What does the greater Severn estuary do for us? A look at the ‘ecosystem services’ it provides......
Introduction

In this study we have examined some of the benefits, or ‘ecosystem goods and services’, that people obtain from the natural environment of the Severn. In particular, we have explored how these benefits could be mapped to show the important areas.

One of the UK’s largest natural features, the Severn Estuary, important in its own right as a rich and globally important wildlife site, gives us other things too - to the industries and economies of our great port cities of Bristol and Cardiff, but also beyond and into the wider Severnside communities.

At its most tempestuous it might bring floods, but equally its rich silts store carbon that would otherwise contribute to climate change. A vital trade artery serving the great Severnside ports but also a natural place that serves our wellbeing. It’s valuable to us.

Looking forward, marine clean power technologies and other development opportunities on the coast will continue to show how our natural environment underpins our economy and our wellbeing. Making the right choices, maximising value and growth while managing the natural environment well, is a very big prize here.

The full report of the project, including its maps, provides a new set of materials that we hope will help to inform better decision making in relation to the Severn.

Key messages

The report shows that habitats within the estuary provide significant benefits - from cycling and storage of carbon through to flood risk management, recreational activities and inspiration for complex cultural interests.

Key ecosystem benefits identified include:

- The presence of significant marine transport links and ports which support regional, national and international trade and industry.
- Multiple benefits from the Severn’s extensive intertidal areas, particularly mud bank and intertidal saltmarsh habitats.
  The study highlighted their importance for:
    - flood risk management
    - carbon sequestration and burial (storage)
    - archaeological resources
    - fisheries
More research will be required to fully understand the impacts of changes to the environment on the supply of these benefits to the people of Severnside and beyond.

What are ecosystem services?

The Ecosystem Services concept considers the environment in terms of what it does for people: how it provides the essential things we need for our health, wellbeing and economy. Ecosystem services are usually described as falling within one of four categories:

- **Provisioning**: raw materials obtained from ecosystems including food, water, and timber
- **Regulating**: the role of the environment in providing a safe and comfortable place to live, for example by maintaining the climate, ensuring clean air and water, and protecting against flooding and erosion
- **Cultural**: the opportunities provided for recreation, as well as the feelings of wellbeing provided by enjoyment of wildlife, tranquil spaces and landscapes, and the spiritual and religious significance of particular locations and their role in cultural heritage
- **Supporting**: the processes on which all other ecosystem services depend, such as primary production, nutrient cycling and soil formation

The rest of this report provides a short summary of the work of the main project against each ecosystem service studied.

A full technical report containing further details of the project is available:


The full report of this project and its maps can be downloaded at:

http://staging.pml.ac.uk/Research/Projects/Ecosystem_service_mapping_in_the_Severn_estuary_an

This project was funded by the Natural Environment Research Council (NERC) Marine Renewable Energy Knowledge Exchange, and conducted in partnership between the RSPB and Plymouth Marine Laboratory.
The project: Ecosystem service mapping in the Greater Severn Estuary and Bristol Channel

This project aimed to identify the locations within the Severn Estuary and Bristol Channel where key ecosystem services are located. The project took a broad scale approach, focusing on five key services that the landscape provides:

1. Ports and shipping
2. Carbon storage
3. Flood risk management
4. Wild food, fisheries and migratory fish
5. Archaeology and sense of place

Using these five ecosystem services, the project’s key objectives were to:

1. Map the services and related activities within a Geographical Information System (GIS)
2. Explore the potential valuation approaches to quantify the level benefit provided by each service
3. Communicate findings to stakeholders

The research highlighted:

- Where gaps in current knowledge and understanding exist when it comes to assessing the benefits provided by the ecosystem services looked at
- The challenges and barriers to assessment, which can be used to inform future research
- Hotspots where the most benefit is delivered for each of the services across the region, providing developers with an insight into locations with high consenting risk

More work is required to fully understand the benefits that society receives from the Severn Estuary and Bristol Channel. However, the hotspot maps created provide the first steps in developing an evidence base for communicating the importance of these sites, whilst providing a baseline to examine future opportunities and costs that may arise from future marine renewable energy developments.

For further information contact:

RSPB: Mark Robins: mark.robins@rspb.org.uk

PML: Tara Hooper: tarh@pml.ac.uk
**Ports and shipping**

**Background**
Historically, Bristol was one of Britain's largest ports, notable for its industrial, military and cultural importance. Although this has now changed in favour of the modern, large scale shipping facilities at Royal Portbury and Avonmouth, the trade that operates from these dockyards maintains the long-lived global shipping connections originally forged in Bristol. Similarly, Port Talbot, Swansea, Cardiff and Newport are Wales' largest ports. With historic links to both the coal mining and steel industries, these ports hold great cultural significance, in addition to economic importance, for South Wales. The cultural links to shipping, ship building and traditional fishing industries are also maintained through the smaller ports, such as Appledore, Ilfracombe, Lydney and Gloucester, that are still in operation across the region.

**Importance of the estuary**
- Crucial links to trade through imports and exports of commodities
- Importance of trade to the regional economy and employment
- Additional benefits, eg recreational boating and fishing, are provided by the space and navigation routes of the estuary, facilities of the ports, and access routes (eg slipways)

**Mapping the benefits**
- Market supply levels of ports dependent upon tonnage of imports and exports
- Spatial assessment of shipping intensity data enabled supply levels for regions within the region that provide channels for pilotage to be mapped (see Map 1)

**What can be valued?**
- Jobs created by the ports
- The value of goods and their final destination
- Value of the shipping for transportation, as compared to other modes of transport
- Cultural significance

**Results**
- The physical features of the estuary and channel enable significant trade links to exist between southwest England, South Wales and the rest of the world
- The highest levels of shipping traffic are along the north Devon coast, leading into the centre of the Bristol Channel, towards the ports at Cardiff, Newport and Avonmouth/Portbury
- Large deep sea ports in close proximity to major road and rail networks provide a significant economic benefit

**Limitations**
- Current maps are limited by lack of data and would be improved by the inclusion of information on the individual commodities imported and exported through each port to provide a more detailed market value that may not be captured by using tonnage alone
- Future assessments of the benefits provided to the large port and shipping industry by deep water channels should include calculating the transportation costs per tonne per km within the major shipping channel
Key considerations
- It is likely that any future renewable energy developments that obstruct shipping routes and navigational channels are likely to face high consenting risk due to the economic and social importance of the region’s ports.

Map 1. Shipping traffic intensity reproduced from MMO marine planning portal data. Shipping intensity (no of ships) ranges from 1 (lowest) to 5 (highest).
Carbon storage

Background
Coastal and marine ecosystems play a particularly valuable role in the capture and storage of atmospheric carbon dioxide, \( \text{CO}_2 \), and so can help mitigate climate change. Vegetated coastal ecosystems, such as seagrass beds, saltmarshes and mangroves, are particularly effective at long-term carbon storage compared to the equivalent amount of carbon that can be stored in the equivalent area of terrestrial forest [1], making these coastal ecosystems incredibly important. The carbon captured and stored within these ecosystems is commonly known as ‘blue carbon’.

Importance of the estuary
- The large areas of saltmarsh and mudflats are important estuarine habitats for capturing and storing carbon and reducing greenhouse gas emissions
- The scale of saltmarsh habitats is reflected in their designation as being of national and European importance [2]

Mapping the benefits
- Carbon capture and storage capabilities of broad scale habitat types
- Carbon capture and storage capabilities of using detailed habitat data relating to the flora present, in addition to broad habitat type (see Map 2)

What can be valued?
- Social Cost of Carbon – the value of climate change impacts into the future of one additional tonne of carbon released into the atmosphere today
- The estimated economic value of saltmarsh and mudflats capturing and storing carbon within the estuary

Results
- The habitats within the upper reaches of the estuary, from Cardiff and Bridgwater Bays to Gloucester in the north, have the greatest potential to store carbon
- Swansea Bay and the Taw/Torridge estuaries are also important
- Saltmarshes within the estuary have an estimated value of £131,600 per year for their blue carbon [3]

Limitations
- The mapping approach used may overestimate the level of carbon stored
- Ground-truthing the levels of carbon present within the different habitats present in the estuary through sampling in the field would provide greater accuracy
- The capture and storage of carbon through primary production carried out by photosynthetic phytoplankton is not included. Future assessments in the region could benefit from considering these data

Key considerations
- Blue carbon could contribute to the British Government’s commitment to reduce greenhouse gas emissions by 80% by 2050, as compared to the 1990 baseline
- Environmental Impact Assessments (EIAs) would benefit from examining the relationship between the natural carbon storage potential of the development site and the projected carbon reduction targets presented for the development, to ensure carbon savings are maximised and an overall reduction in greenhouse gas emissions is achieved
Map 2. Carbon storage levels based on detailed habitat type (substratum and species).
The level of carbon stored ranges from 0 (lowest) to 5 (highest) [4, 5, 6].
Flood risk management

Background
Much of the British coastline is at risk from flooding and as a result man-made sea defences have been constructed in many regions. However, coastal habitats such as saltmarsh offer natural protection against flooding, and reduce the need for (and the associated economic costs of) hard engineered sea defences, whilst also preventing the loss of natural habitats through construction work. Damaging these coastal habitats may reduce their ability to mitigate flood risk and lead to extensive costs, both from flood damage to homes and businesses and through the creation of man-made defences where natural barriers are removed. The physical properties of the Greater Severn Estuary and Bristol Channel provide significant natural flood defences in a region at high risk from flooding; the depth and structure of the channels aid drainage whilst intertidal features provide a natural buffer zone to rising waters. As urban areas have encroached onto flood plains throughout southwest England and South Wales, the value of natural flood protection is increasingly important.

Importance of the estuary
- Rocky shores, saltmarshes and sand dunes provide a barrier zone between inhabited land and the estuarine and marine environment

Mapping the benefits
- Four different elements act together to reduce flood risk and were mapped (see Map 3)
  i) Flood water storage (based on the physical properties of estuary)
  ii) Water current reduction
  iii) Wave reduction
  iv) Drainage of river water

What can be valued?
- Cost of damage prevented as a result of the presence of the habitat
- Cost of avoidance of the construction of extensive man-made flood defences for flood prevention

Results
- A high level of flood risk management benefits is seen along the entire length of the coastline, from north Devon to Gloucester and Milford Haven, and along the Welsh coast to Gloucester
- The greatest benefits are provided through the Inner Bristol Channel, from Cardiff and Bridgwater Bays in the south, up to Gloucester in the north

Limitations
- Inclusion of the entire terrestrial catchment is required for full assessment
- Flood protection is only one element: the role of different habitats in mitigating coastal erosion is also of great importance
- Rocky coasts and cliffs were not included, although they occur in the region
- Many man-made defences exist in the region, and the area will also be heavily affected by future sea level rise
- The use of more advanced modelling/valuation methods to assess the full importance of these habitat features to welfare in the region would be a sensible next step
- Models providing full interactions of terrestrial habitats and features would provide the means of examining the full effect of developments and future scenarios
Key considerations

- Reduction of intertidal habitats, particularly saltmarsh and reed beds, will have a negative impact on flood risk management in the region, and hence is an important aspect of impact assessments.

Map 3. Habitat supply levels for the environmental benefit from flood water storage.
Fisheries, wild food and migratory fish

Background
The waters of the Severn Estuary and Bristol Channel support one of the most diverse fisheries in Britain. Commercial fishing is limited within the estuary itself, but the wealth of fish species supported by the rich nursery areas (111 species have been recorded [7]) provide valuable fishing grounds in the Bristol Channel: combined landings from the region were worth £11,000,000 in 2010 [8]. The commercial eel fisheries form the most valuable inland fishery in England and Wales, making a significant contribution to the rural economy in these areas. The extensive shoreline and tributary rivers also support widespread recreational angling. Traditional fishing techniques are still practised in several places to harvest salmon and European eel, with trap fisheries providing a cultural link across several thousand years of fishing in the region.

Importance of the estuary
- Spawning and nursery grounds for many fish species, including Atlantic salmon and European eel within the tributary rivers
- Supply of fish stocks for commercial fisheries further downstream in the Bristol Channel and beyond
- Migratory pathways for Atlantic salmon and European eel
- Recreational fishing, contributing to tourism and local businesses, and human health and wellbeing

Mapping the benefits
- Identifying the locations within the region where the habitats and environmental features provide the greatest supply of benefits for fisheries, wild food and migratory fish (see Map 4)

What can be valued?
- Market values for commercial fisheries
- Expenditure in local communities for recreational fisheries
- Existence value for fish species
- Bequest value (value of conserving species) for future generations

Results
- The region is essential in providing breeding and nursery grounds for Atlantic salmon and habitat for European eel, aiding stocks of international importance
- The Torridge, Lyn and Wye are particularly important for juvenile salmon
- The Taw Torridge and upper Severn are important areas for netting adult salmon
- The Lyn, Usk and Wye estuaries support the highest levels of adult salmon caught by rod and line
- The Usk and upper Severn Estuary are of greatest importance for eel

Limitations
- Supply level designation could be improved through use of multiple year data
- Maps detailing nursery habitat supply levels for all commercial species and higher resolution maps for Atlantic salmon and European eel, as well as for shad and lamprey, are needed to provide baseline data against which the potential effects of environmental change could be assessed to aid future management of stocks
- Valuation of recreational fisheries would be improved by using additional data from local and national surveys (eg [9])
Key considerations

- The importance of specific habitats, habitat features and quality should be taken into account in development decisions. The impacts and opportunities should be assessed at the earliest stages of the decision making process to reduce consenting risk, and to identify impacts on commercial fisheries, recreational angling and the traditional fisheries that operate within the area.

Map 4. Fisheries and wild food benefit supply based on habitat, ranging between 0 (lowest) to 5 (highest).
Archaeology

Background
The Severn Estuary, inner Bristol Channel and the surrounding catchment provide some of the richest links through human history in Europe. Of particular significance are the shifting mudflats which contain links to our early ancestors via the 8000 year old Goldcliff Footprints, whilst extensive Roman forts, pottery and land reclamation also exist in the region. The use of mediaeval fish traps remains in areas where local residents continue to practise traditional fishing methods, and in more recent times the sentry and machine gun posts, anti-aircraft defences and forts found along the region’s shore reflect the strategic importance of the Channel during the Victorian era and Second World War. The historical importance of local and global transport links provided by both the estuary and Bristol Channel is evident in the well preserved port facilities and shipwrecks from Roman, mediaeval and Tudor times through to the present day.

Importance of the estuary
- Linked to over 8000 years of history
- Intertidal mud, specifically peat habitats, is important for the preservation of archaeological sites

Mapping the benefits
- Mapping of archaeological sites focused on
  i) All Historical Environment Records (HER)
  ii) Mesolithic to Bronze Age finds around Cardiff and North Somerset to Gloucester
- These data were used to relate habitat types and environment features to archaeological benefit supply (See Map 5)

What can be valued?
- Tourism through visitor numbers, and accommodation bookings
- Travel cost – people’s willingness to pay to visit sites
- Research interest through the level of research grants linked to a site or the number of educational visits to a site
- Bequest value –people’s willingness to pay for the site to be preserved for the benefit of future generations

Results
- The greatest density of archaeological finds is predominantly located around the shorelines of the upper estuary and around the historic ports. Swansea and Bridgwater Bays and the Taw Torridge are also important
- Intertidal peat deposits are internationally important due to the Mesolithic finds associated with them

Limitations
- The method is based on number of sites, and so excludes other components of their value such as sense of place, cultural identity and other intrinsic values
- Mapping all HER provides an indication of the number and diversity of sites, but this should be subdivided by historical period
- HER may be collated differently within each county or region, therefore it is vital to consult archaeological experts within the earliest stages of development
- The large number of internationally important sites found within a small area of the upper Severn Estuary demonstrates the need for detailed assessments
- The relationship between habitat types and environmental features is not fully understood. Further consultation with the archaeological research community would benefit the development of this approach.
Key considerations

- Due to the high diversity of sites within the region, the irreplaceable nature of archaeological finds, the importance to understanding human history and the cultural link to past societies, it is strongly advised that archaeologists are consulted from the earliest stages to provide site-specific advice.

Map 5. The levels of archaeological interest within the Severn Estuary and Bristol Channel, based on habitat type. Scores range from 0 (lowest) to 5 (highest).
Sense of place

Background
Sense of place describes a person's connection to a particular location and reflects the strong emotional ties created by place interactions and experiences. This provides a unique personal association with landscapes, and the historical and cultural properties of a specific place or region. A person's sense of place is rarely associated with economic wealth, but predominantly with the health, wellbeing and relaxation offered by 'their place'. Changes to an environment, such as new large-scale developments, can affect the way people view that environment and their associated sense of place, resulting in negative effects on the community or public opposition preventing proposed developments. Identifying what aspects of the environment within the Severn Estuary and Bristol Channel link to people's sense of place may guide planners and developers in their decision making, informing the process by highlighting issues or key aspects at the outset of projects.

Importance of the estuary
It is clear that many locations within the Severn Estuary and Bristol Channel create a strong sense of place for the local community and visitors, but there is little formal documentation of these place attachments.

Mapping the benefits
- Mapping was not undertaken due to a lack of data
- Instead potential mapping techniques were reviewed:
  1. Interviews – *Why is the estuary important to you?*
  2. Photovoice method (photographic records with associated comments)
  3. Community Voice method (community, as opposed to individual, perceptions)

What can be valued?
- These methods do not provide straightforward economic valuation data. The different interpretation of value between individuals relating to the environment around them may be inappropriate for monetary valuation.
- However, human perspective and community opinion and perceptions can be recorded through qualitative analysis, such as identifying prevalent viewpoints, and be brought to group discussions to provide a means of opening discussion

Results
- The techniques described above could be used within a larger cultural mapping programme for the region

Limitations
- Measuring sense of place is still a developing area
- Documenting what constitutes sense of place throughout the study region would require significant effort and resources, particularly to get involvement from stakeholders across multiple communities
- Current approaches would suit a number of smaller projects to present overviews of areas; however, the methods would still need to be applied as targeted projects to aid location specific planning or development decisions

Key considerations
- Identifying the aspects of the environment that relate to a local community's sense of place is important at the outset of planning and development
- Understanding sense of place would identify regions where developments would have the greatest impacts and also help in designing mitigation solutions
- Methods aiding community involvement in decision making and mitigation are useful tools to engage the public and help reach acceptable solutions
References


