Estuaries

(partial review in 2004)

1. A Definition

Estuaries are partially enclosed coastal water bodies which are open to the sea, but which usually have reduced salinity owing to inputs of freshwater from rivers and streams.

They are among the most productive of natural ecosystems on earth, and although the number of species that are able to tolerate this constantly changing environment is relatively low when compared to the marine environment, the species populations can be astronomical and estuaries are of critical importance to the biodiversity of Devon.

Dartmouth

Several fish such as the sea bass use Devon's estuaries as nursery or spawning grounds, and salmon pass through our estuaries on their journey up river to spawn. Astonishingly high densities of worms, shellfish, crustaceans and micro-organisms are to be found buried in the mud and sand and these provide food for nationally and internationally important numbers of migratory waders and wildfowl that grace our estuaries in autumn and winter. Indeed the particularly mild winter climate of the South-West's estuaries provides an important refuge destination for many thousands of additional waders and wildfowl if conditions elsewhere in Britain become severe.

Estuaries demonstrate important earth science processes and features, such as sediment dynamics and the sea level changes which drowned river valleys in geological history. As such they are an important resource for education and research. Geologically, estuaries are short lived and transient ecosystems.

Devon boasts no less than twelve estuaries of a variety of types and sizes, constituting an extremely diverse range of habitats; sand and mud flats, rocks, saltmarsh, intertidal reedbeds, eel grass beds, open water, etc..

Water salinity plays a large part in determining the species of animals, plant and algae to be found in estuarine habitats. Some of Devon's estuaries, such as the Taw Torridge and Exe, are of the type with relatively high freshwater

influence and therefore a range of salinities over the course of a tidal cycle. Organisms that live in such estuaries therefore need to be able to tolerate a broad range of salinity conditions or migrate on a tidal cycle. Many rias, such as the Salcombe-Kingsbridge estuary, have a different salinity regime because relatively small amounts of freshwater enter them from rivers and streams and therefore are host to a subtly different biological resource than bar-built estuaries, with organisms more typical of fully marine conditions, thus holding the higher ecological diversity of species of the marine habitat but also the very high biomass indicative of estuaries.

Apart from salinity, the other major physical determinants of the estuarine life are sediment size and coarseness, and seabed type. Estuaries generally are predominated by muds and silts, with coarser deposits, usually of marine origin, occurring at the mouths of estuaries as sand flats and banks. Also - surrounding topography, aspect, exposure, tidal range and currents, and depth have an effect.

Estuaries contain a variety of habitats, and this action plan will cover the following categories, while recognising their interrelatedness in the estuarine system; mudflats (including mussel and oyster beds), sandflats, eel grass (*Zostera*) beds, and saltmarsh (including intertidal reedbed), sheltered rock foreshore, sheltered rock seabed.

The Otter Estuary

2. Why an Action Plan?

Estuaries have in the past and continue to be a focus of man's activities; as sheltered harbours and sites for the towns and cities, with consequent pressures from industrial, agricultural and domestic effluents, as important fisheries, sites for agricultural land claim and urbanisation, and more recently

as an important recreational resource.

Most of Devon's estuaries have been modified by the activities of man to a lesser extent than others in terms of agricultural land claim and large scale industrial activity, and this naturalness makes our estuaries all the more special.

Nevertheless, if we are to maintain the health and environmental integrity of estuaries in Devon the varied pressures placed on them from tourism, recreation, fisheries and other sources must be managed carefully so that they can continue to be sustainable for these uses as well as a rich resource for biodiversity.

3. Characteristic wildlife

Estuaries are very rich environments, both in terms of the number of micro-invertebrate species they support, and of the sheer numbers of individuals.

Organisms such as diatoms (single celled algae found on the mudflats) and bacteria (found on and within the mudflats), form the base of most estuarine food webs. Larger marine algae are plentiful, including the familiar wracks and other seaweeds such as the sea lettuce. Several Devon estuaries support areas of an unusual flowering plant, the eelgrasses, which provide both a food source and habitat. Salt marshes support a rich and colourful flora, e.g. sea aster and sea lavender and macro-invertebrate community.

Numerous invertebrate species feed on the plankton, diatoms, bacteria and detritus, in turn eaten by larger predators, including worms such as nematodes, the voracious ragworm and king ragworm, molluscs like the mussel, cockle and spire shell, and crustaceans such as shore crabs and various shrimps. Many of these animals can occur in astronomical densities and numbers on and within estuarine substrates, and they are abundant enough to be the food of the tens of thousands of wading birds, wildfowl and fish that are often present within our larger estuaries at any one time in autumn or winter.

Fish may also be very abundant and diverse, including bass, flounder, dab, plaice, grey mullet, sand eels. Fish are a favourite diet of birds including grebes, cormorants, terns and gulls and saw-billed ducks.

4. Special species

The following species of conservation concern are associated with estuaries in Devon. Species marked (p) are 'Species of Principal Importance in England' (NERC Act, S.41).

- **Birds**: cormorant, little egret, pintail, shoveler, teal, wigeon, mallard (c), goldeneye, shelduck, dark-bellied brent goose (p), red-breasted merganser, oystercatcher, turnstone, sanderling, dunlin, knot, curlew sandpiper, little stint, ringed plover, bar-tailed godwit, black-tailed godwit (p), avocet, curlew (p), whimbrel, snipe, ruff, grey plover, golden plover, redshank, greenshank, herring gull (p), lesser black backed gull, little tern, roseate tern (p), common tern, arctic tern, Sandwich tern, osprey

- **Fish**: allis shad (p), Atlantic salmon (p), smelt (p), long-snouted seahorse (p), short-snouted seahorse (p)

- **Molluscs**: native oyster (p), horse mussel, fan mussel (p)

- **Algae**: *Lophosiphonia reptabunda*

- **Flowering plants**: eelgrass

5. Distribution and current extent

Devon's twelve estuaries are distributed largely on the south coast, with only the Taw Torridge on the north coast.

Devon contains a total of approximately 3000 ha of intertidal mud- and sand-flats, plus about 550 ha of saltmarsh.

The Taw - Torridge

6. Current problems for estuaries in Devon (1998)

Shoreline developments: In a high proportion of Devon's estuaries there are constant demands for estuarine locations to be considered for land claim. Although these are subject to planning and other licences, the piecemeal approach remains a threat to our estuaries.

Water quality: Effects of nutrient enrichment from run-off and sewage outfalls depend on local circumstances and also depend on which organisms one is considering; for example species diversity may be depressed by organic enrichment whilst the numbers of individuals (e.g. certain worms or algae in the form of "blooms") and/or size of certain species (e.g. the algae *Enteromorpha* spp.) are increased, because there is more 'food' available to them. It should be remembered that estuaries are naturally high nutrient environments, so high levels are to be expected as a "normal" baseline level. Oil pollution incidents, both chronic and acute, have the potential to smother or poison estuarine fauna and flora.. Antifouling paints are a necessary evil for many types of vessel, the deleterious effects of some such as TBT well documented, and although the use of TBT on all craft is now illegal, some reports suggest that the latest generation of anti-foulants is hardly better. However inputs of TBT and other biocides and toxic heavy metals into estuarine systems may still result from large commercial vessels and re-suspension of contaminated sediments. In addition to heavy metal contaminants, there are other potentially toxic chemical used for other boat maintenance activities (lubricants, solvents, detergents, emulsifiers, abrasives etc.), the effects of which are frequently misunderstood.

Coastal squeeze: The restriction of the extent of coastal habitats such as saltmarsh caused by man-made barriers such as sea walls preventing the natural inundation of areas fringing the intertidal zone. Predicted rises in sea level will vastly compound the present problem, as well as causing predicted changes such as increases in storm activity, changes in the predominant wave direction and sedimentation/erosion patterns.

Bait digging: Removal of crabs, rag and lug worms, sand eels may cause local depletion of food reserves of wading birds, terns or fish, or prevent them from feeding or roosting in certain areas due to disturbance. Inspection of collecting structures leads to some re-suspension of sediment and structures may lead to habitat change i.e. by introduction of a hard substrate - current research investigation.

Potential over-exploitation of shellfisheries: In addition, increases in suspended sediment following fishing practices such as trawling and dredging operations may adversely affect communities by smothering, physical damage, habitat and community changes.

Changes in sediment type and distribution: Resulting from dredging and extraction within estuaries (as part of management for navigation or mineral use), or more indirect effects as sediments suspended in the water column are carried by currents and deposited elsewhere. Animals of sand flats and banks may be susceptible to smothering by the input of finer sediments - some level of sedimentation is likely within estuaries. Re-suspension of sediments also brings re-suspension of pollutants into the water column and upper layers of

sediment once re-deposited. Sediment dredging may be detrimental to those studying geomorphological aspects of estuaries.

Invasion of non-native species: This may pose a threat to native communities. Examples include animals such as the Pacific oyster (now feral in several estuaries) and Manila clam and plants such as common cordgrass which invades salt marshes and the brown alga *Sargassum muticum* affecting eelgrass beds.

Inappropriate grazing of stock: Lack of, under-grazing or over-grazing on salt marshes results in sub-optimum conditions for characteristic saltmarsh communities.

Lack of maintenance of river banks: In the upper reaches of some estuaries results in collapse of banks and leads to lack of protection of valuable saltmarsh and reedbeds and subsequent loss to erosion.

Lack of knowledge: Of a range of biological/ecological matters, such as the distribution of certain organisms, notably eelgrass beds, but also a range of other organisms, and lack of knowledge of the susceptibility of organisms and communities to natural and man-induced environmental changes. General lack of knowledge of natural background levels of silt, nutrient and micro-organism inputs and most importantly, what the true climax communities would be for estuarine habitats without anthropomorphic impacts.

Devon has some of the finest estuaries in the country, which have long provided for the enjoyment of all manner of recreational pursuits from walking to sailing. It remains a challenge to ensure that the balance between these needs and those of wildlife remains environmentally sustainable.

7. Recent changes in extent (1998)

Reclamation of estuarine habitat has taken place: on the Exe, with loss of intertidal mudflats and saltmarsh, and loss of grazing marsh due to the construction of a canal in the 17th Century and railways in the mid 19th Century; on the Tamar, with the construction of naval dockyards and industrial development; on the Plym, with reclamation in the 1800s and 1970s; Taw-Torridge, with losses to agriculture over the last 200 years, and flood defence works in the 1980s and 1990s.

In addition to these more dramatic examples, most of our estuaries in Devon have experienced some scale of habitat loss.

Trends in the quality of habitats are less easily quantified, but overall the water quality of estuaries is believed to have improved over the last few decades.

8. Current site protection

The Exe Estuary is designated as a classified SPA (under the EC Wild Birds

Directive) and a Ramsar site (under the Ramsar Convention on Wetlands of International Importance). Plymouth Sound and Yealm Estuaries are classified as SPA and SAC (under the EU's Habitats and Species Directive). Braunton Burrows is at the core of North Devon's Biosphere Reserve (a UNESCO designation).

Parts, or all, of the following estuaries in Devon have been designated as SSSIs; Otter, Exe, Salcombe/Kingsbridge (marine SSSI and LNR), Erme, Tamar-Tavy, and Taw-Torridge. Dawlish Warren is a NNR.

9. Current positive initiatives for estuaries in Devon (1998)

- Schemes of management for candidate marine SACs.

- 'Important Bird Areas' is a non-statutory designation of sites identified as qualifying for protection as an SPA under the EC Wild Birds Directive, and in Devon include Exe and Tamar estuaries.

- Reserves managed specifically for the purposes of biodiversity include RSPB reserves, Local Nature Reserves (and for local community access to natural open spaces; formal and informal education; etc.) and DWT reserves.

- Estuary Management Plans are being implemented on the Exe, Dart, Kingsbridge/Salcombe, Tamar-Tavy, Avon, Erme, Yealm, Teign and Taw-Torridge estuaries. These non-statutory plans provide a framework for the resolution of estuarine issues through collaboration, within a vision of sustainable management of estuaries.

- Local Environment Agency Plans (LEAPs), formerly called Catchment Management Plans, were developed by the Environment Agency (EA) and its partners, and addressed all issues under the EA's remit, including targets for biodiversity, on a river catchment basis. In Devon, LEAPs were produced for the following catchments: Lim/Axe, Sid/Otter, Exe, Teign, Dart, Avon & Erme (which includes Salcombe/Kingsbridge), Tamar Estuary and Tributaries (which includes Yealm), Taw-Torridge, Hartland Streams, and Lyn & North Devon Streams. LEAPs have since been superseded by the Devon Areas 'local contribution.'

- Shoreline Management Plans, devised in partnership between EA, LAs and EN, define management options for coastal defences.

- Development Plans produced by planning authorities generally have protective policies for important wildlife sites and for the coastal zone, reflecting national guidance and European directives.

- Water quality improvements, such as the EC Urban Waste Water Treatment Directive (implemented by programmes such as Asset

Management Plans). South West Water Services Plc's "Clean Sweep" programme is the local face of these national and international initiatives.

- National Trust "managed retreat" under MAFF Habitat Scheme (Saltmarsh option) underway at Saltram, which allows the tide to flow over an area of previously defended land, thereby establishing conditions which will lead to the establishment of a well-developed saltmarsh community.

(note: MAFF is now a discontinued body. Its responsibilities have fallen to Defra.)

- Wetland Bird Survey (WeBS) is a national co-ordinated monthly count of shorebirds and wildfowl on several of Devon's estuaries; run by BTO, WWT, RSPB, and JNCC.

- Seaquest record "megafauna" of estuaries.

- An eelgrass working group has been established.

- The University of Plymouth and others are undertaking a programme of research and monitoring within the Yealm, Erme, Avon and Salcombe/Kingsbridge estuaries.

- MAFF/Devon Sea Fisheries Committee undertook scallop growth trials in the Salcombe/Kingsbridge estuary in 2003. Monitoring of oysters for the possible accumulation of organophosphates is being conducted in the Dart estuary by DSFC, EA and SHDC.

- Surveying and mapping eelgrass sites is underway at certain sites in the County (e.g. Salcombe/Kingsbridge estuary by English Nature, Salcombe Harbour Authority / South Hams District Council, and in Torbay by Torbay Council).

- Institute of Terrestrial Ecology research programme on Exe estuary into the carrying capacity of estuarine and coastal areas for waders and wildfowl.

- TTEP are researching properties of managed retreat sites as a tool for improving water quality.

- Water quality and fisheries monitoring programme of the Environment Agency.

- Site monitoring (habitats and species) at managed sites, such as Dawlish Warren NNR.

10. Biodiversity planning context

National BAP Context

Habitats of principal importance in England (NERC Act, S.41):

- Coastal saltmarsh
- Estuarine rocky habitats
- Seagrass beds

Current national BAP targets can be viewed on the Biodiversity Action Reporting System (BARS).

Regional Plan Context

Regional targets for priority BAP habitats can be found on the website of Biodiversity South West.

Associated Action Plans within the Devon BAP:

- Rocky foreshore
- Rocky seabed
- Rivers, streams, floodplain and fluvial processes
- Grazing marsh
- Atlantic salmon
- Curlew
- Otter

11. Biodiversity objectives and targets for estuaries in Devon

Objective 1

Protect, maintain and enhance the extent and condition of estuarine habitats in Devon and ensure the protection of species which depend upon these habitats, subject to natural change.

Targets:

- Ensure no net loss of intertidal area within Devon's estuaries and no loss of sub-tidal area (or 'valuable' terrestrial area) for intertidal gain.

- Seek to favour natural processes and the creation of saltmarsh, though not at the expense of other important habitats or estuarine features (note: many ria estuaries (drowned river valley) are characteristically steep sided and any increase in saltmarsh area may not be appropriate).

- At least maintain extent and distribution of eelgrass beds in Devon estuaries.

- Assess feasibility of restoration of damaged or degraded eelgrass beds.

Objective 2

Ensure all relevant plans encourage an integrated approach to the delivery of Biodiversity targets for estuarine habitats and species.

Target:

- Ensure all estuaries are covered by current, relevant management plans to integrate BAP targets.

12. Wider benefits from pursuing these objectives

The pursuit of the objectives and targets set out above will not only benefit the biodiversity of estuaries. Conservation has wider benefits and advantages for society, by providing a resource which is the basis of many aspects of the local economy, and by adding to the quality of life of the people of Devon in ways which are beyond actual financial measure. Thus enhancing the interests of biodiversity may also enhance the interests of society as a whole. Some of these wider benefits are as follows:

- Maintenance of sustainable fisheries, by protection and management of nursery areas for fish such as bass, and by encouraging the sustainable harvesting of fish and shellfisheries.

- Enhancement of possibilities for tourism, especially the sustainable kind, thereby boosting local economies.

- Diversification of farming activities by encouraging grazing on upper salt marshes.

13. Priority or indicative actions for estuaries in Devon

Action	Key Partners

1. Ensure that all local planning strategies (inc. Local Development Frameworks) take full account of protected sites, wildlife legislation and planning guidance including PPG9 (and forthcoming revision) and PPG20.	DCC; LAs; EN
2. Ensure that all relevant plans that affect estuaries (e.g. Estuary Management Plans, Shoreline Management Plans) have biodiversity targets attached to them or referred to.	LAs; EA; EN
3. Continue to enforce pollution legislation, raise awareness and seek to ensure, by lobbying, that leisure and commercial boat maintenance practices prevent chemical pollution entering estuaries. Need to define roles of key partners.	EA; Harbour Auths; LAs
4. Promote the positive management of salt marshes through the use of WES and agri-environment schemes and management plans to include (as appropriate) grazing regimes and re-alignment (managed retreat) to restore or create saltmarsh. Need to identify who will advise on stocking rates, etc.	EA; EN; DEFRA; DWT; RSPB
5. Monitor the extent and condition of estuary habitats and communities (to include monitoring of roosting and feeding birds where they are susceptible to disturbance by human activity). Ongoing need but limited by funding.	EN; EA; DWT; RSPB; DBRC
6. Ensure that sediment dredging and dumping operations pay due regard to any estuarine and marine biotopes and where possible take ameliorating measures. Where practical, seek to allow natural sediment dynamics in estuaries (this may not always be possible or practical, due to human activity elsewhere within catchments affecting the sediment loading of the estuary).	Harbour Auths; EA; LEMPs
7. Promote schemes for local management and control of commercial and leisure bait extraction so that elements of native biodiversity are sustained.	LEMPs
8. Continue to provide interpretation facilities ensuring that they do not compromise the protection of sensitive features and that the advice given is based on consensus in order to avoid contradictions in advice.	TICs; LEMPs
9. Promote, disseminate and implement established codes of conduct for leisure and commercial users of Devon's estuaries. Review codes and progress regularly.	LEMPs
10. Promote research in estuaries including sediment dynamics, ecological effects of commercial bait harvesting and pilot projects for saltmarsh and eel grass bed restoration. Research to include baseline saltmarsh survey and a predicted change due to climate change and sea level rise - gains and losses. Survey also needed to quantify the quality of salt marshes ref. common cordgrass invasion.	EA; EN; LEMPs; Universities; DWT; RSPB; DSFC

Estuaries Action Plan Champion - Devon County Council

Abbreviations used in text and table

BAP	Biodiversity Action Plan
DSFC	Devon Sea Fisheries Committee
DWT	Devon Wildlife Trust
EA	Environment Agency

EN	English Nature
LAs	Local Authorities
LEMPs	Local Estuary Management Partnerships
RSPB	Royal Society for the Protection of Birds
TIC	Tourist Information Centre
WCTB	West Country Tourist Board

Discontinued body referred to in text:

MAFF	Ministry of Agriculture, Fisheries and Food