that wetland habitat, with controlled flooding, increases fish abundance and species richness (Jurajda *et al*., 2004; Cowx and Welcomme, 1998). Wetland designs which incorporate the differing habitat requirements of different life stages of fish also help to increase recruitment and abundance (Cowx, 2001). Wetlands also indirectly improve biological productivity in

other freshwater systems by the export of food, in the form of primary and secondary production (Henning *et al*., 2007).
Wetlands can provide a wide range of ecosystem services and environmental benefits including;

- Flood mitigation, flow regulation and increasing surface water holding capacities (this however, can increase water evaporation). Wetlands in urban areas are especially valuable for flood protection, as they act as natural sponges, buffering the peak flows and flash floods caused by the extensive impermeable surfaces associated with urbanisation, which reduce natural water retention (Junk *et al*., 1989). The wet meadows formed when rivers overtop during a flood, not only attenuate peaks, but also establish important seasonal riparian ecosystems, particularly for fish.

- Regulation of water regimes and ecological function, including recharging and discharging groundwater aquifers (Bullock and Acreman, 2003), stabilising local micro-climates via the regulation of rainfall, temperature and evapotranspiration (Adamus and Stockwell, 1983).

- Erosion control by temporarily storing floodwaters and sediment retention via hydrophytes (plants adapted to grow in water), which bind the soil with their roots. This reduces the amount of sediment in the water, which can clog spawning gravels, smother eggs and clog fish gills (NOAA Fisheries, 2007).

- Nutrient removal and retention (Mitch and Gosselink, 1986: Mitchell, 1994), by encouraging sedimentation (Johnston *et al*., 1984), direct absorption by hydrophytes (Lee *et al*., 1975) and enhancing denitrification (Lowrance *et al*., 1984).

- Toxicant removal, including the absorption of chemical and organic pollutants, and metals from the water by hydrophytes. Metals are also removed via microbially-medicated oxidation/reduction, resulting in metal compounds precipitating into sediments. Wetlands have also been shown to produce a 97% reduction in the flux and concentrations of faecal indicator organisms (FIOs) to recreational waters (Kay *et al*., 2005).

- Carbon sequestration. Wetlands account for approximately 37% of the terrestrial carbon pool (Bolin & Sukamar, 2000), and therefore have a huge potential to help mitigate climate change (Pant *et al*., 2003; Euliss *et al*., 2006).

- Economic benefits through their role in supporting fisheries, agriculture, tourism, recreational sports and the provision of medicinal products (Fisher and Acreman, 2004). The natural filtration properties of wetlands are also typically less expensive and more efficient than modern water purity technologies and, as a consequence, artificially constructed wetlands are commonly used for the treatment of domestic or industrial waste (Allinson *et al*., 2000).

- Physical, mental and societal well-being associated with wetlands (Wilson, 1984; Fuller *et al*., 2007), as well as providing cultural heritage and aesthetic value.

Wetlands provide any marketed and non-marketed benefits for people. It is however, difficult to put a value of the benefits provided to us by wetlands, as, although a large range of the functions and benefits can be valued, determining the value of individual wetlands is difficult, as they do not all perform the same functions or to the same level. Some estimates have been placed on the economic value of natural wetlands compared to drained wetlands. In Thailand, for instance, the net value of wetlands- calculated on both marketed value (e.g. fisheries) and non-marketed (e.g. storm damage protection and carbon sequestration) - is $1,000-$36,000 per hectare, compared with only $200 per hectare for wetland converted into shrimp farms. Similarly, in Canada, freshwater wetlands have been economically valued at $5,800 per hectare, compared with only $2,400 for wetlands drained for agriculture (Millennium Ecosystem Assessment, 2005).

Protection

Wetlands gained protection via the intergovernmental treaty 'The Convention on Wetlands of International Importance', signed in the Iranian town of Ramsar in 1971. This was ratified by the UK in 1976, and is now popularly named the "Ramsar Convention". The treaty requires two main commitments (Ramsar website, 2008):

- The designation of at least one wetland (based on its ecology, botany, zoology, limnology or hydrology) for inclusion in the List of Wetlands of International Importance, which promotes its conservation.

- To promote the wise and sustainable use of wetlands and their resources

The Convention is not regulatory. The UK, therefore, supports Ramsar wetland protection, using other statutory designations, such as Sites of Special Scientific Interest (SSSIs) and Special Areas for Conservation (SAC), under the Wildlife & Countryside Act (WCA) 1981 and EC Habitats Directive. The records show that, in the UK in 2007, there were 146 designated Ramsar sites, covering 782,727 hectares (JNCC, 2008).

An example of wetland restoration is the Great Fen Project, where 3700 hectares of agricultural land and remnant fenland, between Huntingdon and Peterborough, is being restored to wetland. The project will also connect Ramsar and Special Area of Conservation site, Woodwalton Fen National Nature Reserve, with nearby Holme Fen National Nature Reserve. This will create a large site with conservation benefits for wildlife, socio-economic benefits for people, and could also play a strategic role by storing flood water (Great Fen Project, 2008).

Natural England, the Environment Agency, the RSPB and the Wildlife Trusts, have also launched a '50 Year Vision for Wetlands'. This is a new scheme with the aim is to restore and recreate England's most damaged wetlands, in order to reduce flooding and increase species richness. The project involves national mapping of areas suitable for wetland creation (Vision for Wetlands, 2008).

Call for Further Action

The S&TA feels that the preservation and restoration of our freshwater wetlands is vital to the recovery and survival of our native and migratory fisheries, and in response to climate change pressures. We strongly support the '50 Year Vision for Wetlands' objectives, to encourage and facilitate local wetland restoration for the benefit of people, biodiversity and the historic environment. The data collected by this initiative provides an ideal framework to ensure nationwide sustainable wetland restoration.

The S&TA would also like to see:

- Further integration of soft engineering options, such as wetlands, into environmental policy to deliver catchment based objectives, such as reducing the risk from extreme flooding, improving water quality and stabilising flow regimes.

- Multi-discipline objectives for wetland creation, where new wetland are designed to achieve multi-functional benefits, including flood prevention and biodiversity objectives.

- Greater support for the rehabilitation of lateral (between rivers and their floodplains) and longitudinal (between up and downstream river reaches) river connectivity, to reconnect fragmented habitat in order to help increase species resilience to anthropogenic pressures and climate change.

Conclusions

The loss and degradation of our wetland habitat has removed ecosystem services and increased our vulnerability to pressures, such as climate change. Wetlands can play a vital role in climate change adaptation and mitigation in the future, by offering maintenance of water supplies in the predicted drier summers, and protection from floods, sea-level rise and saltwater intrusion, in the forecasted wetter winters. They can also help biodiversity response to climate change, by providing an ecological network for species to migrate and by offering habitat and refugia, which will increase species resilience by preserving species numbers and genetic diversity.

The preservation and rehabilitation of wetlands should no longer be viewed in isolation, but as a step towards achieving wider sustainable water agendas, and political drivers such as the Water Framework Directive (WFD) and Floods Directive. The conservation and restoration of freshwater wetlands is vital to increasing resilience against climate change, by improving our water quality, biodiversity (including fisheries), flood storage capacities and flow regimes in the future.

Acknowledgements

Thanks for the expertise and guidance from Dr Mike Acreman, Centre of Ecology and Hydrology, and Dr Nevil Quinn, University of the West of England, Bristol.

References

Acreman, M.C., Blake, J.R., Booker, D.J., Harding, R.J., Reynard, N., Mountford, J.O., Stratford, C.J. (2008). A method for assessing climate change implications for wetland hydro-ecology with case studies from Great Britain Internal report. Centre for Ecology and Hydrology, Wallingford.

Acreman, M.C., Booker, D.J. and Riddington, R. (2003). Hydrological impacts of floodplain restoration: a case study of the rvier Cherwell, UK. *Hydrology and Earth System Sciences* **7** (1): 75-86.

Adamus, P. R. and Stockwell, L.T. (1983). *A Method for Wetland Functional Assessment*. FHWA, U.S. Department of Transportation, FHWA-IP-82-23.

Allinson, G., Stagnitti, F., Salzman, S., Hill, R.J., Coates, M., Cordell, S., Colville, S. and Lloyd-Smith, J. (2000). Strategies for the sustainable management of industrial wastewater. Determination of the chemical dynamics of a cascade series of five newly constructed ponds. *Phys. Chem. Earth (B)*: **25**: 629-634.

Baldock, D. (1984). *Wetland drainage in Europe. The effect of agricultural policy in four EEC countries*. Russel Press. Nottingham.

Bolin, B. and Sukumar, R. (2000). Global Perspective. In: Watson, R.T., Noble, I. R., Bolin, B., Ravindranath, N H., Verardo, D.J. and Dokken, D.J. (eds.). *Land Use, Land-Use Change and Forestry: A Special Report of the IPCC*. Cambridge University Press, Cambridge, UK, pp. 23-51.

Bullock, A. and Acreman, M. (2003). The role of wetlands in the hydrologic cycle. *Hydrol. Earth Syst. Sci.* **7**: 358-389.

Cowx, I.G. (2001). *Factors influencing coarse fish populations in Rivers*. R&D Publication 18. Bristol: Environment Agency.

Cowx, I.G. and Welcomme, R.L. (eds). (1998). Rehabilitation *of Rivers for Fish*. Fishing New Books, Blackwell Science, Oxford.

Euliss, N. H. Jr., Gleason, R.A., Olness, A., McDougal, R.L., Murkin, H.R., Robarts, R.D., Bourbonniere, R.A. and Warner, B.G. (2006). North American prairie wetlands are important nonforested land-based carbon storage sites. *Science of the Total Environment* **361**: 179-188

Finlayson, C.M. and Davidson, N.C. (1999). Global Review of Wetlands Resources and Priorities for Wetland Inventory: Summary Report. [Online]. Available from: http://www.environment.gov.au/ssd/publications/ssr/144.html. [Assessed: 04/03/08].

Fuller, R. A., Irvine, K. N., Devine-Wright, P., Warren, P.H. and Gaston, K.J. (2007). Psychological benefits of greenspace increase with biodiversity. *Biology Letters* **3** (4): 390-394.

Henning, J.A., Gresswell, R.E. and Fleming, I.A. (2007). Use of seasonal freshwater wetlands by fishes in a temperate river floodplain. *Journal of Fish Biology* **71**: 476-492.

Great Fen Project. (2008). About the project. [Online]. Available from: http://www.greatfen.org.uk [Assessed on 17/06/08].

JNCC. (2008). UK Ramsar Sites. [Online]. Available from: http://www.jncc.gov.uk/page-1388 . [Assessed 23/02/08].

Johnston, C.A., Bubenzer, G.D., Lee, G.B., Madison, F.W. and McHenry, J.R. (1984). Nutrient trapping by sediment deposition in a seasonally flooded lakeside wetland. *J. Environ. Qual*. **13**: 283-290.

Junk, W.J., Bayley, P.B. and Sparks, R.E. (1989). The flood pulse concept in river floodplains. *Canadian Special Publication of Fisheries and Aquatic Systems* **106**: 110-127.

Jurajda, P., Ondrackova, M. and Reichard, M. (2004). Managed flooding as a tool for supporting natural fish reproduction in man-made lentic water bodies. *Fisheries Management and Ecology* **11**: 237-242.

Kay, D., Wyer, M.D., Crowther, J., Wilkinson, J., Stableton, C. and Glass, P. (2005). Sustainable reduction in the flux of microbial compliance parameters from urban and arable land use to coastal bathing water by a wetland ecosystem produced by a marine flood defence structure. *Water Research* 39: 3320-3332.

Lee, G., Bentley, E. and Amundson, R. (1975). Effects of marshes on water quality. In: Hasler, A. (ed). *Coupling of Land and Water Systems*. Springer, New York, USA.

Lowrance, R.R., Todd, R.L. and Asmussen, L.E. (1984). Nutrient cycling in an agricultural watershed: II Streamflow and artificial drainage. *J. Environ. Qual*. **13**: 27-32.

Maitland, P.S. and Morgan, N.C. (1997). *Conservation Management of freshwater habitat: lakes, rivers and wetlands*. Kluwer Academic Publishers.

Merritt, A. (1994). *Wetlands, Industry and Wildlife- a manual of principles and practises*. The Wildlife and Wetlands Trust, Slimbridge.
Michener, W.K. and Haeuber, R.A. (1998). Flooding: natural and managed disturbances. *Bioscience* 48: 677-680.
Millennium Ecosystem Assessment. (2005). Ecosystems and Human Well-Being: Wetlands and Water Synthesis. [Online]. Available from: http://www.millenniumassessment.org/documents/document.358.aspx.pdf . [Accessed on 16/08/08].
Mitch, W.J. and Gosselink, J.G. (1986). *Wetlands*. Van Nostrand Reinhold. New York, USA.
Mitchell, D.S. (1994). Floodplain wetlands of the Murray-Darling Basin: management, issues and challenges. In: Sharley, T. and Huggin, C. (eds). *Murray-Darling Basin Floodplain wetlands management.* Proc. Of the floodplain wetlands management workshop. NSW, Australia.
Natural England. (2008). Section 3.8 of Natural Englands 2008 State of the Environment report. [Online]. Available from: http://www.naturalengland.org.uk/sone/docs/SoNE-Chapter3.pdf . [Accessed 14/09/09].
NOAA Fisheries. (2007). Wetlands and Fish. [Online]. Available from: http://www.nmfs.noaa.gov/habitat/habitatconservation/publications/Fish%20and%20Wetlands%20document.pdf . [Assessed 14/03/08].
Pant, H. K., Rechcigl, J. E. and Adjei, M. B. (2003). Carbon sequestration in wetlands: concept and estimation. *Journal of Food, Agriculture & Environment*: **1** (2): 308-313
Poff, L.N., Allan, J.D., Bain, M.B., Karr, J.R., Prestegaard, K.L., Richter, B.D., Sparks, R.E. and Stromberg, J.C. (1997). The natural flow regime. *Bioscience* **47**: 769-784.
Ramar website. (2008). The Ramsar Convention on Wetlands. [Online]. Available from: http://www.ramsar.org . [Assessed 07/04/08].
Vision for Wetlands. (2008). 50 Year Version for Wetlands. [Online]. Available from: http://www.wetlandvision.org.uk/dyndisplay.aspx?d=home . [Assessed 01/04/08].
Welcomme, R.L. (1979). *Fisheries Ecology of Floodplain Rivers*. Longman, New York.
Wilson, E.O. (1984). *Biophilia*. Cambridge, MA: Harvard University Press.
Zedler, J.B. and Kercher, S. (2005). Wetland resources: status, trends, ecosystem services, and restorability. *Annual Review of Environment and Resources* **30**: 39-74.

For Further Details please contact Janina Gray, Research and Policy Manager, on: janina@salmon-trout.org or 0207 2835838