



An inventory of UK estuaries

Volume 4 North and East Scotland

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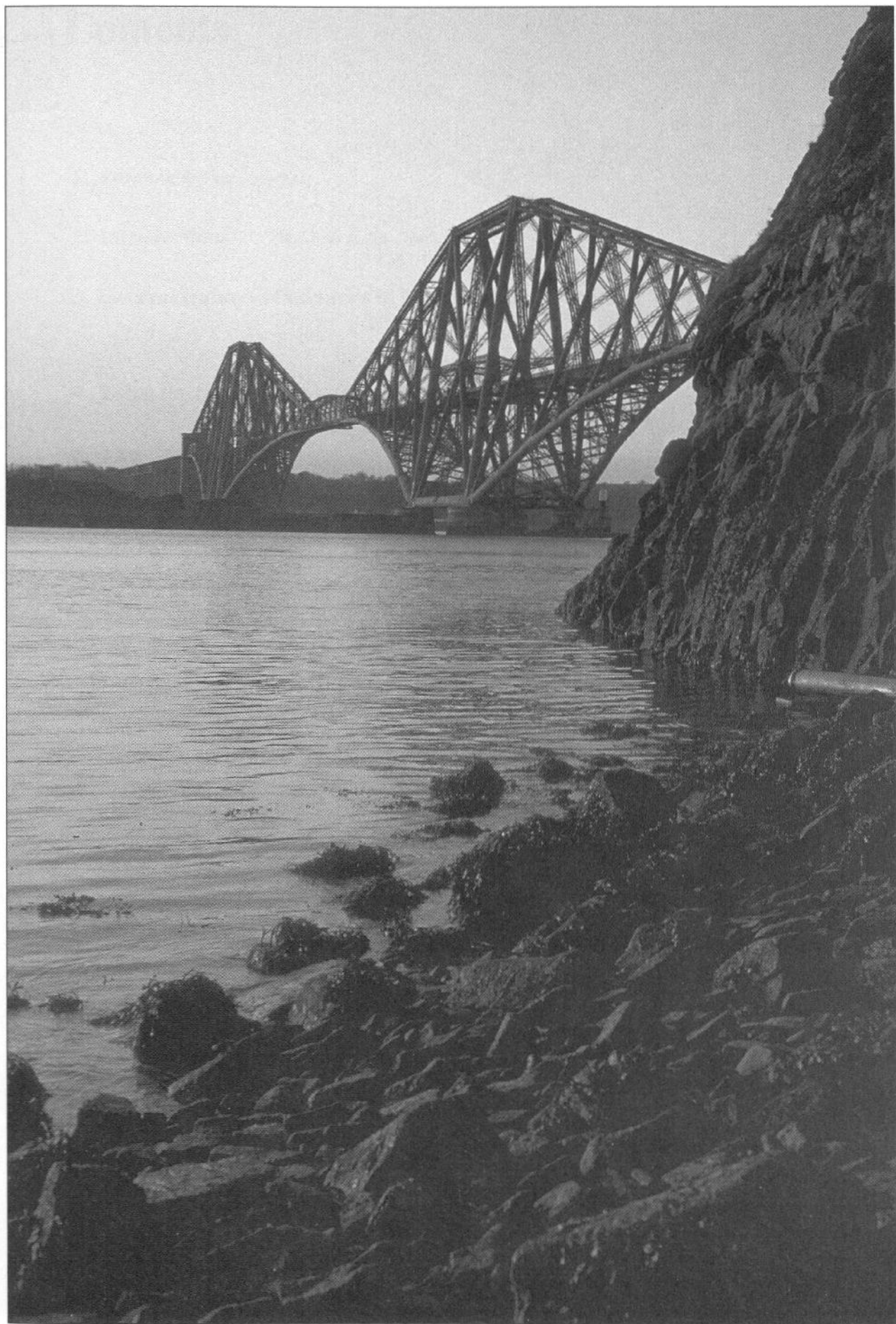
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An inventory of UK estuaries is being produced in seven volumes. The inventory is compiled by the Coastal Review Unit of JNCC's Coastal Conservation Branch. Further reports are in preparation.

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The railway bridge at Queensferry. The Firth of Forth is one of the five largest estuaries in North and East Scotland.
(S.M. Atkins, SNH)



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1 Foreword

Professor Peter Evans

Chairman, Department of Biological Sciences, University of Durham

Viewed worldwide, estuaries are a scarce natural resource, even though some in the deltas of great rivers are of immense size. The British Isles are fortunate in holding a large number and variety of types of estuary, particularly when compared with the rest of temperate and Mediterranean Europe. Yet we have not used most of our estuaries either wisely or sustainably, probably for two reasons: first a lack of knowledge of the natural resources they contain and second a lack of understanding of the effects of the human uses to which they have been, or are being, put.

Pollution problems up-river have readily been apparent to anglers and recreational users alike and there have been long-standing campaigns to improve water quality in many of our rivers. These have begun to bear fruit. Many of the larger estuaries have not attracted such concern from the general public in relation to their water quality. People have increasingly turned their backs on the river corridors as they near the sea and looked further afield for clean recreational areas. As a result discharges of industrial and domestic wastes into estuaries have continued on a large scale, though restrictions are gradually being introduced (or even self-imposed by environmentally aware industrial concerns).

Even less obvious to the general public has been the steady loss of intertidal land within estuaries, to land-claim for industrial development and to dredging for the creation of wider and deeper shipping channels and berths needed to accept the larger vessels in which we import more raw material as our own accessible resources of many minerals and chemicals decline. Intertidal and even permanent shallow-water areas of estuaries have been buried under domestic rubbish and other solid wastes, or sometimes permanently flooded for water storage schemes. To these established, though often not sustainable, uses are being added new demands: barrage schemes for power generation, harbour developments for pleasure craft and many others.

Knowledge of the natural resources of the British estuaries has been slow to accumulate. Even one of the most obvious of the biological resources, the bird populations, had not been counted in more than a few of the smaller estuaries before the 'Birds of Estuaries Enquiry', now organised by the BTO, WWT, RSPB, and JNCC, was launched in 1969. The very idea of attempting a count of all the birds using the shores of the Wash in Lincolnshire and Norfolk was considered impractical before a Cambridge Bird Club team, of which I was a member, attempted the task in the mid-1950s. Quantification of other resources has proven even more difficult: fishery catch statistics do not necessarily permit identification of spawning and nursery areas, yet for several species these lie in estuaries and are vital for the continued health of our fish stocks. The role of algae and other plants in stabilising estuarine shores against erosion is only now becoming

understood in a more quantitative way though it had been appreciated for more than half a century that planting of the cord-grass *Spartina* provided an extra line of defence against erosion of soft shores.

Now we are faced with the reality of sea level rise and the need for rethinking coastal defences. People have come to appreciate the value of the wildlife resources of estuaries, and industries located on estuaries increasingly appreciate the advantages of developing a 'green image' backed by actions such as the reduction of waste discharges to confirm it. This, therefore, is a particularly appropriate time to launch this *Inventory of UK estuaries*, building on the excellent publication *Nature conservation and estuaries in Great Britain* which appeared in 1991. That book, edited by Dr Davidson, who is a co-author of several of the chapters in these present inventory volumes, was the last major review published by the former Nature Conservancy Council. I am proud to have persuaded my fellow Council members in the mid-1980s to commission that work which has, I believe, influenced attitudes to estuary use in a most positive way.

I well recall, during the Examination in Public of the Teesside Structure Plan in 1975, appealing for a national planning policy to be developed for estuarine use. It was considered impossible at that time. But today there is great enthusiasm including guidance from government for coastal conservation and management, in part as a result of our growing international responsibilities for example in relation to the management of the North Sea, the implementation of the Ramsar Convention on Wetlands of International Importance and the acceptance of the EC Directives on the Conservation of Wild Birds (1979) and Habitats and Species (1992). The need for detailed information to enable sensible estuarine management plans to be formulated not only in a local but also a national and international context has never been greater. I commend these volumes to all interested in the planning, sustainable development, management and conservation of UK estuaries. It is an authoritative base-line from which to prepare for the 21st century.

Peter Evans

Durham, January 1993

2 Introduction

N.C. Davidson & A.L. Buck

Coastlines change continually under the forces of wave, tide, current and wind. In some places along the coast the hard rocks laid down millions of years ago or the softer, more recent, glacial deposits are being eroded. These eroded sediments are transported by currents, often for considerable distances, out into deeper water or along the shore. Much of this sediment is deposited along the coastline: coarse sediments forming shingle and sand beaches, and fine particles forming mudflats in sheltered bays, inlets and river estuaries. All these types of estuary act as 'sediment sinks' that trap much of the sediment moving along the coast. Where the estuary is formed by a river discharging into the sea, particles carried downstream by the rivers are deposited in the reduced currents and shelter of the river mouth, adding to the sediments of marine origin.

In time these sediments build up in estuaries, become stable and parts may become vegetated to provide a complex of habitats. Saltmarsh vegetation colonises intertidal flats that have accumulated to levels above mid-tide height. Where sand is blown onshore there is development of sand dunes, or where larger deposits move onshore shingle ridges develop. In the event of restricted drainage within sand dunes or shingle ridges, or even within saltmarshes, saline lagoons can form. This variety of coastal habitats is often in a state of change, adjusting to the short-term effects of winds, tides, waves and currents, and are shaped by the more gradual changes over periods of thousands of years as sea levels rise and fall.

The inflow of water from rivers and the sea brings a continual influx of nutrients. In river estuaries the freshwater brought down the river meets the saline water from the sea. In some estuaries these water bodies mix well, with tidal movements and variations in river flow creating large variations in water salinity over short periods of time.

The complex of estuarine habitats that develops under these conditions supports a variety of plants and animals which have adapted to exploit the nutrient-rich but continually changing tidal conditions. Relatively few species have evolved to cope with the extremes of constantly changing salinity and tidal levels of river estuaries but those that have often occur in great densities. As a result the estuarine mudflats and saltmarshes in temperate regions such as the United Kingdom are amongst the most productive ecosystems in the world. This rich plant and invertebrate life provides an abundant food supply for predators such as fish, which often use the shelter of estuaries for spawning and as nursery areas. Some species of birds and mammals feed on these fish, whilst many others feed directly on the saltmarsh vegetation and on the abundant molluscs, crustaceans and worms living in soft sediments. The relatively mild winter weather conditions of estuaries in the United Kingdom make them additionally attractive wintering grounds for migratory waterfowl from a large area of the northern hemisphere.

The coastline of the United Kingdom is particularly well endowed with estuaries, and these vary greatly in their geomorphological origins, size, shape, extent of freshwater influence, and the complex of marine and coastal habitats that occur there. These estuaries are widely recognised as one of the greatest natural assets in the UK.

UK estuaries vary greatly also in the extent to which they have been used, changed or destroyed by people exploiting their natural resources. People have used estuaries for many centuries and for many purposes. Some uses, such as ports, exploit the shelter offered by the physical structure of the estuary. Others, for example barrages, control or exploit tidal movements. Many traditional practices depend on sustainable use of the rich natural resources such as fish and shellfish found in estuaries. A recent trend has seen estuaries as the focus for leisure activities, in water, land and air. These range from organised activities such as sailing regattas to informal uses such as walking and the quiet enjoyment of these often spectacular wild landscapes and their wildlife.

Effective conservation of estuaries for their wildlife requires the maintenance of the diversity of the estuarine network throughout Britain and internationally, and the sustainable management of individual estuaries in this network. Yet many parts of estuaries have already been destroyed through human activities leading to land-claim and degradation. Such pressures continue and damage can arise through the subtle interaction of the human urge to control estuaries (e.g. by constructing sea defences against flooding) and the estuaries' natural movement in response to rising sea levels.

There is increasing recognition that managing and maintaining our coasts and estuaries for the future depends on co-operation between the groups of users, coastal managers and decision makers. This co-operation is increasingly being sought through processes of integrated coastal zone planning and management (CZM). Many CZM initiatives are focused on estuaries since it is often here that there is most overlap and potential conflict between people and the natural estuarine resource.

In developing estuary management plans there is a need for sound baseline information on the natural resource and how it is being used. Such information is needed both in detail for the estuary under consideration and more broadly so as to set a particular feature or site in its wider national and international context. To provide this British national context as a baseline for the development of sustainable use objectives, the Nature Conservancy Council (NCC) undertook an Estuaries Review which published *Nature conservation and estuaries in Great Britain* as a national overview of estuaries, their wildlife, their conservation and their human uses (Davidson *et al.* 1991).

An inventory of UK estuaries follows on from this national overview, and provides a summary of resource, wildlife, conservation status and human use features on each of the 163 estuaries identified by the Estuaries Review around the coasts of the United Kingdom. Much of the information presented in the inventory was collated between 1988 and 1991 during the work of the Estuaries Review. Where possible, however, we have included more up-to-date information. Where this more recent information is given the relevant dates are indicated in each display. The inventory thus provides a 'snap-shot' in time for the state of the UK estuarine resource at the end of the 1980s.

An inventory of UK estuaries takes the form of a series of standardised dossiers, taking each estuary (as defined by the Estuaries Review) in turn. Each of these reports gives a summary of the key features of interest or significance for estuary management from a nature conservation perspective. An inventory entry is designed to give initial summary information about a feature and to help direct users to more detailed sources of information should this be required. The inventory is not, however, intended to provide comprehensive listings of plant and animal species recorded on the estuary. Nor can it provide more than the initial basis for the development of practical coastal zone management initiatives such as integrated estuary management plans.

The inventory provides part of a sound information base for estuary management. Taken together with the national overview provided by *Nature conservation and estuaries in Great Britain*, the information in the inventory permits estuary managers to set the resource on a particular estuary in its national and international context - an important stage in the identification of management issues. The inventory should also help understanding of the great importance of the UK estuarine resource by the many user-groups and those involved in decision-making. Its availability for use in matters of development planning and control ensures that there is a readily available single source of summarised information, eliminating the need to search through a great variety of sources in many different styles of presentation. In addition the snap-shot information in the summary provides an easy-to-use basis for broad-scale monitoring of change in the estuarine resource and its human uses.

An inventory of UK estuaries is being published in six regional volumes, most including 20-30 estuary reports. The regions are shown in Figure 1. Boundaries have been chosen largely on topographical grounds to provide meaningful geographical zones. For England and Wales these boundaries coincide broadly with the known divisions of major coastal sediment cells.

There is also an introductory volume (volume 1). This provides more detail of the rationale of the inventory, explanations of the approach to site definition and selection, details of the information sources used for the inventory, and summary tables listing estuary locations and characteristics updated and corrected from those in Davidson *et al.* (1991). Users of the inventory are strongly urged to consult this volume for definitions before undertaking detailed interpretation of site reports. Since many people who have helped with the Estuaries Review and inventory work have contributed to more than one volume we have included a full Acknowledgements

section in this introductory publication rather than in each regional volume.

We give below a brief overview of the estuarine resource in this North and East Scotland coastal area covered by Volume 4, then a short key to using and interpreting the information entries in each site report, followed by the site reports.

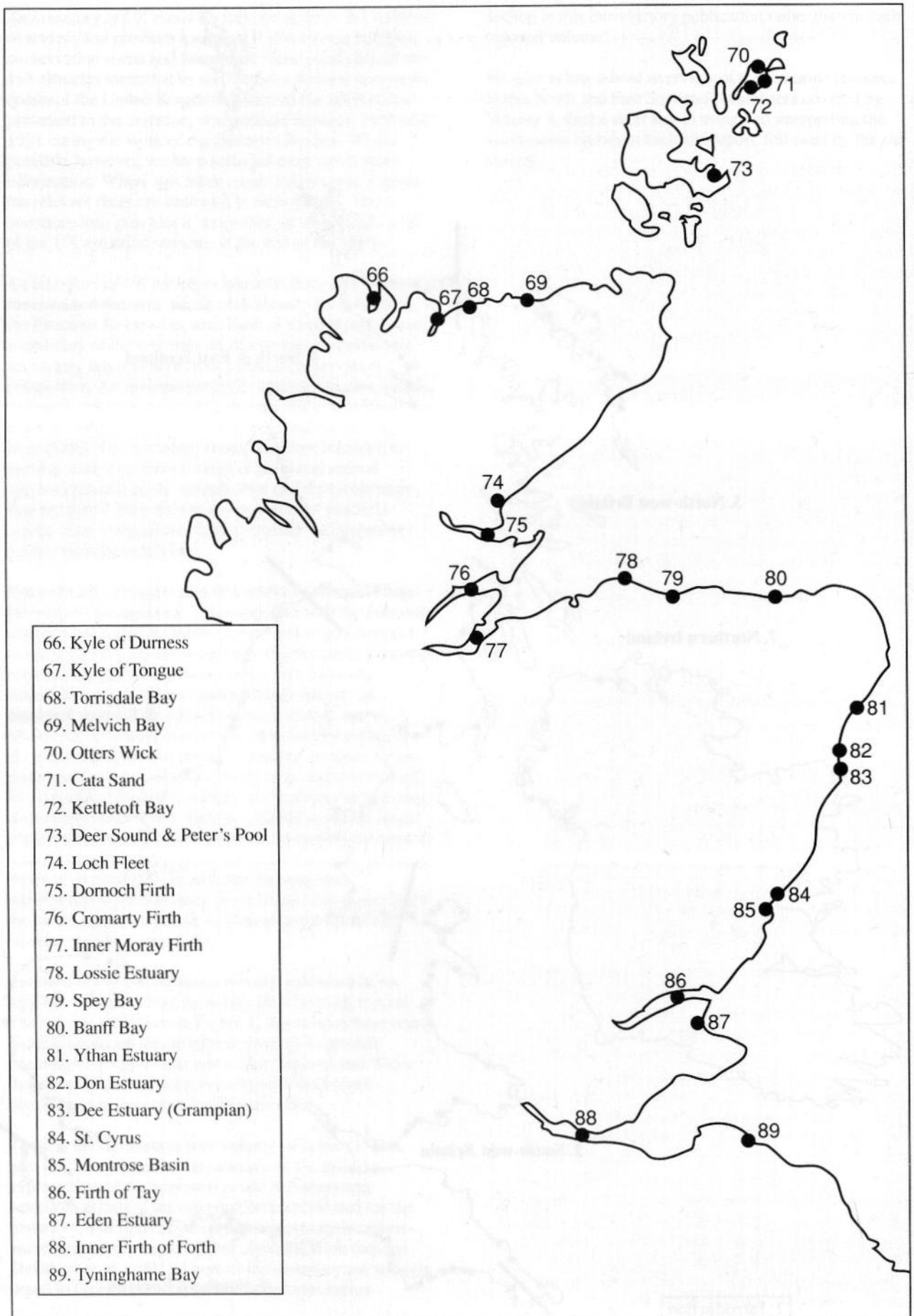


Figure 2 The locations and names of the 24 estuaries covered by Volume 4 of *An inventory of UK estuaries*. See the site map in each regional report for the precise boundaries of the site identified as the core estuary.

3 General features of estuaries in North and East Scotland

A.L. Buck & N.C. Davidson

Resource distribution and size

This volume covers the 24 estuaries on the north-east coast of Britain between Cape Wrath on the north-west tip of mainland Scotland, and St Abb's Head. The largest estuaries on the northern shore are two sea lochs, namely the Kyle of Durness and the Kyle of Tongue. Other sea lochs on this coast have insufficient soft sediment to qualify for inclusion in the *Inventory*. The six other estuaries on the northern shore and on the Orkney islands are generally small. Further south along the eastern shore of Scotland are several large estuaries: the Cromarty and Dornoch Firths, the Inner Moray Firth, the Firth of Tay and the Inner Firth of Forth. Figure 2 shows the names and locations of the estuaries covered by this volume.

Seven estuaries in this North and East Scotland region are of fjord or fjard geomorphology, reflecting the glacial history of Scotland, but the land in the east of Scotland is flatter than that in the west with fairly extensive areas of shallow water off the coast. Nine of the estuaries in North and East Scotland are bar built (all but one of the total number of bar built estuaries in Scotland); two estuaries are coastal plain type; and one is an embayment. The larger Firths, namely the Moray, Cromarty and Dornoch Firths, the Firth of Tay and the Inner Firth of Forth, are of complex origin. There are no rias in this area and few coastal plain estuaries, an indication that the land is generally rising relative to sea level.

Tidal ranges vary within the region, but are either macrotidal (i.e. with tidal ranges greater than 4 metres) or mesotidal (i.e. with tidal ranges of between 2 and 4 metres). Those estuaries along the north coast just qualify as macrotidal, while those in the Orkneys have the smallest tidal ranges in North and East Scotland and are mesotidal. The Inner Firth of Forth has the largest tidal range in the region (4.8 metres) but most of the open coast estuaries are mesotidal or just qualify as macrotidal.

The largest estuaries within this region are the Firth of Tay (12,265 ha), Dornoch Firth (11,663 ha), Inner Moray Firth (11,150 ha), Cromarty Firth (9,232 ha) and the Inner Firth of Forth (8,401 ha). Only seven of the nineteen other estuaries in the region exceed 500 ha in total area. The intertidal areas of estuaries in the region show a similar pattern, for only five sites (Dornoch Firth, Cromarty Firth, Inner Moray Firth, Firth of Tay and Inner Firth of Forth) have over 1,000 ha of intertidal area. The remaining sites, although small, include some of the most unspoilt estuaries in Britain.

The areas and lengths of key features of each estuary are listed in Table 1, and Table 2 provides a summary of the size of the estuarine resource in North and East Scotland.

Wildlife features

Coastal habitats and aquatic estuarine communities

Estuaries are composed of a mosaic of inter-related subtidal, intertidal and terrestrial habitats, with the relative composition and variety of these habitats depending on a great many physical, chemical and biotic factors. The estuaries on North and East Scotland differ from those in South-west and North-west Britain in that a large proportion of the total estuarine habitat (54%) is subtidal at low tide, with only 46% of the estuaries intertidal, and in many estuaries this is chiefly represented by intertidal sandflats and mudflats. The intertidal flats, especially soft mudflats, of estuaries support large populations of marine worms, molluscs and other invertebrates, often living in high densities and with high biomass. These in turn provide an abundant food supply for estuarine predators, notably fish and migratory waterfowl.

In some parts the intertidal flats in the high tidal range estuaries are composed of mobile sediments, since much of the fine silt that would otherwise deposit to form mudflats is held in suspension by high current velocities. This characteristic contributes substantially to the geomorphological interest of such estuaries. Soft mudflats in the estuaries in North and East Scotland are confined to the extremely sheltered inlets and bays and the upper reaches of the larger firths. In many of the estuaries throughout this region the intertidal flats are a mosaic of both sandflats and mudflats, with sandflats dominating the estuaries in the extreme north of the region and the outer parts of the larger Firths.

In terms of size, tidal flat distribution is dominated by the large Firths (Dornoch, Cromarty and Inner Moray Firths, Firths of Tay and Forth) which between them contain 82% of the tidal flats in North and East Scotland. The remaining nineteen estuaries together contain only a small proportion of the total area of intertidal flats in the region, but provide a network of intertidal feeding grounds which is vital for waders and wildfowl. In total North and East Scotland contains almost 10% of the total area of tidal flats in Great Britain.

Saltmarshes play a major role in estuarine processes, both through the cycling of nutrients within the estuary and through their role as 'soft' sea defences dissipating wave energy. As much of the coastline of this North and East Scotland region is relatively exposed, saltmarshes are a correspondingly scarce habitat in this region and total 2,167 ha, which form just under 5% of the British saltmarsh resource. Nevertheless saltmarshes are widespread on the estuaries in North and East Scotland, occurring on all but one (23 estuaries in total), but they generally form only a very small proportion of the

Table 1 Areas, shoreline and channel lengths and mean spring tidal range measurements for estuaries in North and East Scotland.

Estuary	Area (ha)	Intertidal area (ha)	Saltmarsh (ha)	Shoreline (km)	Channel length (km)	Tidal range (m)
66. Kyle of Durness	1,328	561	6	28.9	12.7	4.0
67. Kyle of Tongue	1,818	422	8	37.2	14.2	4.3
68. Torrisdale Bay	200	139	11	9.8	2.9	4.3
69. Melvich Bay	78	33	4	6.9	3.0	4.3
70. Otters Wick	553	310	5	12.0	2.6	2.8
71. Cata Sand	218	204	7	7.9	1.3	2.8
72. Kettleoft Bay	191	122	6	6.7	1.9	2.8
73. Deer Sound & Peter's Pool	1,287	305	7	25.4	6.4	3.2
74. Loch Fleet	695	522	34	20.7	6.6	4.0
75. Dornoch Firth	11,663	4,397	400	284.5	42.8	3.4
76. Cromarty Firth	9,232	3,642	227	120.5	32.7	3.7
77. Inner Moray Firth	11,150	4,783	516	169.6	32.3	4.1
78. Lossie Estuary	56	30	2	13.3	4.4	4.1
79. Spey Bay	49	29	22	4.9	0.9	3.4
80. Banff Bay	102	16	1	8.6	2.8	3.1
81. Ythan Estuary	282	201	25	28.2	10.9	3.7
82. Don Estuary	23	9	1	5.5	2.4	3.7
83. Dee Estuary (Grampian)	97	7	0	18.7	5.8	3.7
84. St Cyrus	156	136	8	12.8	2.1	4.1
85. Montrose Basin	842	739	58	21.9	8.0	4.1
86. Firth of Tay	12,265	5,720	502	170.3	53.7	3.7
87. Eden Estuary	1,041	937	32	27.7	11.1	3.7
88. Inner Firth of Forth	8,401	4,798	173	272.5	54.8	4.8
89. Tynningame Bay	507	400	112	25.8	5.9	4.5

Table 2 Total areas and lengths of the regional estuarine resource in North and East Scotland.

Total area (ha)	Subtidal area (ha)	Intertidal area (ha)	Intertidal flats (ha)	Saltmarsh (ha)	Shoreline (km)	Channel length (km)
62,234	33,772	28,462	26,295	2,167	1,340.3	322.2

intertidal area. Only in the more sheltered bays and estuaries are there extensive areas of saltmarsh. The Dornoch, Cromarty and Inner Moray Firths, the Firth of Tay, the Inner Firth of Forth and Tynninghame Bay are the only estuaries in the region with greater than 100 ha of saltmarsh. Of these sites, only the saltmarshes of the Dornoch and Inner Moray Firths occupy 10% or more of the intertidal area of the estuary.

Three estuaries in the region (Dornoch Firth, Inner Moray Firth and Firth of Tay) contain nationally important saltmarshes. That is, they support a full and representative sequence of plant communities covering the variation found in Great Britain. The saltmarshes of the Firth of Tay are also of note for the largest continuous stand of tidal *Phragmites* reedbed in Britain. In the northern parts of Britain there has been much less human interference with saltmarshes, and so these northern marshes are important for the presence of natural transitions to non-tidal vegetation, notably grasslands. Transitional grassland communities occur on seven estuaries in this region, which comprise 23% of British estuaries with this feature.

The cord-grass *Spartina anglica* is rare in the estuaries of North and East Scotland and is found only in the saltmarshes of the Dornoch Firth, the Cromarty Firth, the Eden Estuary and the Inner Firth of Forth. Despite the deliberate planting of *Spartina* on at least two estuaries in the region (Cromarty Firth, Inner Firth of Forth) between 1921 and 1951 to encourage stabilisation of the coastline, the invasion and colonisation of open mudflats by *Spartina* has not been as rapid or widespread as in many parts of England and Wales. Today *Spartina* forms a only very small proportion of the saltmarshes in which it is present (less than 1% of the total saltmarsh area of each estuary). Attempts to control *Spartina* in North and East Scotland are occurring only on the Eden Estuary.

There are several extensive sand dune systems on the North and East coasts of Scotland, where the high-energy environment and prevailing winds combine to form large accumulations of sand. Twelve estuaries in North and East Scotland have sand dune systems associated with them, of which eleven dune systems (on eight estuaries) are nationally important. These are Invernaver on Torrisdale Bay, Ferry Links and Coul Links on Loch Fleet, Morrich More on the Dornoch Firth, Culbin Sands on the Inner Moray Firth, the Sands of Forvie and Foveran Links on the Ythan Estuary, St Cyrus, Barry Links and Tentsmuir on the Firth of Tay and Earls Hall Muir on the Eden Estuary.

There are two substantial shingle structures associated with estuaries in North and East Scotland, namely the Culbin Shingle Bar on the Inner Moray Firth and the Kingston Shingles on Spey Bay, both of national importance. The Culbin shingle is an offshore shingle bar, part of a complex system of sand dunes and shingle ridges. The structure acts as a barrier island, protecting the shore from wave attack, and shelters intertidal flats and saltmarshes. The Culbin shingle has become vegetated only in parts. In contrast the Kingston shingle is largely vegetated and supports a varied shingle flora. Patches of bare intertidal shingle are found on over just under half (ten) of the estuaries in this region.

Coastal saline lagoons are scarce in North and East Scotland, and associated with only two estuaries in the region. Within Cromarty Firth there is a saline lagoon behind the shingle spit at Alness and on the Inner Firth of Forth there is a series of lagoons at Skinflats.

The largest areas of coastal grazing marshes and other lowland grasslands are found outside North and East Scotland, but four of the estuaries in the region have adjacent grasslands (Otters Wick, Deer Sound & Peter's Pool, Dornoch Firth and Inner Firth of Forth).

The aquatic estuarine benthic communities of thirteen of the estuaries within North and East Scotland have been recorded and several sites are known to be of marine biological and conservation importance. The diversity of both soft substrate and hard substrate communities within this region is generally lower than that of estuaries in South and South-west England, with the largest recorded diversity (more than seven communities) in the larger Firths and estuaries of the Kyle of Durness, Dornoch Firth, Inner Moray Firth, Firth of Tay, Inner Firth of Forth and Tynninghame Bay. In general the smaller estuaries on the north and east coast of Scotland support lower numbers of aquatic estuarine communities.

Plant and animal species

At least four estuaries within the North and East Scotland region support nationally rare species of vascular plants. Populations of the nationally rare endemic Scottish primrose *Primula scotica* grow on grassland adjacent to three estuaries in North and East Scotland (the Kyle of Durness, Kyle of Tongue and Torrisdale Bay) and a population of the estuarine sedge *Carex recta* grows within the Inner Moray Firth.

Of particular note is the recent discovery of a population of the polychaete worm *Marenzelleria viridis* in the Firth of Tay. This is a new European record of a North American species and the recorded densities of this worm within the Tay may be among the highest known.

The terrestrial invertebrate faunas of saltmarshes on estuaries in North and East Scotland are generally rather poorly known compared with those of southern and eastern England. The Conan Islands and *Phragmites* reedbeds at Dingwall in the upper reaches of the Cromarty Firth and the Sands of Forvie on the Ythan Estuary are three sites known to support invertebrate species of note and there are many sand dune sites associated with estuaries that are of interest for their invertebrate assemblages. Tentsmuir at the mouth of the Firth of Tay, the Sands of Forvie on the Ythan Estuary, Culbin Sands on the Inner Moray Firth, Morrich More on the Dornoch Firth and Invernaver on Torrisdale Bay each support a variety of terrestrial invertebrates that includes nationally rare or scarce species. Also of interest for their invertebrate assemblages are Mound Alderwoods which have developed on the former estuarine sediments of Loch Fleet, and the shingle spit at Whiteness on the Inner Moray Firth.

The water quality of many of the estuaries in North and East Scotland is mostly classed as very good. These estuaries support a variety of adult fish species and are

spawning and nursery areas for others. For example studies in the Inner Firth of Forth have shown that at least 34 species of fish use the estuary at some time during the year, including more unusual species such as the angler fish *Lophius piscatorius* and the lump sucker *Cyclopterus lumpus* as well as commercially important species such as cod *Gadus morhua* and herring *Clupea harengus*. Many estuaries in North and East Scotland support good salmon *Salmo salar* fisheries, although the presence of salmon in some of the more industrial areas is limited by pollution and weirs. The Firth of Tay is one of the few Scottish estuaries to be used as a spawning ground by smelt *Osmerus eperlanus* and smelt are now known to be returning to the Firth of Forth in increasing numbers as a result of improving water quality. The Ythan Estuary is known to support a large population of the sand goby *Pomatoschistus minutus*.

Many estuaries in the UK are of great importance to migratory and wintering waterfowl (waders and wildfowl). The habitat mosaics of estuaries in North and East Scotland provide feeding and roosting sites for many waterfowl species. Many of these birds, which come from a vast area of arctic and boreal breeding grounds between Canada and Siberia, are wholly or largely dependent on estuaries during their non-breeding period. Overall the estuaries in North and East Scotland support over 155,000 waterfowl in midwinter (January), some 9% of the total British estuarine waterfowl population at that time of year. Numbers of waterfowl on the more northerly estuaries in this region may, however, reach a peak earlier (October/November) with birds moving south and west to milder areas during cold weather.

Since migratory waterfowl depend on a network of estuaries during their year, many birds move between estuaries even during the winter period, so that the total number of individuals using a site can be considerably higher than those present at any one time. Average peak winter counts of waterfowl suggest that at least 275,000 birds may be using these estuaries during the winter period. Since seven estuaries, mostly on the northern coastline of mainland Scotland and in the Orkney Islands, are not regularly counted this figure may be even higher.

The largest concentrations of wintering waterfowl occur on the large firths of the east coast of Scotland, notably on the Firth of Forth, Montrose Basin, Moray Firth, Firth of Tay, Cromarty Firth and Dornoch Firth. These six estuaries each attain international importance by supporting over 20,000 waterfowl during winter. Many waterfowl species are known to move regularly between the firths and inlets of the Moray Firth Basin (from Loch Fleet to Findhorn Bay at the eastern extremity of the Moray Firth review site). Overall this basin forms one of the most important parts of the UK coastline for wintering waterfowl, supporting almost 70,000 waterfowl in January alone.

These six estuaries plus the Ythan Estuary are internationally important also for supporting over 1% of the flyway population of at least one species or biogeographic population of waterfowl. (The Lossie Estuary is also indicated as internationally important for one species, but since the estuary forms only a minor

part of the waterfowl count area for this site, this is not included in the estuarine listing.) There are internationally important populations of at least nine species of waterfowl on estuaries in North and East Scotland. These are: whooper swan *Cygnus cygnus*, pink-footed goose *Anser brachyrhynchus*, greylag goose *A. anser*, wigeon *Anas penelope*, red-breasted merganser *Mergus serrator*, knot *Calidris canutus*, bar-tailed godwit *Limosa lapponica*, redshank *Tringa totanus* and turnstone *Arenaria interpres*.

A further fifteen species of waterfowl attain numbers of national importance (i.e. over 1% of their national population): shelduck *Tadorna tadorna*, gadwall *Anas strepera*, teal *A. crecca*, eider *Somateria mollissima*, long-tailed duck *Clangula hyemalis*, common scoter *Melanitta nigra*, goldeneye *Bucephala clangula*, goosander *Mergus merganser*, ringed plover *Charadrius hiaticula*, golden plover *Pluvialis apricaria*, sanderling *Calidris alba*, purple sandpiper *C. maritima*, dunlin *C. alpina*, black-tailed godwit *Limosa limosa*, and curlew *Numenius arquata*.

In addition the shallow waters of the Moray Firth Basin are considered the most important area for wintering seaducks in Britain, holding very large proportions of the British populations of several species, notably velvet scoter *Melanitta fusca*, common scoter *M. nigra* and long-tailed duck. The British wintering population of eiders is concentrated on the east coast of Scotland, notably the Aberdeen coast, the Firth of Forth and especially the Firth of Tay which supports about 50% of the British population.

Wintering waterfowl are concentrated on the larger firths but most other estuaries provide winter habitat for some waterfowl, so forming parts of the site network on which these birds depend. Numbers and densities are generally low on the mostly sandy small river estuaries and inlets in northern Scotland, but especially in Orkney these places form an integral part of the mosaic of coastal sites, including sandy beaches and rocky shores, that are of major international importance for several waders, notably curlew, redshank, turnstone, ringed plover and purple sandpiper.

In addition to these wintering populations, other individuals of some waterfowl species use these estuaries as migration staging sites in spring and autumn and as moulting sites in autumn. Two estuaries are particularly interesting for moulting waterfowl. The Firth of Forth has an autumn moulting flock of up to 3,000 shelducks, one of only three estuaries in Britain with a large population at this time. A recently developed moult migration in Britain is that of non-breeding and immature feral Canada geese *Branta canadensis* chiefly from the breeding population in Yorkshire to moult in autumn on the Beaulieu Firth (the inner part of the Moray Firth site).

The saltmarshes, shingle ridges and grasslands around estuaries provide habitat for breeding wader populations, chiefly redshank, oystercatcher, lapwing *Vanellus vanellus* and ringed plover. In North and East Scotland the most diverse assemblages are at Otters Wick and Deer Sound & Peter's Pool on Orkney, Dornoch Firth and Cromarty Firth (each with six

species) and Inner Moray Firth (five species). Parts of the Inner Firth of Forth, Montrose Basin, and Dornoch, Cromarty and Inner Moray Firths have some of the highest densities of saltmarsh-breeding waders recorded in Britain, and densities of grassland-breeding waders on Orkney sites are some of the highest in Britain. There are also large breeding populations of ringed plover on the Firth of Forth, Inner Moray Firth and Tynninghame Bay.

Most of the large breeding seabird colonies in northern and eastern Scotland are on cliff coasts outside estuaries. Only the Inner Moray Firth (mostly common and arctic terns *Sterna hirundo* and *S. paradisaea*), Ythan Estuary (chiefly Sandwich tern *S. sandvicensis*, herring gull *Larus argentatus* and kittiwake *Rissa tridactyla*) and St Cyrus (herring gull and fulmar *Fulmarus glacialis*) have total seabird populations exceeding 1,000 pairs. In addition, the Ythan Estuary and St Cyrus have been known to support small breeding colonies of little tern *Sterna albifrons*, a species which has recently declined in eastern Scotland. Eiders breed around many of the estuaries in northern and eastern Scotland, with a particularly large breeding population on the Sands of Forvie (Ythan Estuary) and other large populations around Montrose Basin, Firth of Tay and Eden Estuary, together forming at least a quarter of the British breeding population.

Otters *Lutra lutra* are common and widespread on estuaries in North and East Scotland. They are recorded on all but two of the 24 estuaries in this region, the Inner Firth of Forth and Tynninghame Bay, and on these two they have been recorded upstream of the normal tidal limit of the estuary. Groups of grey seals *Halichoerus gryphus* and common seals *Phoca vitulina* regularly use at least ten estuaries within the region, and an estimated 1,000 common seals breed on the east coast of Scotland, mainly within the Dornoch, Cromarty and Inner Moray Firths and the Firth of Tay and Eden Estuary. In addition the Moray and Cromarty Firths hold the largest known population of resident bottle-nose dolphins *Tursiops truncatus* in Europe.

Conservation status

The important and diverse wildlife and landscape features of much of the UK estuarine resource have been recognised by many parts of estuaries and their surroundings being designated under a variety of local, national and international measures, both statutory and non-statutory. The estuaries of North and East Scotland are typical of this pattern in which there are often several overlapping site designations covering parts of an estuary. In addition to this site-based approach, through which much of estuarine conservation has traditionally been delivered, some of the estuaries covered in this report (Dornoch Firth, Cromarty Firth, Inner Moray Firth, Firth of Tay, Inner Firth of Forth) are now also included in a variety of coastal zone planning and management initiatives.

Sites of Special Scientific Interest (SSSIs), the major statutory designations for the delivery of site-based wildlife conservation, cover many parts of the intertidal and associated terrestrial areas of North and East Scotland. All but seven (Kyle of Tongue, Melvich Bay,

Otters Wick, Deer Sound & Peter's Pool, Lossie, Don and Dee (Grampian) Estuaries) of the estuaries covered by this volume have at least one associated SSSI, although SSSIs, like most other designations, cover only parts of each estuary. In Scotland, SSSIs extend to the Low Water Spring tides mark, in contrast to England and Wales where they extend only to the Mean Low Water mark.

In all there are 47 SSSIs associated with estuaries in this region, 14% of estuarine SSSIs in Great Britain. The Inner Firth of Forth currently has the largest number of SSSIs (fourteen) associated with any estuary in this area. SSSIs on the Inner Firth of Forth are typical of those on many British estuaries - a mixture of small SSSIs notified for their geological and geomorphological features and a few larger sites of biological or mixed interest covering tidal flats, saltmarshes and associated terrestrial habitats. Other estuaries in the region covered by five or more SSSIs are the Dornoch Firth, Inner Moray Firth and Firth of Tay. SSSIs associated with estuaries in this region cover a total of 48,907 ha (almost 13 % of the British estuarine SSSI area), with by far the largest areas of SSSI being on the Inner Moray Firth, Firth of Tay, Dornoch Firth, Inner Firth of Forth and Cromarty Firth.

Six of the 42 declared estuarine National Nature Reserves (NNRs) in Britain are on the intertidal or terrestrial habitats of the estuaries covered by this volume. These include several areas of intertidal flats or saltmarshes, e.g. Invernaver on Torrisdale Bay, St Cyrus and Nigg and Udale Bays on the Cromarty Firth. Others include the intertidal flats and sand dunes of the Sands of Forvie and the Ythan Estuary, the sand dunes of Tentsmuir on the Firth of Tay, and the estuarine woodlands of Mound Alderwoods adjacent to Loch Fleet.

Local Nature Reserves are statutory designations made by local authorities (in consultation with country conservation agencies) with objectives similar to those of NNRs but in the local interest of the site and its wildlife. Of the 33 designated LNRs which occur on estuaries, four lie within the region: Donmouth on the Don Estuary, Montrose Basin, Eden Estuary and Aberlady Bay on the Inner Firth of Forth.

Two international designations are particularly relevant to estuarine habitats and their birds. The Ramsar Convention designates wetlands of international importance especially as waterfowl habitat (Ramsar sites); and Special Protection Areas (SPAs) are designated under the EC Directive on the Conservation of Wild Birds. For estuarine waterfowl populations both designations often apply. As yet no part of the estuaries of North and East Scotland have been designated as Ramsar sites or SPAs, but there are proposals for Ramsar/SPA sites which may include parts of Otters Wick, Cata Sand, Loch Fleet, Dornoch Firth, Cromarty Firth, Inner Moray Firth, Spey Bay, Ythan Estuary, St Cyrus, Montrose Basin, Firth of Tay, Eden Estuary and Inner Firth of Forth.

Other wildlife conservation sites include the Scottish Wildlife Trust reserves on three estuaries, RSPB reserves on or adjacent to the Inner Moray Firth, and the Sands of Forvie on the Ythan Estuary which has been

designated as a European Biogenetic Reserve for its lowland heath interest.

There are also several landscape conservation designations that partly cover estuaries in North and East Scotland. Two estuaries (Kyle of Tongue and Torrisdale Bay) lie within National Scenic Areas (a Scottish landscape designation), and seven estuaries lie wholly or partly within areas identified by the Scottish Office as preferred Coastal Conservation Zones under National Planning Guidelines. In addition there is a Country Park adjacent to one estuary in North and East Scotland (Tynninghame Bay).

Features of human use

Many parts of the coastline of North and East Scotland are largely natural and little affected by damaging human activities. Few people live close to the estuaries covered in this volume, with the exception of the Inner Firth of Forth (> 500,000 population). Elsewhere, only the eastern coast estuaries of the Don and Dee (Grampian) Estuaries which flow through Aberdeen, the Inner Moray Firth and the Firth of Tay have nearby urban populations exceeding 50,000 people. The majority of the remaining estuaries have nearby populations of less than 5,000 people. Hence there are few parts of the estuarine resource in North and East Scotland that have been subjected to the major urban and industrial pressures characteristic of estuaries close to large conurbations. The more typical human uses of many estuaries in North and East Scotland are the exploitation of natural resources and recreation.

Few estuaries in North and East Scotland have been subjected to substantial sea defence measures such as construction of sea walls. This is due, in part, to land areas rising relative to sea level (through continuing isostatic rebound after the last ice age). As a result, the erosion problems which often lead to the construction of major sea defences are not as significant in North and East Scotland as they are, for example, in South-east England. Also, as many estuaries are incised steeply into hard rock systems, they are not surrounded by substantial low-lying areas vulnerable to flooding. Seven of the 24 estuaries in North and East Scotland have no sea defences present, and only two estuaries in the region (the Lossie Estuary and Montrose Basin) have artificial sea defences along 50% or more of the shoreline. In many areas there are long stretches of natural transitions from intertidal to terrestrial habitats. There are also a few, small areas where the abandonment or breaching of sea walls that previously protected small islands have allowed reversion of cultivated mudflat or saltmarsh, for example the Alloa Inches on the Inner Firth of Forth.

Despite this overall pattern of generally low-intensity use of estuaries, there are a number of places where intensive human use occurs and where there has been substantial loss and damage to the estuarine resource. For example, there have been extensive areas of historical land-claim on some estuaries such as the Inner Firth of Forth, where around 2,280 ha have been claimed since 1900 (at least 21% of the former total area of the estuary), and the Firth of Tay, where 150 ha was lost between 1800 and 1900 (1% of the former total

area).

Heavy industrial activities are concentrated on the larger Firths, and as a result of the North Sea gas and oil industries there are a range of associated industrial developments on a number of estuaries in North and East Scotland. These include oil rig platform and pipeline building yards, oil and gas terminals and repair and servicing facilities. Large complexes include Nigg Bay on the Cromarty Firth and Whiteness Head in the Inner Moray Firth. There are other large industrial complexes and ports on the Cromarty Firth, Inner Moray Firth, Firth of Tay and Inner Firth of Forth, and at least seven other estuaries have small ports and harbour facilities.

Other urban and infrastructure developments have, and are, altering estuarine features. Two of the estuaries on which housing and car-park developments were taking place in 1989 were in North and East Scotland: the Ythan Estuary, in association with bridge reconstruction in the early 1980s, and the Firth of Tay. There have also been further proposals for such developments in this region.

Although the coastlines of North and East Scotland are largely undeveloped, some areas are popular spots for tourism and recreation. A wide variety of leisure pursuits, from general beach use and bathing to water-based recreation, take place on parts of these estuaries, especially during the summer months. This is particularly true for the estuaries that are easily accessible and close to large population centres, and recreational pursuits along these shores can be intensive in some areas. However, most recreation on the estuaries of Scotland occurs at a much lower intensity than on estuaries, for example, in the South and South-east of Britain for example, and appears not to present any major problems of damage or disturbance to estuarine wildlife and habitats.

A variety of traditional land uses exploit the natural plant and animal resources of these North and East Scotland estuaries. Grazing of saltmarshes and sand dunes is widespread, and seine- and bag-netting and fish-trapping are known to occur on several estuaries within the region. Hand-gathering of molluscs also occurs, with dredging for molluscs on small numbers of estuaries. In association with the presence of fisheries, especially salmonid fisheries, on the estuaries in this area, culling of seals and fish-eating birds such as red-breasted merganser and goosander is widespread. On a UK-wide basis these activities occur predominantly in North and East Scotland. Seal culling occurs on ten estuaries in North and East Scotland and on only three estuaries outside this region, and culling of fish-eating birds occurs on nine estuaries in the region and on only four other estuaries in Britain.

Compared with estuaries in other parts of Britain in 1989 there were relatively few development proposals for the estuaries in North and East Scotland. There were no current proposals for tidal power or leisure barrages, and a scheme for a barrage across the Inner Moray Firth had been withdrawn. Proposals in 1989 on the larger firths were chiefly of an industrial nature. For example on the Cromarty Firth there were proposals for oil

4 Using the inventory

A.L. Buck

This section provides some brief descriptions and keys to interpreting the presentations of information in the site reports. Full descriptions of the methodology, information sources and presentations are given in Volume 1 (Introduction) of the inventory.

The rationale for site definition and selection follows that developed by Davidson *et al.* (1991). It should be noted that some of the information collated by Davidson *et al.* (1991) has been updated and corrected in some instances, and that the core estuary sites as presented in the inventory now include some adjacent intertidal areas treated separately in the Estuaries Review (also see below).

A short key to the inventory

Inventory sites are numbered and presented in clockwise sequence from Land's End. Note, however, that the numbering of estuaries in Northern Ireland follows on from those in Great Britain. Where data was collected or measured from sources other than the Estuaries Review or Coastal Review Unit, these sources are identified below. Information refers to the period 1988-1990 unless otherwise stated.

Site map

Sites were selected for inclusion in the Estuaries Review and inventory using a definition of an estuary based on that developed by NERC (1975): a partially enclosed area at least partly composed of soft tidal shores, open to saline water from the sea, and receiving fresh water from rivers, land run-off or seepage.

For the inventory only sites with a tidal channel longer than 2 km or sites with a shore width of over 0.5 km at low water along a shoreline greater than 2 km are included. The upstream limit is normally taken as the Normal Tidal Limit (NTL), the upper shoreline limit is an interpreted high water mark approximating to the highest astronomical tides (EHWS), and seaward limits are set as either a 'bay closing line' or 'across mouth' (XM) or an 'along shore' (AS) set by the low water mark. On sites that are not isolated from their neighbours, an arbitrary boundary 'between adjacent estuaries' (BAE) has been set, usually at the mid-point of the shore between the sites, or where the intertidal zone is at its narrowest. Note that the low water mark is that shown on 1:50,000 O.S. maps - mean low water in England and Wales, low water spring tides in Scotland.

The approach used for the Estuaries Review and inventory has been to locate a 'core site' of intertidal and subtidal habitats. The core site boundary is shown on the site map. For a few estuaries we have, in addition, defined adjacent areas of 'associated intertidal' habitat where this is outside the inventory estuary mouth but has a functional link to the estuary, for example where the area forms part of an estuarine structure when considered at larger scale, or where there are links through area use by mobile wildlife.

It is difficult to define standard geographical zones for the inclusion of terrestrial habitats associated with estuaries. For this reason we have followed the Estuaries Review in collating information for an 'associated terrestrial' zone that varies in extent between sites, but which includes functional units of maritime-influenced wildlife habitat and areas of human use that closely affect the core estuary.

Estuary size characteristics and description

Measurements of *total area* and *intertidal area* have been rounded to the nearest 1 ha.

Shore length and *channel length* measurements have been rounded to the nearest 0.1 km.

Tidal ranges have been derived from High and Low Water for Mean Spring Tides for the site closest to the defined estuary mouth, from Hewitt & Lees-Spalding. (1988).

Human population gives numbers of people living in towns reaching within 1 km of the tidal shore, from the results of the 1981 population census. Population figures greater than 5,000 have been rounded off to the nearest 1,000.

Water quality descriptions are from the DoE River Quality in England and Wales Survey 1991, (National Rivers Authority 1991) and the Water Quality Survey of Scotland 1985 (Scottish Development Department 1987).

Wildlife features

All *coastal habitat* areas are rounded to the nearest 1 ha. Areas for sandflats and mudflats were not measured separately, and are given as a combined figure. Saltmarsh areas are derived from NCC's *Saltmarsh survey of Great Britain* (Burd 1989).

Aquatic estuarine communities. The classification of aquatic estuarine communities - subtidal and intertidal marine communities of substrates not vegetated by higher plants - was prepared by the Estuaries Review using methodology developed by the Marine Nature Conservation Review (MNCR). The Estuaries Review classification was prepared before completion of all relevant survey work by MNCR so this classification should be treated as preliminary. It is being developed further by MNCR. Information on the presence of these benthic communities (rather than the substrates on which they occur) was not available during the review for all sites, although further work is in progress. The benthic plant and animal communities are divided into two broad categories: those on soft substrates and those on hard substrates, and are further divided into communities describable largely on their physico-chemical characteristics. Some of the communities occur on both the intertidal and subtidal parts of estuaries. Communities are as follows:

Soft substrates

1. Gravel/shell gravel community
2. Maerl beds
3. Exposed sand community
4. Clean sand community
5. Common mussel beds
6. Horse mussel beds
7. European oyster beds
8. Surface algal community
9. Current-swept sand community
10. Sand/muddy sand community
11. Muddy gravel community
12. Muddy 'offshore' sand community
13. Normal/variable salinity muddy community
14. *Zostera* and *Ruppia* beds
15. Variable/reduced salinity mud community
16. Reduced salinity mud community

Hard substrates

17. Exposed rocky shore community
18. Moderately exposed rocky shore community
19. Sheltered rocky shore community
20. Variable salinity rocky shore community
21. Reduced (variable) salinity rocky shore community
22. Reduced salinity rocky shore community
23. *Sabellaria* reef community
24. Current-exposed sheltered rocky shore community
25. Exposed rock community
26. Sheltered rock community
27. Hydrozoan/bryozoan turf community
28. Slipper limpet beds
29. Artificial substrata community
30. Variable salinity rock community
31. Variable salinity clay community
32. Reduced (variable) salinity rock community
33. Reduced salinity rock community

Birds. Major sources of information on wintering waders and wildfowl are the BTO/JNCC/RSPB Birds of Estuaries Enquiry (BoEE) co-ordinated by the British Trust for Ornithology, and the National Wildfowl Count (NWC) operated by the Wildfowl and Wetlands Trust. Information in the inventory is calculated from five year peak monthly counts for waterfowl for the winters 1986/87 - 1990/91. The proportions of international and national populations of individual species are shown where these are of national or international importance ($\geq 1\%$ of the relevant population except where this value is < 50 birds).

Information for some estuaries or parts of estuaries not regularly covered by the BoEE is included from the BTO/WSG Winter Shorebird Count from midwinter 1984/85. Breeding bird data comes from the JNCC/Seabird Group's Seabird Colony Register and a variety of other national, regional and local surveys (see Volume 1 for details).

Additional wildlife features. Information presented here includes: nationally rare plants i.e. those found in fifteen or fewer 10 km squares in Great Britain (from the Rare Plants Database); Red Data Book (RDB) terrestrial invertebrates (from JNCC's Invertebrate Site Register - ISR); and a variety of other recorded features of conservation interest, for example rare fish, amphibians, reptiles and mammals. Note that 'recently recorded' species of terrestrial invertebrate have been recorded since 1970.

Conservation status

The presence of both statutory and non-statutory wildlife and landscape conservation sites is shown. Known proposals for Sites of Special Scientific Interest, National Nature Reserves, Local Nature Reserves, 'Ramsar' sites and Special Protection Areas are also indicated where these were in their final stages of preparation for designation during completion of the inventory.

Abbreviations to the designations are as follows:

NCR	Nature Conservation Review site
GCR	Geological Conservation Review site
SSSI (B)	Site of Special Scientific Interest (biological)
SSSI (G)	Site of Special Scientific Interest (geological and/or geomorphological)
SSSI (M)	Site of Special Scientific Interest (mixed biological and geological/geomorphological)
NNR	National Nature Reserve
LNR	Local Nature Reserve
Ramsar	Wetland of International Importance (Ramsar Convention)
SPA	Special Protection Area (EC Directive on the conservation of wild birds)
AONB	Area of Outstanding Natural Beauty (Countryside Commission)
CWT	County Wildlife Trust reserve
RSPB	Royal Society for the Protection of Birds reserve
ESA	Environmentally Sensitive Area (MAFF)
NP	National Park (England and Wales only)
WWT	Wildfowl and Wetlands Trust centre/reserve
NT	National Trust land
NSA	National Scenic Area (Scotland only)
HC	Heritage Coast (Countryside Commission)
Other	Marine Nature Reserves, Areas of Special Protection, Country Parks etc.

Human use

Features of human use data were collected and collated largely between February and June 1989 (from a wide variety of sources chiefly through members of NCC's regional staff with responsibility for conservation management for each estuary). Activities listed as 'Present' and/or 'Proposed' indicate that status only during that period. Proposals include both those developments subject to consent applications and those subject to less formal public discussion and/or investigation. When more recent information is available, changes since 1989 in present activities or the status of proposals are noted in the text, as are major proposals that have arisen since 1989.

Categories of human use. The bar chart shows, for each broad use category, the percentage of activity types in that category known to occur in 1989. For a fuller explanation of this analysis see the introductory volume of the Inventory.

Further reading

Further reading lists selected references containing further information on the estuary and its wildlife. Note that not all this further reading refers to detailed scientific studies: some sources are general or are historical descriptions of life on these estuaries or are even part of the extensive fictional literature that describes estuaries.

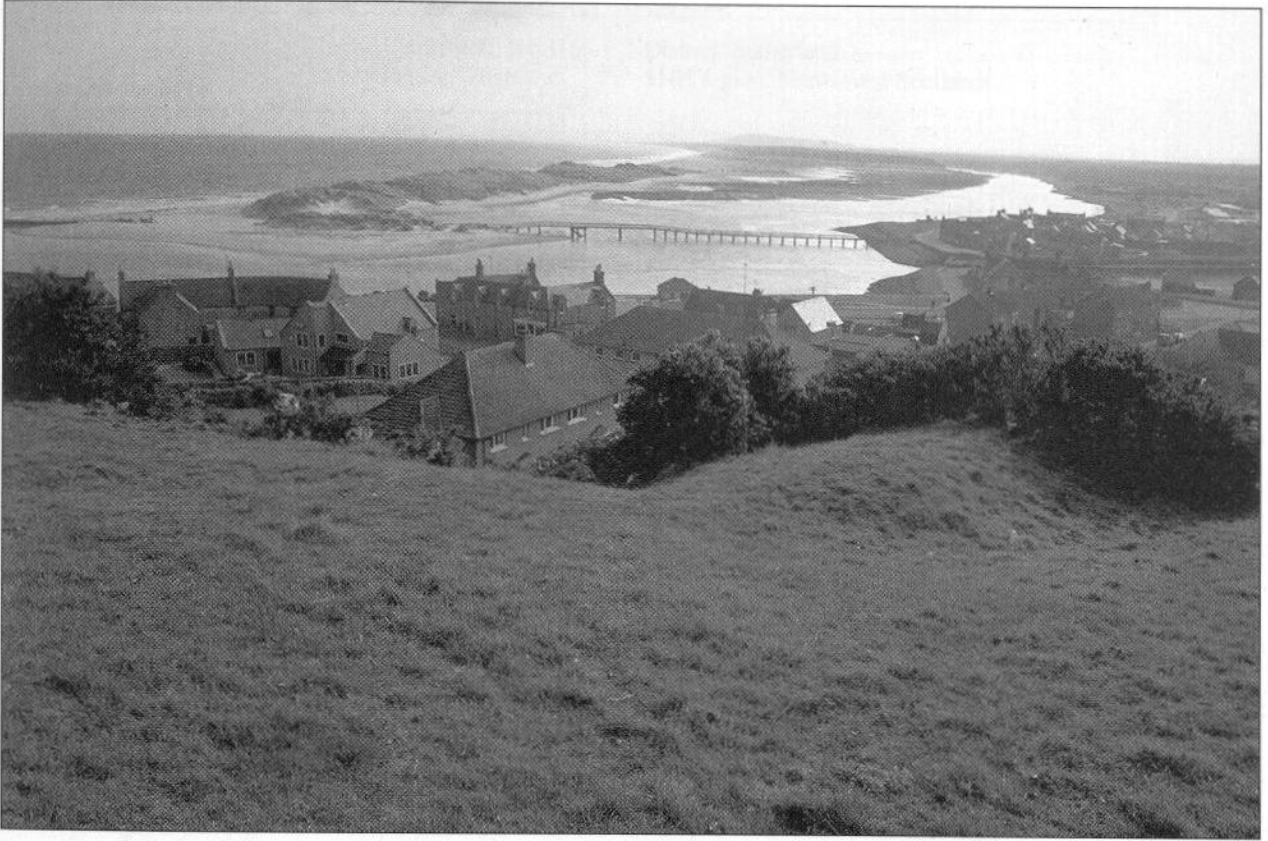
References

- Buck, A.L. In prep. *An inventory of UK estuaries.*
Peterborough, Joint Nature Conservation Committee.
- Burd, F. 1989. *Saltmarsh survey of Great Britain.*
Peterborough, Nature Conservancy Council.
(Research and survey in nature conservation, No. 17.)
- Davidson, N.C., & Buck, A.L. 1993.
An inventory of UK estuaries. Volume 1. Introduction.
Peterborough, Joint Nature Conservation Committee.
- Davidson, N.C., Laffoley, D.A., Doody, J.P., Way, L.S.,
Gordon, J., Key, R., Drake, C.M., Pienkowski, M.W.,
Mitchell, R., & Duff, K.L. 1991.
Nature conservation and estuaries in Great Britain.
Peterborough, Nature Conservancy Council.
- Hewitt, R.L., & Lees-Spalding, I.J. eds. 1988.
The Macmillan & Silk Cut Almanac.
London, Macmillan.
- National Rivers Authority. 1991. *The quality of rivers,
canals and estuaries in England and Wales.*
Bristol, National Rivers Authority.
(Water quality series, No. 4)
- Natural Environment Research Council. 1975.
Estuaries research.
NERC Publications Series 'B', No. 9.
- Scottish Development Department. 1987.
Water quality survey of Scotland 1985.
Edinburgh, HMSO.

5 The estuaries

A.L. Buck

Kyle of Durness



The mouth of the Lossie Estuary, which is sheltered by a sand-covered shingle spit. (S.M. Atkins, SNH)

Grid square	UTM Easting	UTM Northing	UTM Zone	UTM Datum	UTM Spheroid	UTM Projection
10	500000	6000000	18N	WGS 84	WGS 84	UTM

Description

The Kyle of Durness is a sheltered inlet on the north coast of Scotland, and is one of the best examples of a fjord in the British Isles. The inlet is 10 km long and is bounded by steep, rocky hills. The water is clear and the surrounding landscape is beautiful. The inlet is a popular destination for tourists and is a great place to visit.

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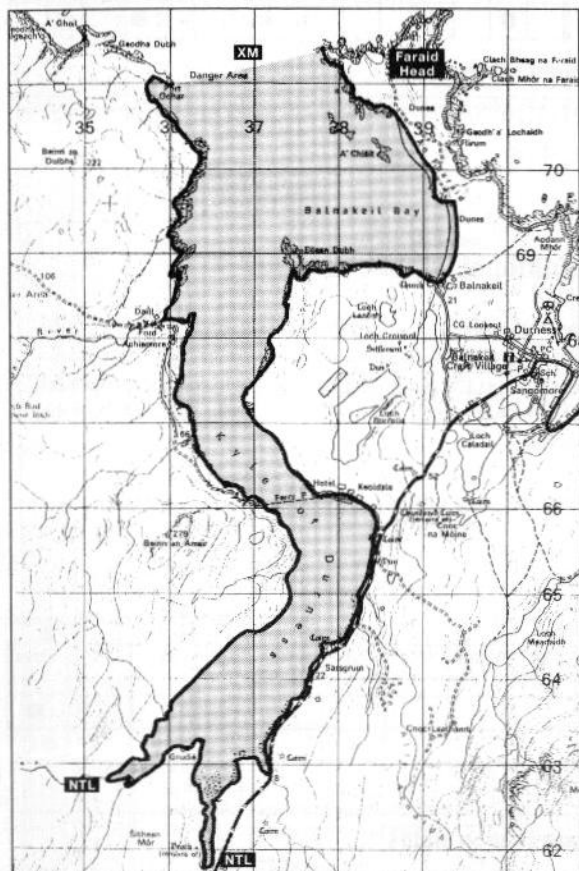
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Centre grid: NC3766
Region: Highland

District: Sutherland
SNH region: North-west Scotland

Review site location



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XM = Across mouth
NTL = Normal tidal limit
■ = Core site



Total area (ha)	Intertidal area (ha)	Shore length (km)	Channel length (km)	Tidal range (m)	Geomorph. type	Human population
1,328	561	28.9	12.7	4.0	Fjord	< 5,000

Description

The Kyle of Durness is a shallow sea loch on the north coast of Scotland, and is one of the best examples of a clear water, macrophyte-rich limestone loch in the region. Its main freshwater input comes from the rivers Dionard and Grudie, which wind across a large area of intertidal sandflats at low tide. Water quality has been classified as grade 1.

At the head of the Kyle of Durness where the Grudie River enters the estuary, there is a small area of grazed saltmarsh. The main area of saltmarsh is bordered by an eroding bank, with fringing strips of saltmarsh extending

further north along the shore. The saltmarsh is grazed.

Towards the mouth of the loch the channel deepens and widens into Balnakeil Bay. The eastern shore of the bay is enclosed by the rocky promontory of Faraid Head. A large part of this peninsula is covered by sand dunes, which in places form a ridge of very tall, marram-covered dunes. This sand dune system is highly dynamic and is one of the few areas where machair-type vegetation can be found on the mainland. On the southern shore of Balnakeil Bay there is a conspicuous rock platform with low cliffs.

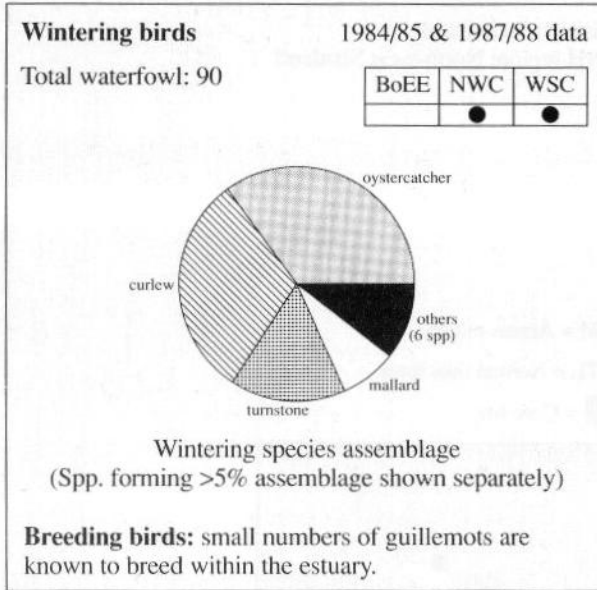
Wildlife features

Coastal habitats

	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other
	●	●	●	●	●	●				
Area (ha)	767	6	550							

● = major habitat ● = minor habitat

Birds



Aquatic estuarine communities

Soft substrate

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
		●		●								●		●	

Hard substrate

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
●	●	●		●												

Additional wildlife features

The nationally rare endemic Scottish primrose *Primula scotica* grows on the estuary, and the invertebrate fauna recorded on the Kyle of Durness includes the proposed RDB 3 micromoth *Stigmella dryadella* and one Notable species.

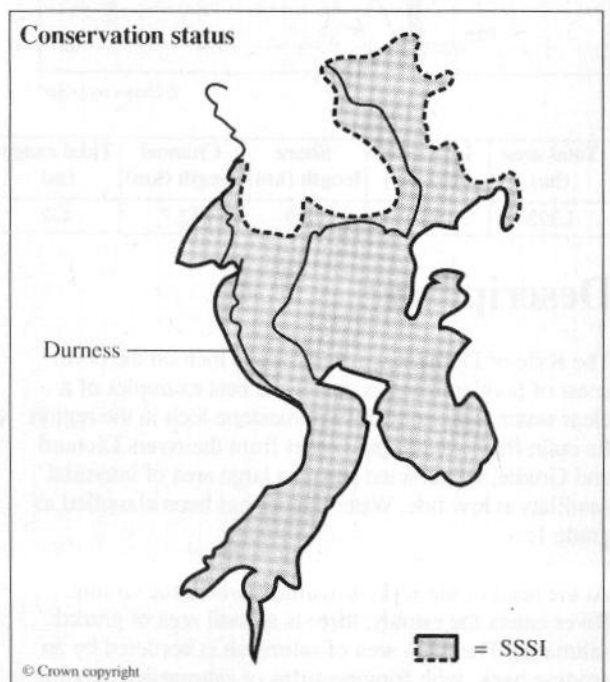
Otters are also present on the estuary.

Conservation status

	NCR	GCR	SSSI (B)	SSSI (G)	SSSI (M)	NNR	LNK	Ramsar	SPA	AONB	CWT	RSPB	ESA	NP	WWT	NT	NSA	HC	Other	
No.	1	1			1															1

● = designated ● = proposed

Much of the estuary is covered by the Durness mixed Site of Special Scientific Interest (1,997 ha) which is also a Nature Conservation Review site and a Geological Conservation Review site. The Kyle of Durness is also a preferred Coastal Conservation Zone.



Human activities

Present	Proposed	
●	●	Coast protection & sea defences Linear defences Training walls Groynes Brushwood fences <i>Spartina</i> planting Marram grass planting
		Barrage schemes Weirs & barrages for river management Storm surge barrages Water storage barrages & bunds Leisure barrages Tidal power barrages
		Power generation Thermal power stations Import/export jetties (power generation) Wind-power generation
		Industrial, port & related development Dock, port & harbour facilities Manufacturing industries Chemical industries Ship & boat building Others
		Extraction & processing of natural gas & oil Exploration Production Rig & platform construction Pipeline construction Pipeline installation Import/export jetties & single-point moorings Oil refineries Mothballing of rigs & tankers
●		Military activities Overflying by military aircraft Others
●		Waste discharge Domestic waste disposal Sewage discharge & outfalls Sewage treatment works Rubbish tips Industrial & agricultural waste discharge Thermal discharges (power stations) Dredge spoil Accidental discharges Aerial crop spraying Waste incinerators Others
		Sediment extraction Capital dredging Maintenance dredging Commercial estuarine aggregates extraction Commercial terrestrial aggregates extraction Non-commercial aggregates extraction Hard-rock quarrying
●	●	Transport & communications Airports & helipads Tunnels, bridges & aqueducts Causeways & fords Road schemes Ferries Cables
		Urbanisation Land-claim for housing & car parks
●	●	Education & scientific research Sampling, specimen collection & observation Nature trails & interpretative facilities Seismic studies & geological test drilling Marine & terrestrial archaeology Fossil collecting

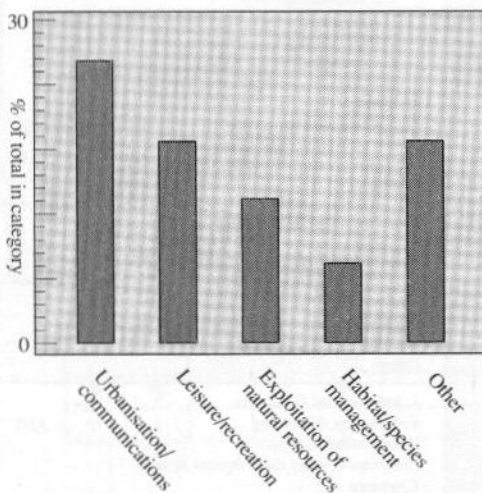
Present	Proposed	
●		Tourism & recreation Infrastructure developments Marinas Non-marina moorings Dinghy & boat parks Caravan parks & chalets Leisure centres, complexes & piers Aquatic-based recreation Power-boating & water-skiing Jet-skiing Sailing Sailboarding & wind-surfing SCUBA & snorkelling Canoeing Surfing Rowing Tourist boat trips/leisure barges Angling Other non-commercial fishing Bathing & general beach recreation Terrestrial & intertidal-based recreation Walking, including dog walking Bird-watching Sand-yachting 4WD & trial-biking Car sand-racing Horse-riding Rock-climbing Golf courses Clay-pigeon shooting Others Airborne recreation Overflying by light aircraft Radio-controlled model aircraft Others
		Wildfowling & hunting Wildfowling Other hunting-related activities
		Bait-collecting Digging & pumping for lugworms & ragworms Hydraulic dredging for worms Others
		Commercial fisheries Fish-netting & trawling Fyke-netting for eels Fish traps & other fixed devices & nets Crustacea Molluscs – Hand-gathering Dredging Hydraulic dredging
●	●	Cultivation of living resource Saltmarsh grazing Sand dune grazing Agricultural land-claim Fish-farming Shellfish farming Bottom & tray cultivation Suspended cultivation Crustacea farming Reeds for roofing <i>Salicornia</i> picking Others
●		Management & killing of birds & mammals Killing of mammals Killing of birds Adult fish-eating birds Adult shellfish-eating birds Gulls Geese
		Wildlife habitat management <i>Spartina</i> control Habitat creation & restoration Marine Intertidal Terrestrial Habitat management
●		Others

Features of human use

There are few activities occurring on the Kyle of Durness. The estuary is used for general beach recreation, walking and bird-watching, there is a small golf course at Balnakeil Bay and there are one or two moorings present. In summer a warden guides visitors along nature trails around the estuary.

All of the saltmarsh and sand dunes around the estuary are grazed. Grey seals are sporadically culled to protect the fishery, for the Dionard river is one of the best salmon fisheries in the country.

Categories of human use



Further reading

Glasgow University Exploration Society. 1975. *Durness expedition June/July 1975*. Unpublished, Glasgow University.

Institute of Terrestrial Ecology. 1979. The invertebrate fauna of dune and machair sites in Scotland. The north coast. *Nature Conservancy Council, CSD Report*, No. 255c.

Jones, A.M. 1975. *A littoral survey of the Kyle of Durness, Sutherland*. Department of Biological Sciences, University of Dundee.

Radley, G.P., Crawford, I.C., & Waite, A.R. 1989. *National sand dune vegetation survey. Site report No. 15, An Fharaid*. Peterborough, Nature Conservancy Council. (Contract Surveys, No. 57.)

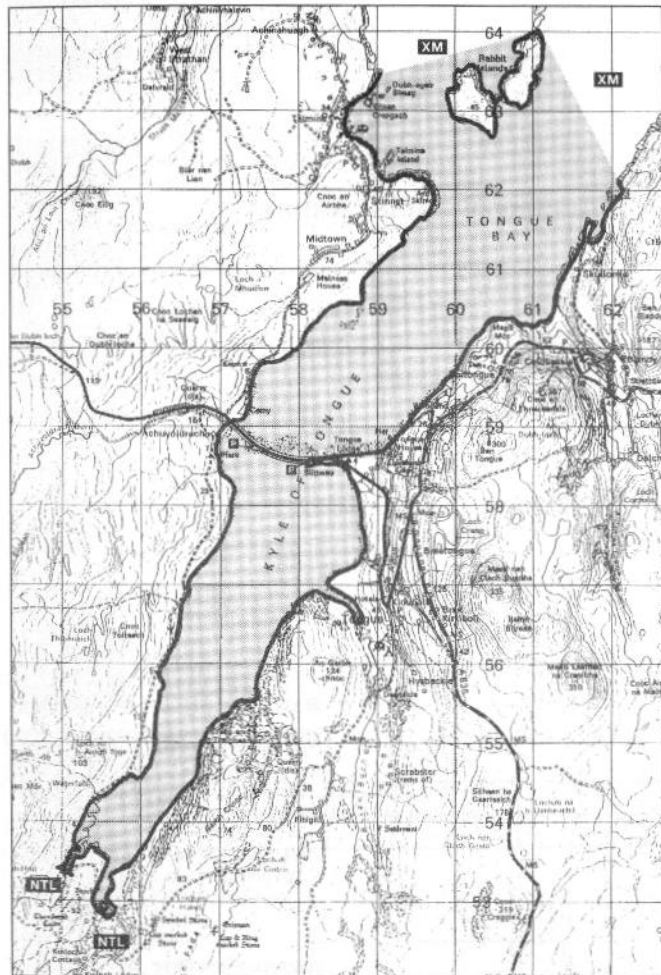
Ritchie, W., & Mather, A. 1969. *A survey of the beach, dune and machair areas of North and West Sutherland*. Report by the Department of Geography, University of Aberdeen to the Countryside Commission for Scotland.

Scott, K., & Law, D. 1984. *Saltmarsh survey of North-west Scotland. Caithness and Sutherland*. Unpublished, Nature Conservancy Council.

Centre grid: NC5858
Region: Highland

District: Sutherland
SNH region: North-west Scotland

Review site location



© Crown copyright

XM = Across mouth

NTL = Normal tidal limit

■ = Core site



Total area (ha)	Intertidal area (ha)	Shore length (km)	Channel length (km)	Tidal range (m)	Geomorph. type	Human population
1,818	442	37.2	14.2	4.3	Fjord	< 5,000

Description

The Kyle of Tongue is a shallow sea loch on the north coast of Scotland. The estuary seldom exceeds 11 metres in depth except for its outer reaches, where Rabbit Islands are connected to the mainland by a spit, for here the channel deepens to almost 27 metres. The freshwater inflow into the Kyle of Tongue comes from several rivers and burns, and water quality has been classified as grade 1.

At low water the subtidal channel is very narrow and flows across extensive intertidal flats. The innermost flats

are muddy and saltmarsh has developed where freshwater streams enter the Kyle, which is composed largely of mid/upper saltmarsh vegetation. There is also a small area of saltmarsh on the eastern shore where the Rhian Burn flows into the estuary.

Towards the mouth of the Kyle of Tongue extensive sandflats are exposed at low water, which are fringed by coarse boulder beaches.

Wildlife features

Coastal habitats

	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other
	●	●	●	●		●	●			
Area (ha)	1,376	8	434							

● = major habitat ● = minor habitat

Birds

Wintering birds 1984/85 & 1986/87 data

Total waterfowl: 600

BoEE	NWC	WSC
	●	●

Wintering species assemblage
(Spp. forming >5% assemblage shown separately)

Breeding birds: there are small breeding colonies of herring gull, lesser black-backed gull, kittiwake, shag and great black-backed gull and a moderate-sized colony of fulmar. Small numbers of ringed plover are also known to breed on the estuary.

Aquatic estuarine communities

Information unavailable.

Additional wildlife features

The nationally rare endemic Scottish primrose *Primula scotica* grows on the estuary.

Otters are present on the estuary, and seals haul out on the sandbanks.

Conservation status

	NCR	GCR	SSSI (B)	SSSI (G)	SSSI (M)	NNR	LNR	Ramsar	SPA	AONB	CWT	RSPB	ESA	NP	WWT	NT	NSA	HC	Other
No.																	●		●
																	1		1

● = designated ● = proposed

Kyle of Tongue is a National Scenic Area and a preferred Coastal Conservation Zone.

Features of human use

There are very few activities occurring on this site. A causeway in the middle of the estuary incorporates a road bridge and has linear defences alongside it. There is also a single sewage discharge outfall, and all of the saltmarsh is grazed by sheep.

Further reading

Ritchie, W., & Mather, A. 1969. *A survey of the beach, dune and machair areas of North and West Sutherland*. Report by the Department of Geography, University of Aberdeen to the Countryside Commission for Scotland.

Human activities

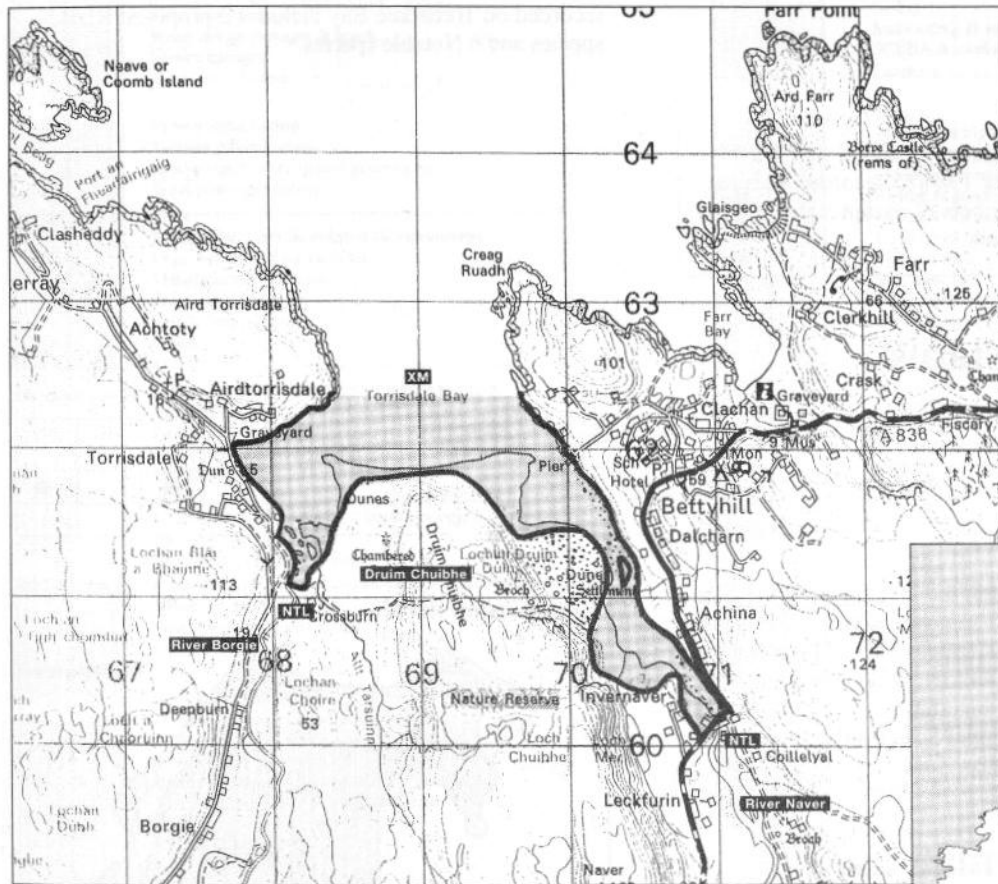
Present	Proposed	
●		Coast protection & sea defences Linear defences Training walls Groynes Brushwood fences <i>Spartina</i> planting Marram grass planting
		Barrage schemes Weirs & barrages for river management Storm surge barrages Water storage barrages & bunds Leisure barrages Tidal power barrages
		Power generation Thermal power stations Import/export jetties (power generation) Wind-power generation
		Industrial, port & related development Dock, port & harbour facilities Manufacturing industries Chemical industries Ship & boat building Others
		Extraction & processing of natural gas & oil Exploration Production Rig & platform construction Pipeline construction Pipeline installation Import/export jetties & single-point moorings Oil refineries Mothballing of rigs & tankers
		Military activities Overflying by military aircraft Others
●		Waste discharge Domestic waste disposal Sewage discharge & outfalls Sewage treatment works Rubbish tips Industrial & agricultural waste discharge Thermal discharges (power stations) Dredge spoil Accidental discharges Aerial crop spraying Waste incinerators Others
		Sediment extraction Capital dredging Maintenance dredging Commercial estuarine aggregates extraction Commercial terrestrial aggregates extraction Non-commercial aggregates extraction Hard-rock quarrying
●	●	Transport & communications Airports & helipads Tunnels, bridges & aqueducts Causeways & fords Road schemes Ferries Cables
		Urbanisation Land-claim for housing & car parks
		Education & scientific research Sampling, specimen collection & observation Nature trails & interpretative facilities Seismic studies & geological test drilling Marine & terrestrial archaeology Fossil collecting

Present	Proposed	
		Tourism & recreation Infrastructure developments Marinas Non-marina moorings Dinghy & boat parks Caravan parks & chalets Leisure centres, complexes & piers Aquatic-based recreation Power-boating & water-skiing Jet-skiing Sailing Sailboarding & wind-surfing SCUBA & snorkelling Canoeing Surfing Rowing Tourist boat trips/leisure barges Angling Other non-commercial fishing Bathing & general beach recreation Terrestrial & intertidal-based recreation Walking, including dog walking Bird-watching Sand-yachting 4WD & trial-biking Car sand-racing Horse-riding Rock-climbing Golf courses Clay-pigeon shooting Others Airborne recreation Overflying by light aircraft Radio-controlled model aircraft Others
●	●	Wildfowling & hunting Wildfowling Other hunting-related activities
		Bait-collecting Digging & pumping for lugworms & ragworms Hydraulic dredging for worms Others
		Commercial fisheries Fish-netting & trawling Fyke-netting for eels Fish traps & other fixed devices & nets Crustacea Molluscs – Hand-gathering Dredging Hydraulic dredging
●		Cultivation of living resource Saltmarsh grazing Sand dune grazing Agricultural land-claim Fish-farming Shellfish farming Bottom & tray cultivation Suspended cultivation Crustacea farming Reeds for roofing <i>Salicornia</i> picking Others
		Management & killing of birds & mammals Killing of mammals Killing of birds Adult fish-eating birds Adult shellfish-eating birds Gulls Geese
		Wildlife habitat management <i>Spartina</i> control Habitat creation & restoration Marine Intertidal Terrestrial Habitat management
		Others

Centre grid: NC6992
Region: Highland

District: Sutherland
SNH region: North-west Scotland

Review site location



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Total area (ha)	Intertidal area (ha)	Shore length (km)	Channel length (km)	Tidal range (m)	Geomorph. type	Human population
200	139	9.8	2.9	4.3	Fjord	< 5,000

Description

Torrisdale Bay is a small estuary on the north coast of Scotland. It receives freshwater inflow from the rivers Naver and Borgie, which flow through narrow glacial valleys either side of the Druim Chuibhe ridge into a small bay. Water quality has been classified as grade 1.

Much of the estuary is formed of lime-rich intertidal sandflats, which are exposed at low water. Strong northerly winds have blown sand inland, and have modified the river terraces and shingle. On the western, more silty shores where the River Borgie flows into the

bay there are islands of saltmarsh separated by river channels and gravel spreads, with a narrow fringe of saltmarsh along the shore to Torrisdale. On the eastern shore on the banks of the River Naver there is another, smaller area of saltmarsh.

Close to the central ridge of Druim Chuibhe the sandy foreshore grades from typical mobile dunes through blown sand to acidic moor vegetation. On the western shore there is a patch of machair vegetation on the flatter ground, with a small area of dune slack.

Wildlife features

Coastal habitats

	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other
	●	●	●	●	●	●				
Area (ha)	61	11	128							

● = major habitat ● = minor habitat

Aquatic estuarine communities

Information unavailable.

Birds

Wintering birds

Torrisdale Bay is not a regularly counted site. The Winter Shorebird Count of 1984/85 recorded 42 birds, which included small numbers of oystercatcher, ringed plover, curlew and redshank.

Additional wildlife features

The nationally rare endemic Scottish primrose *Primula scotica* is found on the estuary, and the invertebrate fauna recorded on Torrisdale Bay includes 3 proposed RDB species and 6 Notable species.

Otters also use the estuary.

Conservation status

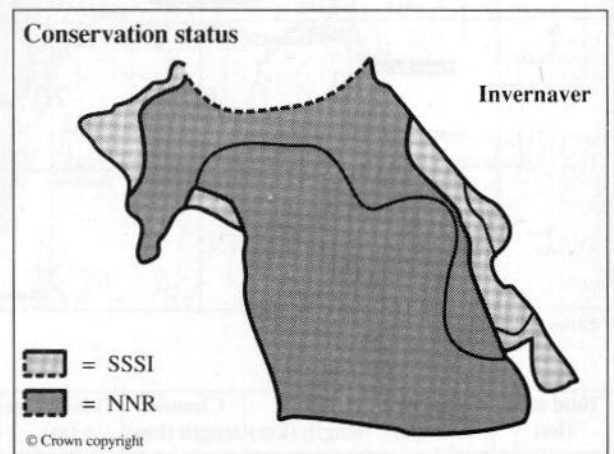
	NCR	GCR	SSSI (B)	SSSI (G)	SSSI (M)	NNR	LNR	Ramsar	SPA	AONB	CWT	RSPB	ESA	NP	WWT	NT	NSA	HC	Other
	●	●			●	●											●		●
No.	1	2			1	1											1		1

● = designated ● = proposed

Most of the estuary lies within the Invernaver mixed Site of Special Scientific Interest (630 ha) of which 551 ha is a National Nature Reserve. Torrisdale Bay is also a Nature Conservation Review and Geological Conservation Review site. Torrisdale and Invernaver is also a GCR site, and Torrisdale Bay is a National Scenic Area and a preferred Coastal Conservation Zone.

Features of human use

There are very few activities occurring on Torrisdale Bay. Leisure pursuits include beach recreation, walking, bird-watching and angling, and the saltmarsh and sand dunes are grazed. Other activities include non-commercial extraction of sand or gravel and culling of goosanders, red-breasted mergansers and seals to protect the salmon fishery.



Further reading

Glasgow University Exploration Society. 1975. *Durness expedition June/July 1975*. Unpublished, Glasgow University.

Institute of Terrestrial Ecology. 1979. The invertebrate fauna of dune and machair sites in Scotland. The north coast. *Nature Conservancy Council, CSD Report*, No. 255c.

Ritchie, W., & Mather, A. 1969. *A survey of the beach, dune and machair areas of North and West Sutherland*. Report by the Department of Geography, University of Aberdeen to the Countryside Commission for Scotland.

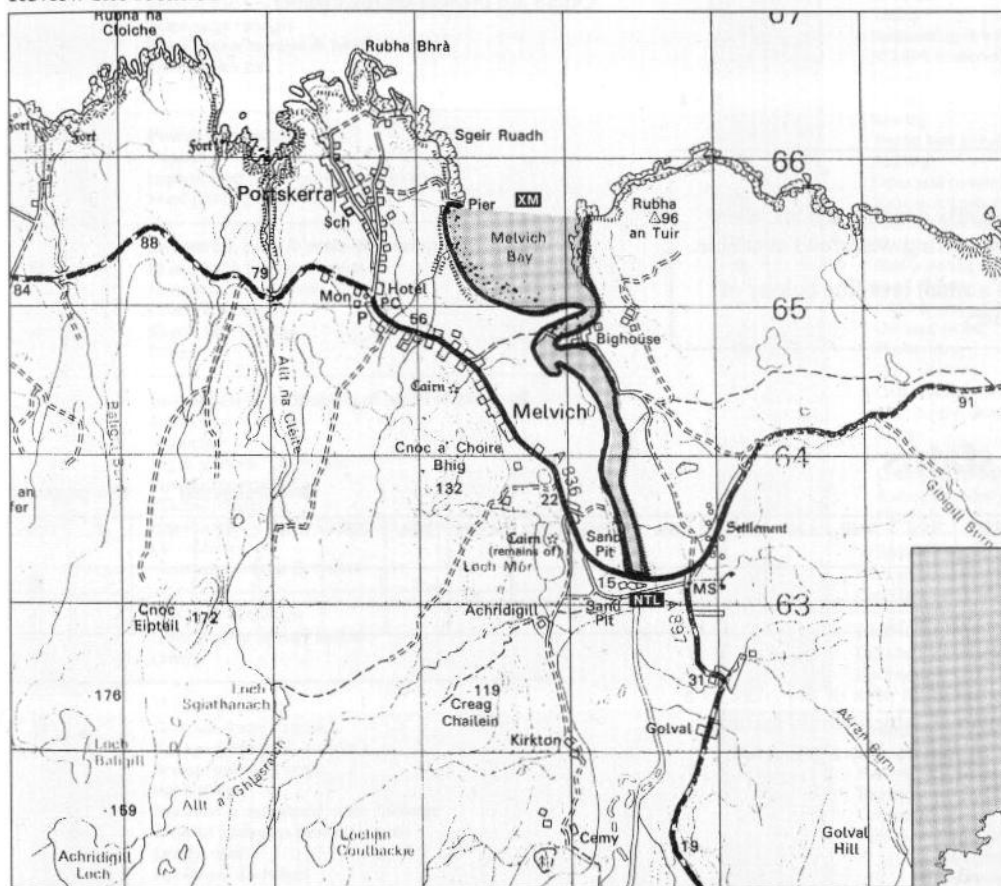
Scott, K., & Law, D. 1984. *Saltmarsh survey of North-west Scotland. Caithness and Sutherland*. Unpublished, Nature Conservancy Council.

Melvich Bay

Centre grid: NC8964
Region: Highland

District: Sutherland
SNH region: North-west Scotland

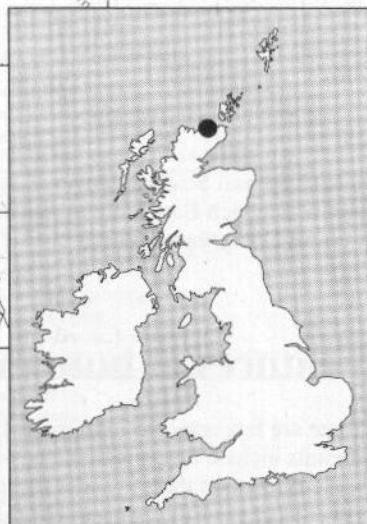
Review site location



XM = Across mouth

NTL = Normal tidal limit

■ = Core site



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Total area (ha)	Intertidal area (ha)	Shore length (km)	Channel length (km)	Tidal range (m)	Geomorph. type	Human population
78	33	6.9	3.0	4.3	Fjord	< 5,000

Description

Melvich Bay is a very small estuary on the north coast of Scotland. Its freshwater input comes from the Halladale river, which opens out into a small bay. Water quality has been classified as grade 1.

The upper reaches of the estuary are protected by two spits, around which the river channel meanders before opening out into the bay. At low tide the intertidal flats

exposed are predominantly sandy, with a small area of saltmarsh upstream of the spits on the western shore of the estuary.

Seaward of the spit the intertidal sandflats give way to a coarse boulder beach, which stretches around to the west of the bay. On the eastern side of the bay there is a stretch of rocky shore.

Wildlife features

Coastal habitats

	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other
	●	●	●	●		●	●			
Area (ha)	45	4	29							

● = major habitat ● = minor habitat

Aquatic estuarine communities

Information unavailable.

Additional wildlife features

Otters are present on the estuary.

Birds

Wintering birds

Melvich Bay is not a regularly counted site and there are no recent records of wintering waterfowl available.

Breeding birds: there is a small breeding colony of guillemot within the estuary.

Conservation status

● = designated ● = proposed

	NCR	GCR	SSSI (B)	SSSI (G)	SSSI (M)	NNR	LNR	Ramsar	SPA	AONB	CWT	RSPB	ESA	NP	WWT	NT	NSA	HC	Other
No.			●																●
			1																1

There is a proposal to designate an area of the coast as a Site of Special Scientific Interest, which would include part of Melvich Bay. Melvich Bay is also a preferred Coastal Conservation Zone.

Features of human use

There are few activities present on this site. Leisure pursuits include beach recreation, walking, bird-watching, horse-riding and there is some angling for salmon in the lower reaches of the estuary. The saltmarsh and sand dunes are grazed, and goosanders and red-breasted mergansers are culled to protect the salmon fishery.

Further reading

Glasgow University Exploration Society. 1975. *Durness expedition June/July 1975*. Unpublished, Glasgow University.

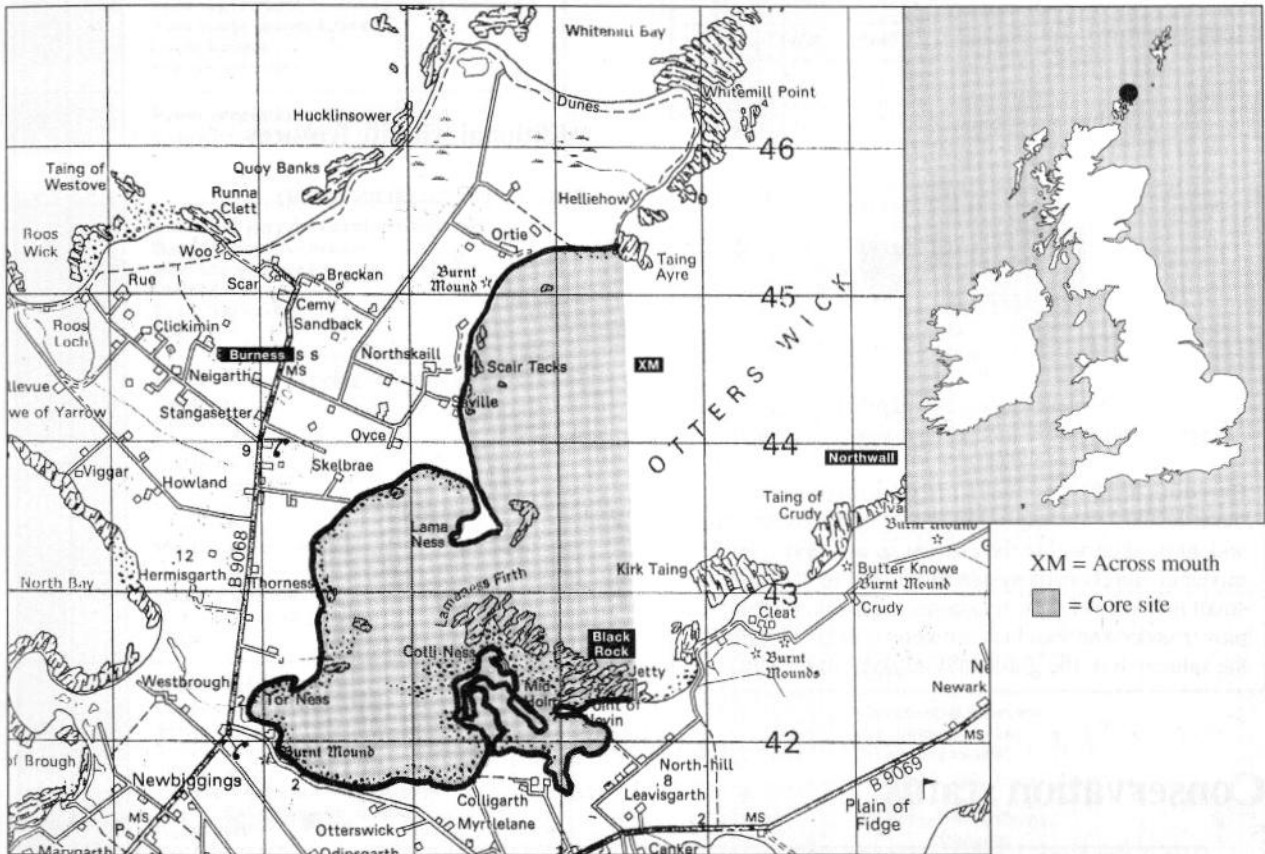
Institute of Terrestrial Ecology. 1979. The invertebrate fauna of dune and machair sites in Scotland. The north coast. *Nature Conservancy Council, CSD Report*, No. 255c.

Ritchie, W., & Mather, A. 1969. *A survey of the beach, dune and machair areas of North and West Sutherland*. Report by the Department of Geography, University of Aberdeen to the Countryside Commission for Scotland.

Centre grid: HY6843
Region: Orkney

District: Sanday
SNH region: North-east Scotland

Review site location



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Total area (ha)	Intertidal area (ha)	Shore length (km)	Channel length (km)	Tidal range (m)	Geomorph. type	Human population
553	310	12.0	2.6	2.8	Fjord	< 5,000

Description

On the north coast of Sanday, one of the northernmost islands of the Orkneys, lies the estuarine site of Otters Wick. Sheltered between the peninsulas of Northwall and Burness, at low tide the innermost shores of Otters Wick are a mixture of sand and shingle. Towards the mouth of the site the intertidal flats become more sandy, and are bordered by rocky shores to the south.

There are three areas of saltmarsh within Otters Wick. At Tor Ness on the innermost shore, saltmarsh has developed behind a small shingle spit, and the saltmarsh here is dissected by sinuous creeks and supports a diversity of saltmarsh vegetation communities. There are further areas of saltmarsh at Oyce on the landward end of Lama Ness and at Black Rock.

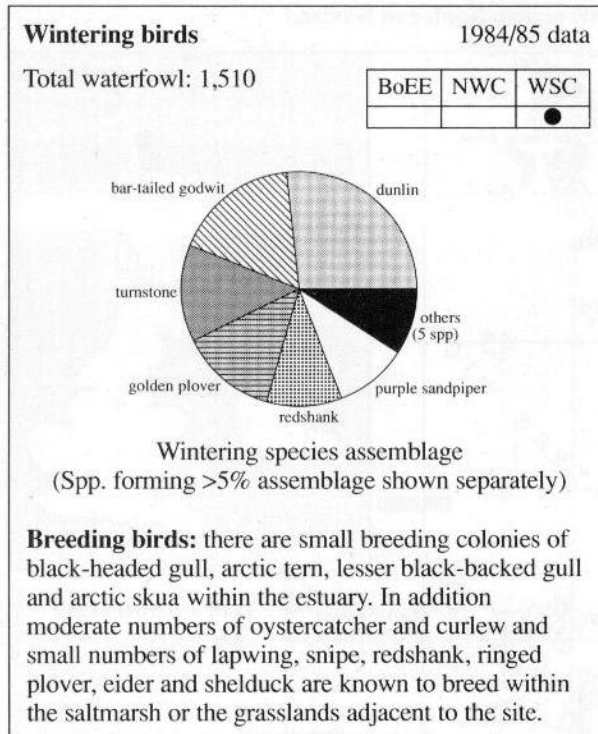
Wildlife features

Coastal habitats

	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other
	●	●	●	●		●		●		
Area (ha)	243	5	305							

● = major habitat ● = minor habitat

Birds



Aquatic estuarine communities

Information unavailable.

Additional wildlife features

Otters are present on the estuary.

Conservation status

	NCR	GCR	SSSI (B)	SSSI (G)	SSSI (M)	NNR	LNR	Ramsar	SPA	AONB	CWT	RSPB	ESA	NP	WWT	NT	NSA	HC	Other
No.								●	●										●
								1	1										1

● = designated ● = proposed

Otters Wick lies within a preferred Coastal Conservation Zone, and East Sanday is a candidate Ramsar site and Special Protection Area.

Features of human use

There are very few activities present on this site. Bottom and tray cultivation of manilla clams occurs, and there is also lobster- and crab-potting, and cockling. Bird-watching and wildfowling also occur but are not intensive. There is also very low-level sewage discharge from septic tanks and farms around the site.

In 1989 there was a further proposal to cultivate manilla clams.

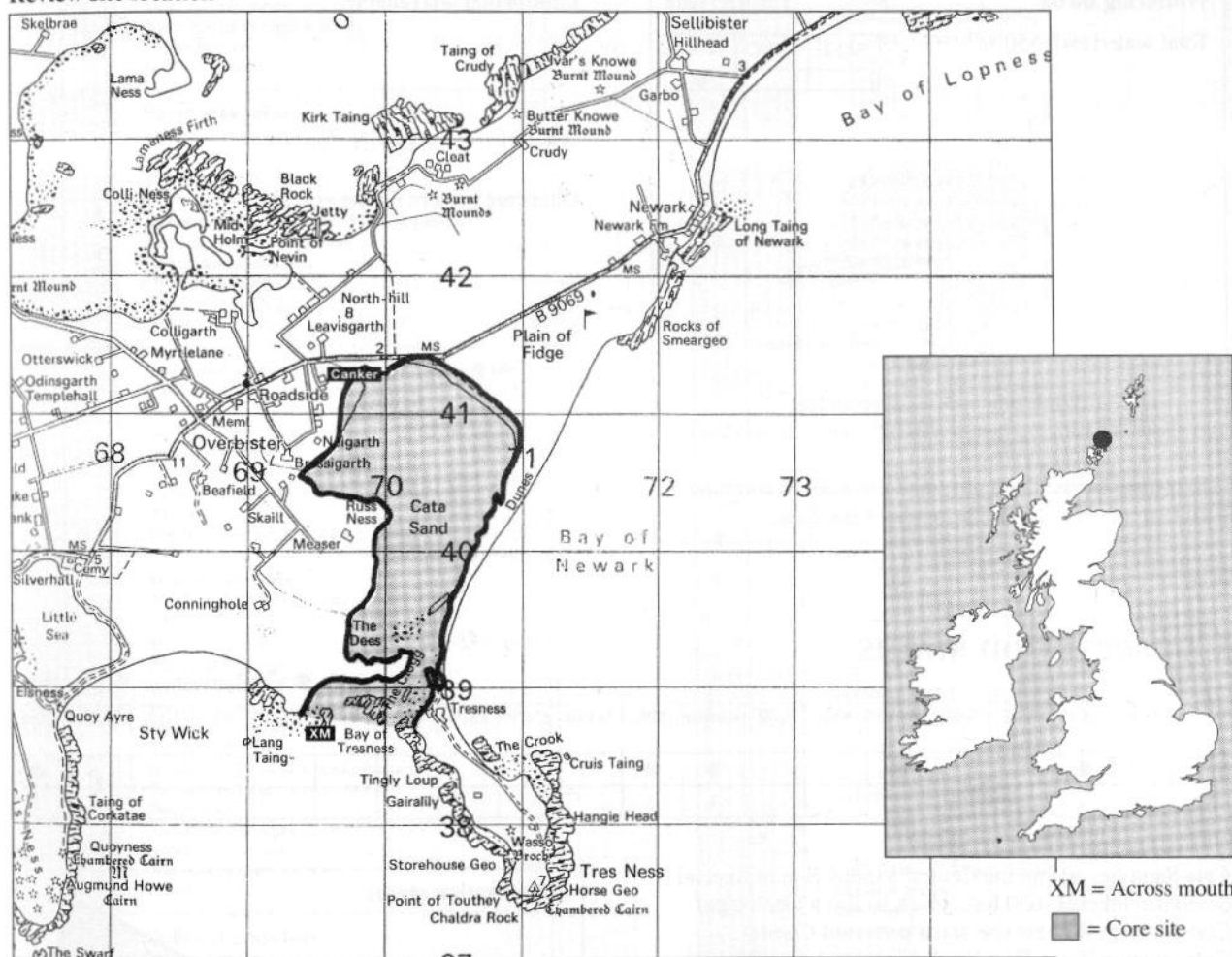
Further reading

- Bullock, I.D., & Gomershall, C.H. 1980. *The breeding populations of terns in Orkney and Shetland in 1980*. Sandy, Royal Society for the Protection of Birds.
- Mather, A.S., Smith, J.S., & Ritchie, W. 1974. *Beaches of Orkney*. Unpublished report to the Countryside Commission for Scotland by University of Aberdeen.
- Shimwell, D.W. 1985. *Saltmarshes of Orkney. Part IIa. A directory of sites*. Unpublished, Nature Conservancy Council.

Centre grid: HY7041
Region: Orkney

District: Sanday
SNH region: North-east Scotland

Review site location



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Total area (ha)	Intertidal area (ha)	Shore length (km)	Channel length (km)	Tidal range (m)	Geomorph. type	Human population
218	204	7.9	1.3	2.8	Bar built	< 5,000

Description

Cata Sand lies on the east coast of the island of Sanday in the Orkneys, and is enclosed on the eastern shore by a large sand and shingle spit that links Tres Ness to the main island. At low tide a large proportion of the site is exposed as intertidal sandflat, with small areas of peripheral saltmarsh. Together these form one of the largest areas of saltmarsh in the Orkneys, and support a diversity of saltmarsh vegetation communities. The

largest single area of saltmarsh is at Canker, where freshwater flows into the estuary.

The sand-covered spit on the east of the site supports a marram-dominated dune system along its length, with an extensive machair of blown shell-sand. Both dry and wet machair are present, with a herb-rich plant community.

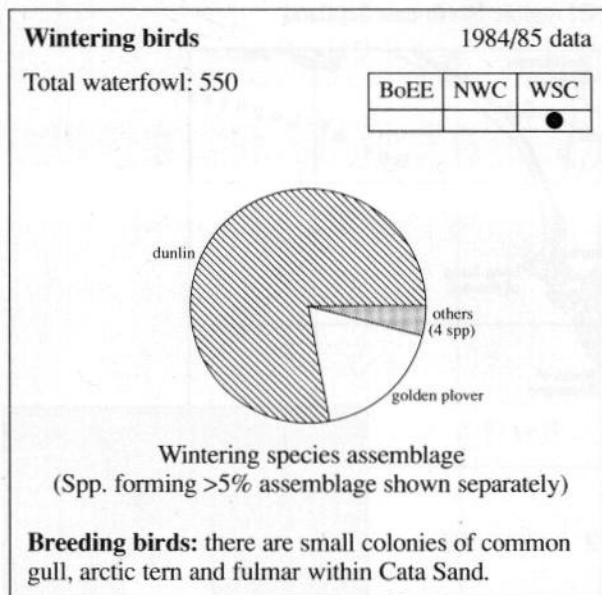
Wildlife features

Coastal habitats

	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other
	●	●	●	●	●	●				
Area (ha)	14	7	197							

● = major habitat ● = minor habitat

Birds



Aquatic estuarine communities

Information unavailable.

Additional wildlife features

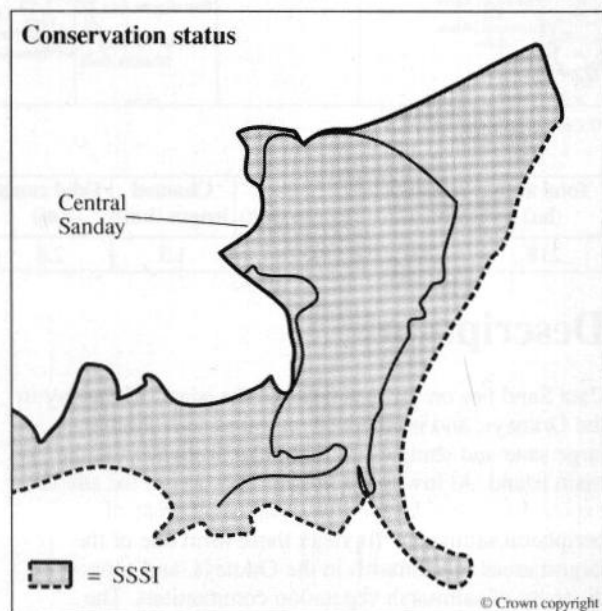
Otters are present on the estuary.

Conservation status

● = designated ● = proposed

	NCR	GCR	SSSI (B)	SSSI (G)	SSSI (M)	NNR	LNR	Ramsar	SPA	AONB	CWT	RSPB	ESA	NP	WWT	NT	NSA	HC	Other	
No.		●			●			●	●											●
		1			1			1	1											1

Cata Sand lies within the Central Sanday Site of Special Scientific Interest (650 ha), which is also a Geological Conservation Review site and a preferred Coastal Conservation Zone. East Sanday is a candidate Ramsar site and Special Protection Area.



Human activities

Present	Proposed	
		Coast protection & sea defences Linear defences Training walls Groynes Brushwood fences <i>Spartina</i> planting Marram grass planting
		Barrage schemes Weirs & barrages for river management Storm surge barrages Water storage barrages & bunds Leisure barrages Tidal power barrages
		Power generation Thermal power stations Import/export jetties (power generation) Wind-power generation
		Industrial, port & related development Dock, port & harbour facilities Manufacturing industries Chemical industries Ship & boat building Others
		Extraction & processing of natural gas & oil Exploration Production Rig & platform construction Pipeline construction Pipeline installation Import/export jetties & single-point moorings Oil refineries Mothballing of rigs & tankers
		Military activities Overflying by military aircraft Others
●		Waste discharge Domestic waste disposal Sewage discharge & outfalls Sewage treatment works Rubbish tips Industrial & agricultural waste discharge Thermal discharges (power stations) Dredge spoil Accidental discharges Aerial crop spraying Waste incinerators Others
●		Sediment extraction Capital dredging Maintenance dredging Commercial estuarine aggregates extraction Commercial terrestrial aggregates extraction Non-commercial aggregates extraction Hard-rock quarrying
		Transport & communications Airports & helipads Tunnels, bridges & aqueducts Causeways & fords Road schemes Ferries Cables
		Urbanisation Land-claim for housing & car parks
		Education & scientific research Sampling, specimen collection & observation Nature trails & interpretative facilities Seismic studies & geological test drilling Marine & terrestrial archaeology Fossil collecting

Present	Proposed	
		Tourism & recreation Infrastructure developments Marinas Non-marina moorings Dinghy & boat parks Caravan parks & chalets Leisure centres, complexes & piers Aquatic-based recreation Power-boating & water-skiing Jet-skiing Sailing Sailboarding & wind-surfing SCUBA & snorkelling Canoeing Surfing Rowing Tourist boat trips/leisure barges Angling Other non-commercial fishing Bathing & general beach recreation Terrestrial & intertidal-based recreation Walking, including dog walking Bird-watching Sand-yachting 4WD & trial-biking Car sand-racing Horse-riding Rock-climbing Golf courses Clay-pigeon shooting Others Airborne recreation Overflying by light aircraft Radio-controlled model aircraft Others
●		Wildfowling & hunting Wildfowling Other hunting-related activities
		Bait-collecting Digging & pumping for lugworms & ragworms Hydraulic dredging for worms Others
		Commercial fisheries Fish-netting & trawling Fyke-netting for eels Fish traps & other fixed devices & nets Crustacea Molluscs – Hand-gathering Dredging Hydraulic dredging
●	●	Cultivation of living resource Saltmarsh grazing Sand dune grazing Agricultural land-claim Fish-farming Shellfish farming Bottom & tray cultivation Suspended cultivation Crustacea farming Reeds for roofing <i>Salicornia</i> picking Others
		Management & killing of birds & mammals Killing of mammals Killing of birds Adult fish-eating birds Adult shellfish-eating birds Gulls Geese
		Wildlife habitat management <i>Spartina</i> control Habitat creation & restoration Marine Intertidal Terrestrial Habitat management
		Others

Features of human use

There are very few activities occurring on this site and these are not intensive. These include sewage discharge from local houses and farms, extraction of sand and shingle by locals, bird-watching and wildfowling. In addition most of the sand dunes are grazed and the potential for cultivating oysters was being investigated in 1989.

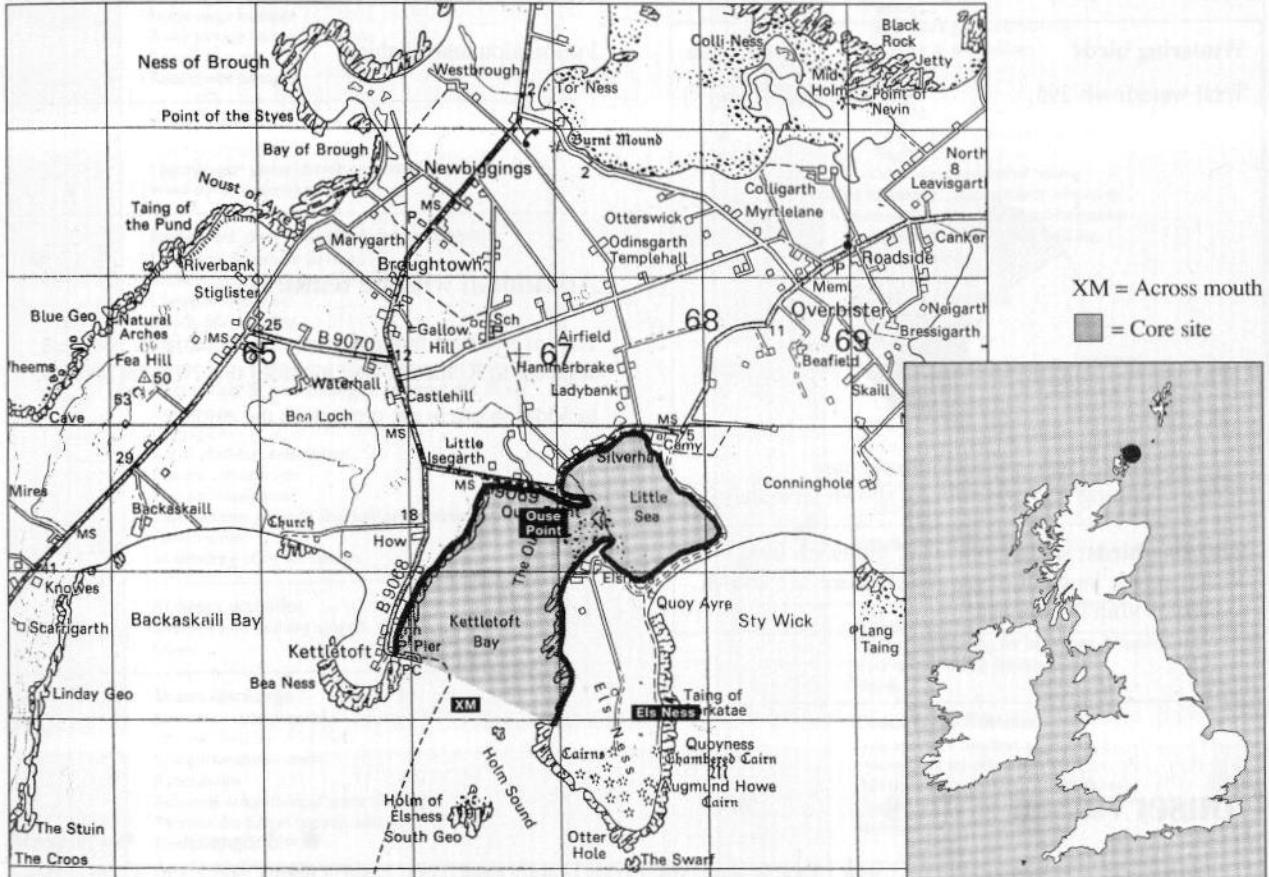
Further reading

- Bullock, I.D., & Gomershall, C.H. 1980. *The breeding populations of terns in Orkney and Shetland in 1980*. Sandy, Royal Society for the Protection of Birds.
- Mather, A.S., Smith, J.S., & Ritchie, W. 1974. *Beaches of Orkney*. Unpublished report to the Countryside Commission for Scotland by University of Aberdeen.
- Shimwell, D.W. 1985. *Saltmarshes of Orkney. Part IIa. A directory of sites*. Unpublished, Nature Conservancy Council.

Centre grid: HY6739
Region: Orkney

District: Sanday
SNH region: North-west Scotland

Review site location



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Total area (ha)	Intertidal area (ha)	Shore length (km)	Channel length (km)	Tidal range (m)	Geomorph. type	Human population
191	122	6.7	1.9	2.8	Fjord	< 5,000

Description

Kettletoft Bay lies on the southern shores of Sanday in the Orkneys, and is in close proximity to the Cata Sand review site. Kettletoft Bay is enclosed to the east by a sand and shingle spit which joins Els Ness to the main island. The innermost part of the estuary is a small bay known as the Little Sea, which exposes an intertidal sandflat at low tide with a fringe of saltmarsh. This saltmarsh is one of the largest and most diverse

concentrations of saltmarsh in the Orkneys.

The outer part of the Little Sea is constricted by the small spit of Ouse Point that protrudes from the mainland, and an area of shingle that adjoins Els Ness. The narrow subtidal channel flows across the sandflat of the outer Kettletoft Bay before opening out into the sea. The shores of the outer bay are predominantly rocky.

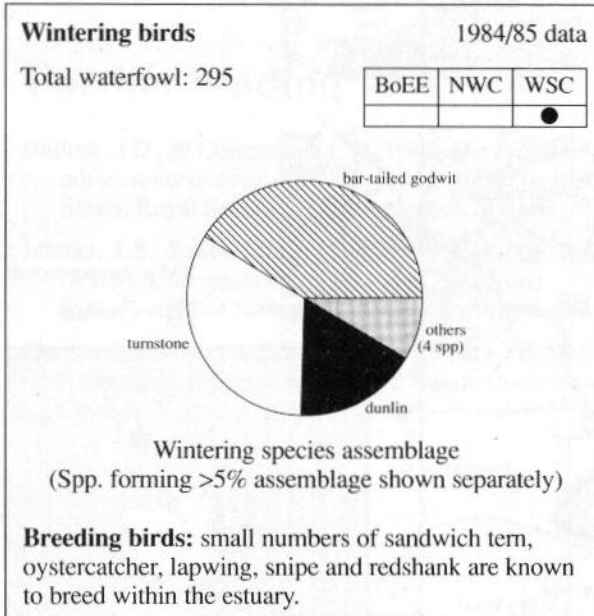
Wildlife features

Coastal habitats

	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other
	●	●	●			●	●			
Area (ha)	70	6	110							

● = major habitat ● = minor habitat

Birds



Aquatic estuarine communities

Information unavailable.

Additional wildlife features

The invertebrate fauna recently recorded from Els Ness adjacent to Kettletoft Bay includes one Notable species.

In addition otters are present on the estuary.

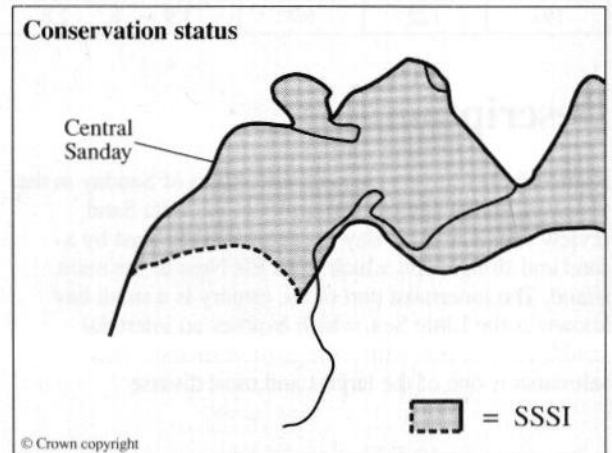
Conservation status

● = designated ● = proposed

	NCR	GCR	SSSI (B)	SSSI (G)	SSSI (M)	NNR	LNR	Ramsar	SPA	AONB	CWT	RSPB	ESA	NP	WWT	NT	NSA	HC	Other	
No.		●			●			●	●											●
		1			1			1	1											1

A large proportion of the estuary is covered by Central Sanday Site of Special Scientific Interest (650 ha) which is also a Geological Conservation Review site. Kettletoft Bay has also been identified as a preferred Coastal Conservation Zone.

East Sanday is a candidate Ramsar site and Special Protection Area.



Human activities

Present
Proposed

		Coast protection & sea defences Linear defences Training walls Groynes Brushwood fences <i>Spartina</i> planting Marram grass planting
		Barrage schemes Weirs & barrages for river management Storm surge barrages Water storage barrages & bunds Leisure barrages Tidal power barrages
		Power generation Thermal power stations Import/export jetties (power generation) Wind-power generation
●		Industrial, port & related development Dock, port & harbour facilities Manufacturing industries Chemical industries Ship & boat building Others
		Extraction & processing of natural gas & oil Exploration Production Rig & platform construction Pipeline construction Pipeline installation Import/export jetties & single-point moorings Oil refineries Mothballing of rigs & tankers
		Military activities Overflying by military aircraft Others
●		Waste discharge Domestic waste disposal Sewage discharge & outfalls Sewage treatment works Rubbish tips Industrial & agricultural waste discharge Thermal discharges (power stations) Dredge spoil Accidental discharges Aerial crop spraying Waste incinerators Others
●		Sediment extraction Capital dredging Maintenance dredging Commercial estuarine aggregates extraction Commercial terrestrial aggregates extraction Non-commercial aggregates extraction Hard-rock quarrying
●		Transport & communications Airports & helipads Tunnels, bridges & aqueducts Causeways & fords Road schemes Ferries Cables
		Urbanisation Land-claim for housing & car parks
		Education & scientific research Sampling, specimen collection & observation Nature trails & interpretative facilities Seismic studies & geological test drilling Marine & terrestrial archaeology Fossil collecting

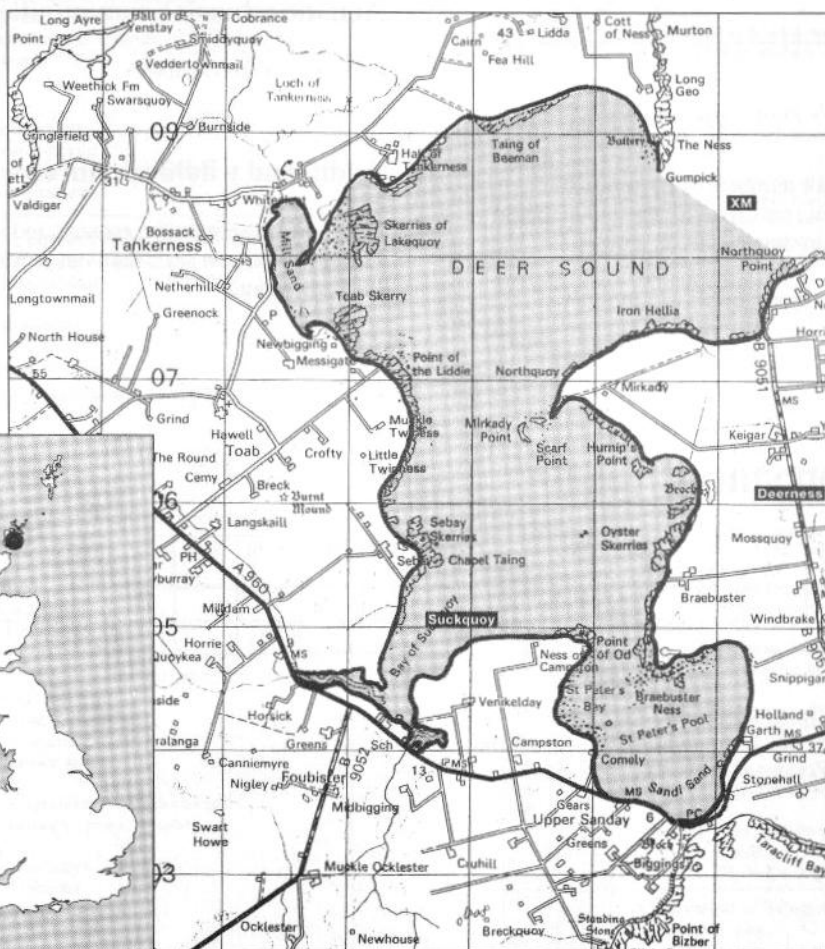
Present
Proposed

		Tourism & recreation Infrastructure developments Marinas Non-marina moorings Dinghy & boat parks Caravan parks & chalets Leisure centres, complexes & piers Aquatic-based recreation Power-boating & water-skiing Jet-skiing Sailing Sailboarding & wind-surfing SCUBA & snorkelling Canoeing Surfing Rowing Tourist boat trips/leisure barges Angling Other non-commercial fishing Bathing & general beach recreation Terrestrial & intertidal-based recreation Walking, including dog walking Bird-watching Sand-yachting 4WD & trial-biking Car sand-racing Horse-riding Rock-climbing Golf courses Clay-pigeon shooting Others Airborne recreation Overflying by light aircraft Radio-controlled model aircraft Others
●		Wildfowling & hunting Wildfowling Other hunting-related activities
		Bait-collecting Digging & pumping for lugworms & ragworms Hydraulic dredging for worms Others
●		Commercial fisheries Fish-netting & trawling Fyke-netting for eels Fish traps & other fixed devices & nets Crustacea Molluscs – Hand-gathering Dredging Hydraulic dredging
●		Cultivation of living resource Saltmarsh grazing Sand dune grazing Agricultural land-claim Fish-farming Shellfish farming Bottom & tray cultivation Suspended cultivation Crustacea farming Reeds for roofing <i>Salicornia</i> picking Others
●		Management & killing of birds & mammals Killing of mammals Killing of birds Adult fish-eating birds Adult shellfish-eating birds Gulls Geese
		Wildlife habitat management <i>Spartina</i> control Habitat creation & restoration Marine Intertidal Terrestrial Habitat management
		Others

Centre grid: HY5404
Region: Orkney

District: Mainland
SNH region: North-east Scotland

Review site location



XM = Across mouth

■ = Core site

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Total area (ha)	Intertidal area (ha)	Shore length (km)	Channel length (km)	Tidal range (m)	Geomorph. type	Human population
1,287	305	25.4	6.4	3.2	Fjord	< 5,000

Description

Deer Sound and Peter's Pool lie on the south-east coast of mainland Orkney. The site is bounded to the south by Dingieshore, a stable sand spit which connects Deerness to the main island. A large subtidal area of the estuary is known as Deer Sound, which is fringed with long stretches of rocky shore.

There are three small bays around the estuary. In the north-west is Mill Sand and on either side of the Venikeldy headland in the south are Suckquoy and St

Peter's Pool. Within these bays lie the main intertidal flats; St Peter's Pool is largely sandflat with some shingle close to the main bay, Mill Sand is mostly sand with some shingle, and Suckquoy is a sand and silt flat. Within these three bays there are small areas of saltmarsh. Two freshwater inflows within the Bay of Suckquoy each have their own discrete patch of saltmarsh, there is a small area of saltmarsh at Mill Sand that grades to heathland, and a narrow band of saltmarsh fringes the intertidal flats of Sandi Sand in St Peter's Pool.

Wildlife features

Coastal habitats

	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other
	●	●	●			●		●		
Area (ha)	982	7	298							

● = major habitat ● = minor habitat

Birds

Wintering birds

Deer Sound & Peter's Pool is not a regularly counted site.

Breeding birds: small numbers of oystercatcher, lapwing, snipe, curlew, redshank, eider, shelduck and ringed plover breed on the grasslands around the estuary.

Aquatic estuarine communities

Information unavailable.

Additional wildlife features

Otters are present on the estuary, and small numbers of grey and common seals haul out at Mill Sands and Mirkady Point.

Conservation status

● = designated ● = proposed

No.	NCR	GCR	SSSI (B)	SSSI (G)	SSSI (M)	NNR	LNR	Ramsar	SPA	AONB	CWT	RSPB	ESA	NP	WWT	NT	NSA	HC	Other		
																				●	
																					1

There are no statutory designations on Deer Sound and Peter's Pool, but the site has been identified as a preferred Coastal Conservation Zone.

Features of human use

There are very few activities on the estuary and most are low-level. These include sewage discharge from septic tanks, bird-watching, angling, cockling at Mill Sands and Sandi Sands, lobster and crab potting and, very occasionally, trial-biking and horse-riding. There is also suspended cultivation of mussels and bottom/tray cultivation of oysters.

Further reading

Shimwell, D.W. 1985. *Saltmarshes of Orkney*. Unpublished, Nature Conservancy Council.

Human activities

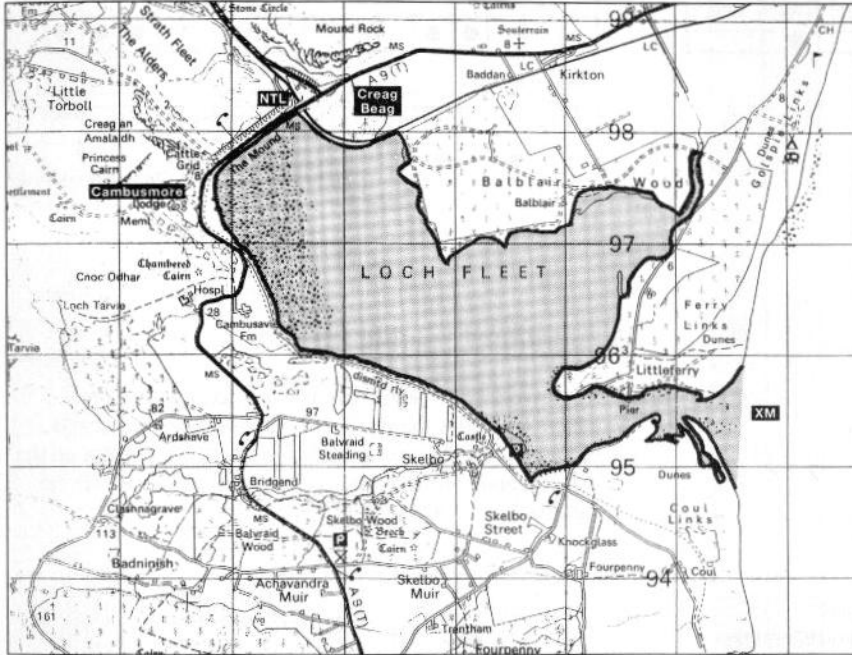
Present	Proposed	
		Coast protection & sea defences Linear defences Training walls Groynes Brushwood fences <i>Spartina</i> planting Marram grass planting
		Barrage schemes Weirs & barrages for river management Storm surge barrages Water storage barrages & bunds Leisure barrages Tidal power barrages
		Power generation Thermal power stations Import/export jetties (power generation) Wind-power generation
		Industrial, port & related development Dock, port & harbour facilities Manufacturing industries Chemical industries Ship & boat building Others
		Extraction & processing of natural gas & oil Exploration Production Rig & platform construction Pipeline construction Pipeline installation Import/export jetties & single-point moorings Oil refineries Mothballing of rigs & tankers
		Military activities Overflying by military aircraft Others
●		Waste discharge Domestic waste disposal Sewage discharge & outfalls Sewage treatment works Rubbish tips Industrial & agricultural waste discharge Thermal discharges (power stations) Dredge spoil Accidental discharges Aerial crop spraying Waste incinerators Others
		Sediment extraction Capital dredging Maintenance dredging Commercial estuarine aggregates extraction Commercial terrestrial aggregates extraction Non-commercial aggregates extraction Hard-rock quarrying
		Transport & communications Airports & helipads Tunnels, bridges & aqueducts Causeways & fords Road schemes Ferries Cables
		Urbanisation Land-claim for housing & car parks
		Education & scientific research Sampling, specimen collection & observation Nature trails & interpretative facilities Seismic studies & geological test drilling Marine & terrestrial archaeology Fossil collecting

Present	Proposed	
		Tourism & recreation Infrastructure developments Marinas Non-marina moorings Dinghy & boat parks Caravan parks & chalets Leisure centres, complexes & piers Aquatic-based recreation Power-boating & water-skiing Jet-skiing Sailing Sailboarding & wind-surfing SCUBA & snorkelling Canoeing Surfing Rowing Tourist boat trips/leisure barges Angling Other non-commercial fishing Bathing & general beach recreation Terrestrial & intertidal-based recreation Walking, including dog walking Bird-watching Sand-yachting 4WD & trial-biking Car sand-racing Horse-riding Rock-climbing Golf courses Clay-pigeon shooting Others Airborne recreation Overflying by light aircraft Radio-controlled model aircraft Others
●		Wildfowling & hunting Wildfowling Other hunting-related activities
		Bait-collecting Digging & pumping for lugworms & ragworms Hydraulic dredging for worms Others
	●	Commercial fisheries Fish-netting & trawling Fyke-netting for eels Fish traps & other fixed devices & nets Crustacea Molluscs – Hand-gathering Dredging Hydraulic dredging
	●	Cultivation of living resource Saltmarsh grazing Sand dune grazing Agricultural land-claim Fish-farming Shellfish farming Bottom & tray cultivation Suspended cultivation Crustacea farming Reeds for roofing <i>Salicornia</i> picking Others
		Management & killing of birds & mammals Killing of mammals Killing of birds Adult fish-eating birds Adult shellfish-eating birds Gulls Geese
		Wildlife habitat management <i>Spartina</i> control Habitat creation & restoration Marine Intertidal Terrestrial Habitat management
		Others

Centre grid: NH7996
Region: Highland

District: Sutherland
SNH region: North-west Scotland

Review site location



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XM = Across mouth

NTL = Normal tidal limit

■ = Core site



Total area (ha)	Intertidal area (ha)	Shore length (km)	Channel length (km)	Tidal range (m)	Geomorph. type	Human population
695	522	20.7	6.6	4.0	Bar built	< 5,000

Description

The present shape of Loch Fleet is a result of the build-up of shingle spits to the north and south of the bay, which have reduced the mouth to a narrow channel and enclosed the basin. At low water the estuary is an extensive intertidal mud- and sandflat, with sand and shingle in the westernmost part of the bay. Loch Fleet is known to support a rich marine fauna that has been described as of primary marine biological importance. Water quality in the estuary has been classified as class 1.

Narrow bands of saltmarsh fringe part of the shores of the loch. The largest single area of saltmarsh has developed at the head of the bay at Balblair, where there is a well-developed turf with occasional creeks and pans. At Creag Beag there is a small patch of saltmarsh around three sheltered tidal pools, and at Cambusmore at the head of the loch is largely mid-upper saltmarsh vegetation which grades to grassland. There is also an area of fringing saltmarsh at Skelbo and on the seaward edge of the dune system of Coul Links, where there is some saltmarsh

vegetation within a long dune slack that is inundated at high tide.

To the north of the estuary mouth is the spit of Ferry Links, which supports a large area of lichen-rich and moss-rich heath and a Scot's pine plantation. These are occasionally flooded by the sea. Coul Links to the south of the estuary mouth is an extensive dune complex which displays a complete transition from foredune to wooded slacks. Here there are also some flooded slacks and winter lochs, and in the drier areas there is some coastal heath. Over 200 plant species have been recorded here.

In 1816 the inner part of Loch Fleet was enclosed from the sea by the embankment of the Mound, and alder and willow woodland rapidly developed on the former estuary. This area, now known as Mound Alderwoods, shows the succession from intertidal flats to natural woodland, and in places conditions are brackish due to leakage of saltwater from Loch Fleet.

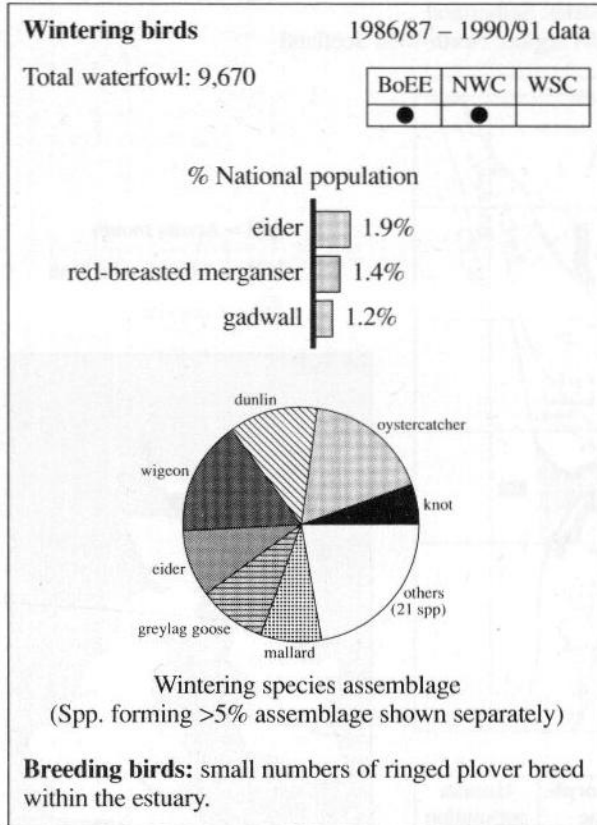
Wildlife features

Coastal habitats

	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other
	●	●	●	●	●					
Area (ha)	173	34	488							

● = major habitat ● = minor habitat

Birds



Aquatic estuarine communities

Soft substrate

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
			●	●								●	●	●	

Hard substrate

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
		●		●												

Additional wildlife features

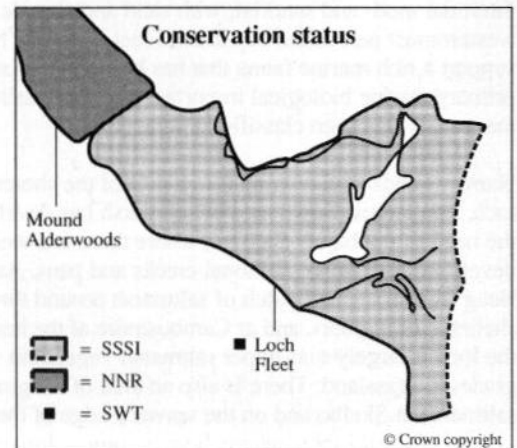
The invertebrate fauna recently recorded within the estuary includes the RDB 2 fly *Helina intermedia* and eight Notable species. In addition otters are present on the estuary, and common seals occasionally haul out on the sandbanks.

Conservation status

● = designated ● = proposed

	NCR	GCR	SSSI (B)	SSSI (G)	SSSI (M)	NNR	LNR	Ramsar	SPA	AONB	CWT	RSPB	ESA	NP	WWT	NT	NSA	HC	Other
	●		●			●		●	●		●								
No.	2		2			1		1	1		1								

The estuary lies within the Loch Fleet biological Site of Special Scientific Interest (1,238 ha), which is also a Nature Conservation Review site and Scottish Wildlife Trust reserve. Mound Alderwoods adjacent to the site has developed on land claimed from the inner estuary, and has been designated as a biological SSSI, a National Nature Reserve and an NCR site. Loch Fleet and the Mound lie within the proposed Moray Basin, Firths and Bays Ramsar site and Special Protection Area.



Human activities

Present
Proposed

●	<p>Coast protection & sea defences Linear defences Training walls Groynes Brushwood fences <i>Spartina</i> planting Marram grass planting</p>
	<p>Barrage schemes Weirs & barrages for river management Storm surge barrages Water storage barrages & bunds Leisure barrages Tidal power barrages</p>
	<p>Power generation Thermal power stations Import/export jetties (power generation) Wind-power generation</p>
	<p>Industrial, port & related development Dock, port & harbour facilities Manufacturing industries Chemical industries Ship & boat building Others</p>
	<p>Extraction & processing of natural gas & oil Exploration Production Rig & platform construction Pipeline construction Pipeline installation Import/export jetties & single-point moorings Oil refineries Mothballing of rigs & tankers</p>
●	<p>Military activities Overflying by military aircraft Others</p>
●	<p>Waste discharge Domestic waste disposal Sewage discharge & outfalls Sewage treatment works Rubbish tips Industrial & agricultural waste discharge Thermal discharges (power stations) Dredge spoil Accidental discharges Aerial crop spraying Waste incinerators Others</p>
	<p>Sediment extraction Capital dredging Maintenance dredging Commercial estuarine aggregates extraction Commercial terrestrial aggregates extraction Non-commercial aggregates extraction Hard-rock quarrying</p>
●	<p>Transport & communications Airports & helipads Tunnels, bridges & aqueducts Causeways & fords Road schemes Ferries Cables</p>
	<p>Urbanisation Land-claim for housing & car parks</p>
●	<p>Education & scientific research Sampling, specimen collection & observation Nature trails & interpretative facilities Seismic studies & geological test drilling Marine & terrestrial archaeology Fossil collecting</p>

Present
Proposed

●	<p>Tourism & recreation Infrastructure developments Marinas Non-marina moorings Dinghy & boat parks Caravan parks & chalets Leisure centres, complexes & piers Aquatic-based recreation Power-boating & water-skiing Jet-skiing Sailing Sailboarding & wind-surfing SCUBA & snorkelling Canoeing Surfing Rowing Tourist boat trips/leisure barges Angling Other non-commercial fishing Bathing & general beach recreation Terrestrial & intertidal-based recreation Walking, including dog walking Bird-watching Sand-yachting 4WD & trial-biking Car sand-racing Horse-riding Rock-climbing Golf courses Clay-pigeon shooting Others Airborne recreation Overflying by light aircraft Radio-controlled model aircraft Others</p>
	<p>Wildfowling & hunting Wildfowling Other hunting-related activities</p>
●	<p>Bait-collecting Digging & pumping for lugworms & ragworms Hydraulic dredging for worms Others</p>
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●	<p>Cultivation of living resource Saltmarsh grazing Sand dune grazing Agricultural land-claim Fish-farming Shellfish farming Bottom & tray cultivation Suspended cultivation Crustacea farming Reeds for roofing <i>Salicornia</i> picking Others</p>
	<p>Management & killing of birds & mammals Killing of mammals Killing of birds Adult fish-eating birds Adult shellfish-eating birds Gulls Geese</p>
	<p>Wildlife habitat management <i>Spartina</i> control Habitat creation & restoration Marine Intertidal Terrestrial Habitat management</p>
	<p>Others</p>

Features of human use

In 1989 there were few activities occurring on Loch Fleet. A causeway known as 'the Mound' crosses the top of the site and has linear defences associated with it. Leisure activities on the estuary include walking, horse-riding, clay-pigeon shooting, bird-watching and angling, and exploitation of the natural resources includes sand dune grazing and digging for lugworms and ragworms.

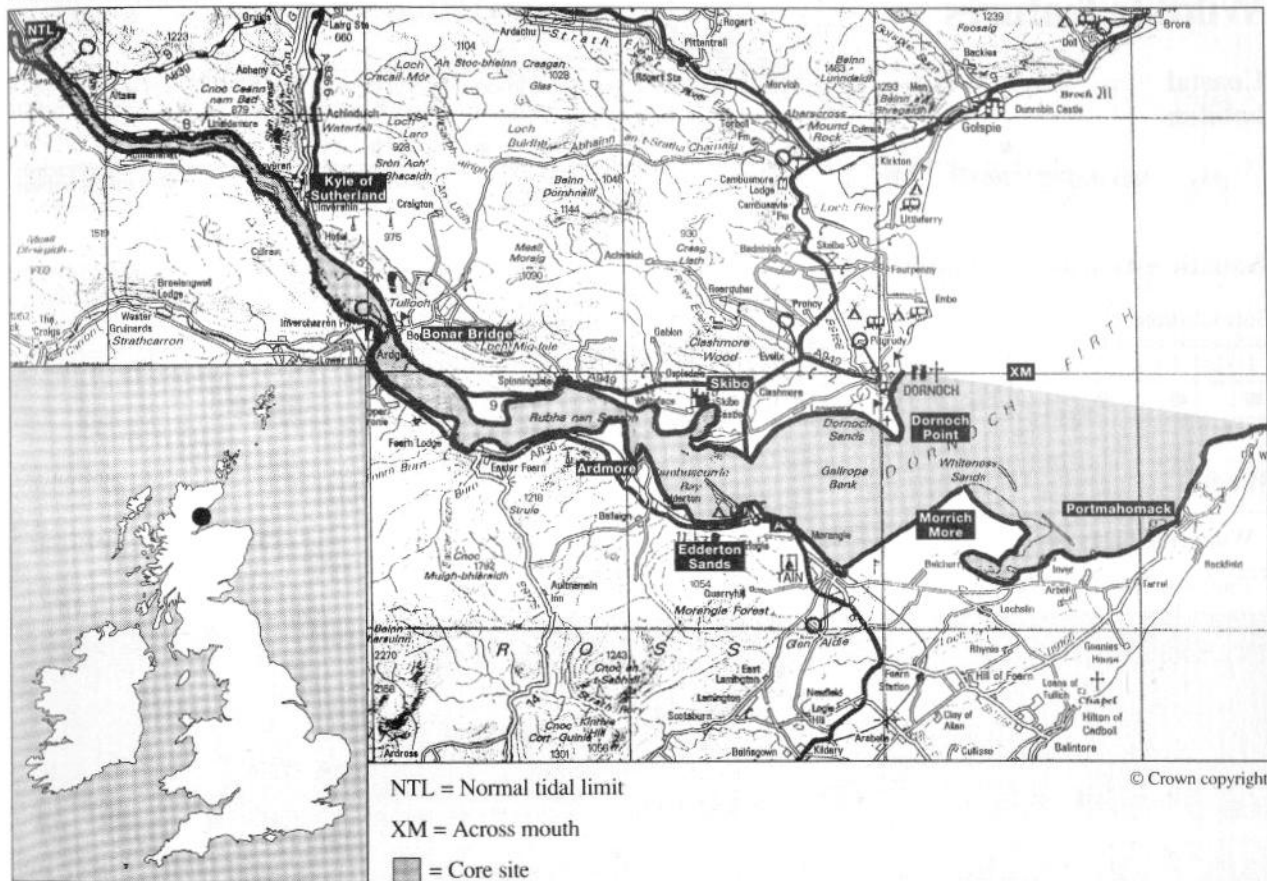
Further reading

- Bartrop, J., Bishop, G., Harvey, R., Holme, N.A., Knight, S.J.T., & Powell, H.T. 1980. Survey of the littoral zone of the coast of Great Britain. 7. Report on the shores of the Moray Firth. *Nature Conservancy Council, CSD Report*, No. 308.
- Fletcher, A., Coppins, B.J., Gilbert, O.L., James, P.W., & Lambley, P.W. 1984. Lichen habitats - lowland heath, dune and machair. A survey and assessment by the British Lichen Society. *Nature Conservancy Council, CSD Report*, No. 522.
- Scott, K., & Law, D. 1984. *Saltmarsh survey of North-west Scotland. Caithness and Sutherland*. Unpublished, Nature Conservancy Council.
- Symonds, F.L., & Langslow, D.R. [1982]. *Shorebirds in the Moray Firth: a progress report for November 1981 - May 1982*. Unpublished, Nature Conservancy Council report to BNOC (Development).
- Symonds, F.L., & Langslow, D.R. 1985. *Shorebirds in the Moray Firth 1981-1985*. Unpublished, Nature Conservancy Council report to Britoil plc.
- Symonds, F.L., & Langslow, D.R. 1986. The distribution and local movements of shorebirds within the Moray Firth. *Proceedings of the Royal Society of Edinburgh*, 91B: 143-167.
- Wells, J.B.J., & Boyle, P.R. 1975. *Loch Fleet littoral survey 22-28 March 1975*. (Contractor: University of Aberdeen) Unpublished, Nature Conservancy Council.

Centre grid: NH7087
Region: Highland

Districts: Ross & Cromarty, Sutherland
SNH region: North-west Scotland

Review site location



Total area (ha)	Intertidal area (ha)	Shore length (km)	Channel length (km)	Tidal range (m)	Geomorph. type	Human population
11,663	4,397	284.5	42.8	3.4	Complex	<5,000

Description

Dornoch Firth is the most northerly of the large Scottish Firths, and unlike the neighbouring Cromarty Firth it is virtually unaffected by industrial development. It takes the form of a fairly narrow, steep-sided and well-wooded estuary, and the water quality within the Firth has been classified as class 1.

The Kyle of Sutherland in the upper parts of the estuary is a narrow channel bordered by broad, flat, flood-plain terraces with extensive areas of grassland and fen. Below Bonar Bridge the channel widens, with mudflats in the

innermost reaches and in the small sheltered inlets of Ardmore, Skibo and Tain. There are patches of shingle in this section of the estuary. There are extensive growths of *Ruppia*, the eelgrass *Zostera* and the algae *Enteromorpha* in Tain Bay, large areas of saltmarsh at Dornoch Point and Skibo, and smaller patches at Bonar Bridge and further upstream. At Dornoch Point the saltmarsh lies in the shelter of the dunes and the vegetation shows the transition between species-rich saltmarsh to damp slacks, with good creek development.

Much of the outer intertidal area is an extensive sandflat that supports a rich marine invertebrate fauna, and on the southern shores from Edderton Sands towards the mouth there are large stony scars with beds of common mussels. There is a large area of rocky shore on the southern side of the estuary near Portmahomack, and the shores of Tarbat Ness have been described as of marine biological importance.

On either side of the mouth of the Dornoch Firth there are sand dunes. At Morrich More the sandflats extend inland to form a large, low-lying dune system and the dunes at Dornoch Point grade through foredunes, dune grassland and fixed dunes into heath and scrub.

Wildlife features

Coastal habitats

	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other
	●	●	●	●	●	●	●			
Area (ha)	7,266	400	3,997							

● = major habitat ● = minor habitat

Aquatic estuarine communities

Soft substrate

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
●		●		●									●	●	

Hard substrate

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
		●		●						●						

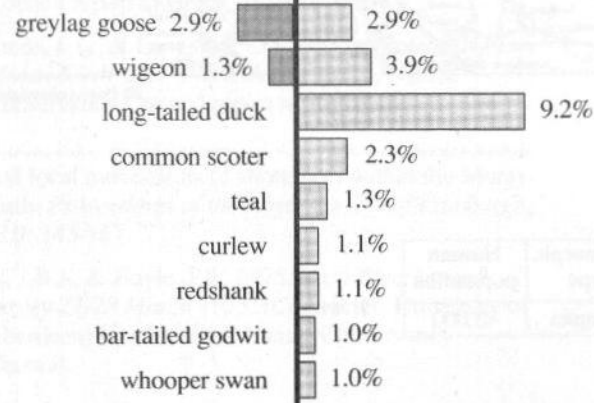
Birds

Wintering birds

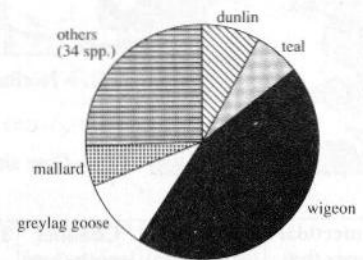
Total waterfowl: 26,200

1986/87 – 1990/91 data

% International population % National population



BoEE	NWC	WSC
●	●	



Breeding birds: there are small colonies of common tern, little tern, arctic tern and common gull within the estuary, and the saltmarshes support low densities of breeding oystercatcher, lapwing, dunlin, curlew and redshank. Small numbers of ringed plover also breed within the Dornoch Firth.

Additional wildlife features

The invertebrate fauna recently recorded on the Dornoch Firth includes the RDB 3 flies *Mycomya lambi* and *Tipula nodicornis*, one proposed RDB species and 20 Notable species. In addition otters have been recorded on the Dornoch Firth and common seals breed within the estuary.

Conservation status

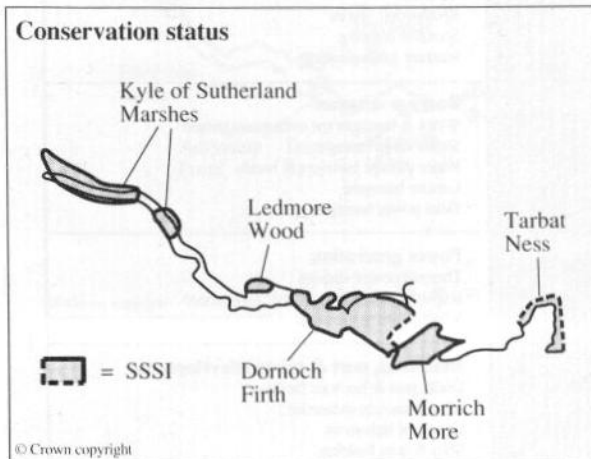
● = designated ● = proposed

	NCR	GCR	SSSI (B)	SSSI (G)	SSSI (M)	NNR	LNR	Ramsar	SPA	AONB	CWT	RSPB	ESA	NP	WWT	NT	NSA	HC	Other
No.	3	2	4		1			1	1								1		2

Around one third of the estuary lies within Sites of Special Scientific Interest. Kyle of Sutherland Marshes (404 ha), Ledmore Wood (95 ha) which is adjacent to the estuary, Dornoch Firth (3,577 ha) and Tarbat Ness (59 ha) are biological SSSIs, and Morrich More (2,957 ha) is a mixed SSSI.

The Lower Dornoch Firth, Morrich More and Ledmore Wood are also Nature Conservation Review sites and Morrich More and Tarbat Ness are Geological Conservation Review sites.

The Dornoch Firth is also a National Scenic Area and preferred Coastal Conservation Zone, and part of the proposed Moray Basin, Firths and Bays Special Protection Area and Ramsar site.



Lichens on Cuthill Links on the northern shore of the Dornoch Firth. (Pat Doody, JNCC)

Human activities

Present	Proposed	
●		Coast protection & sea defences Linear defences Training walls Groyne Brushwood fences <i>Spartina</i> planting Marram grass planting
		Barrage schemes Weirs & barrages for river management Storm surge barrages Water storage barrages & bunds Leisure barrages Tidal power barrages
		Power generation Thermal power stations Import/export jetties (power generation) Wind-power generation
●		Industrial, port & related development Dock, port & harbour facilities Manufacturing industries Chemical industries Ship & boat building Others
●		Extraction & processing of natural gas & oil Exploration Production Rig & platform construction Pipeline construction Pipeline installation Import/export jetties & single-point moorings Oil refineries Mothballing of rigs & tankers
●		Military activities Overflying by military aircraft Others
●		Waste discharge Domestic waste disposal Sewage discharge & outfalls Sewage treatment works Rubbish tips Industrial & agricultural waste discharge Thermal discharges (power stations) Dredge spoil Accidental discharges Aerial crop spraying Waste incinerators Others
●		Sediment extraction Capital dredging Maintenance dredging Commercial estuarine aggregates extraction Commercial terrestrial aggregates extraction Non-commercial aggregates extraction Hard-rock quarrying
●		Transport & communications Airports & helipads Tunnels, bridges & aqueducts Causeways & fords Road schemes Ferries Cables
		Urbanisation Land-claim for housing & car parks
●		Education & scientific research Sampling, specimen collection & observation Nature trails & interpretative facilities Seismic studies & geological test drilling Marine & terrestrial archaeology Fossil collecting

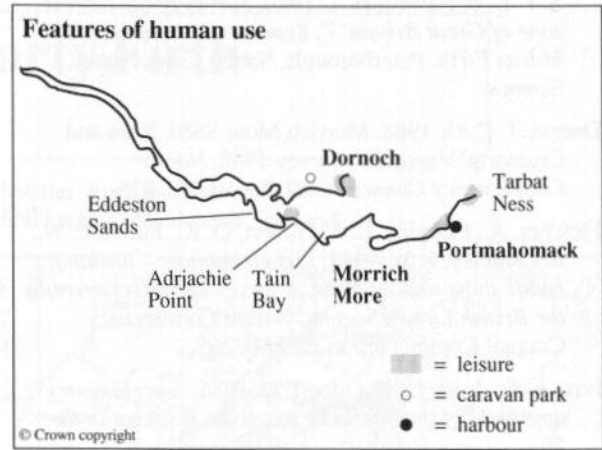
Present	Proposed	
●		Tourism & recreation Infrastructure developments Marinas Non-marina moorings Dinghy & boat parks Caravan parks & chalets Leisure centres, complexes & piers Aquatic-based recreation Power-boating & water-skiing Jet-skiing Sailing Sailboarding & wind-surfing SCUBA & snorkelling Canoeing Surfing Rowing Tourist boat trips/leisure barges Angling Other non-commercial fishing Bathing & general beach recreation Terrestrial & intertidal-based recreation Walking, including dog walking Bird-watching Sand-yachting 4WD & trial-biking Car sand-racing Horse-riding Rock-climbing Golf courses Clay-pigeon shooting Others Airborne recreation Overflying by light aircraft Radio-controlled model aircraft Others
●		Wildfowling & hunting Wildfowling Other hunting-related activities
●		Bait-collecting Digging & pumping for lugworms & ragworms Hydraulic dredging for worms Others
●		Commercial fisheries Fish-netting & trawling Fyke-netting for eels Fish traps & other fixed devices & nets Crustacea Molluscs – Hand-gathering Dredging Hydraulic dredging
●	●	Cultivation of living resource Saltmarsh grazing Sand dune grazing Agricultural land-claim Fish-farming Shellfish farming Bottom & tray cultivation Suspended cultivation Crustacea farming Reeds for roofing <i>Salicornia</i> picking Others
●		Management & killing of birds & mammals Killing of mammals Killing of birds Adult fish-eating birds Adult shellfish-eating birds Gulls Geese
		Wildlife habitat management <i>Spartina</i> control Habitat creation & restoration Marine Intertidal Terrestrial Habitat management
		Others

Features of human use

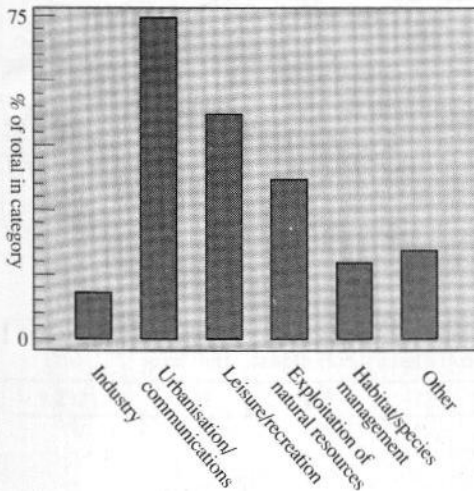
Numerous leisure activities occur on the Dornoch Firth but not all are intensive. Beach recreation is centred on Dornoch, Portmahomack and Adrjachie Point, and there is a large caravan park on Dornoch Links. Exploitation of the natural resources includes grazing over most of the saltmarsh, grazing on the dunes on Morrich More, bag-netting for fish and lobster and crab potting around Tarbat Ness, and there is a mussel fishery at Tain. On the northern shore wildfowling occurs under private agreement with the estates, but on the southern shore wildfowling is open to the public and shooting occurs from Tain Bay to Eddeston Sands.

Industrial activity is very limited and includes a small harbour at Portmahomack, the construction of an oil pipeline, and small-scale sand extraction. Species management includes seal culling to protect the fishery and culling of gulls to reduce air strikes, for the benefit of the military aircraft which use Morrich More.

In 1989 there was a proposal for a rainbow trout fish farm. More recently there has been a proposal for a marina.



Categories of human use



Further reading

- Bartrop, J., Bishop, G., Harvey, R., Holme, N. A., Knight, S. J. T., & Powell, H. T. 1980. *Survey of the littoral zone of Great Britain. 7. Report on the shores of the Moray Firth*. Peterborough, Nature Conservancy Council.
- Dargie, T. C. D. 1988. Morrich More SSSI, Ross and Cromarty. Vegetation survey 1988. *Nature Conservancy Council, CSD Report*, No. 915.
- Fletcher, A., Coppins, B. J., Gilbert, O. K., James, P. W., & Lambley, P. W. 1984. *Lichen habitats – lowland heath, dune and machair. A survey and assessment by the British Lichen Society*. Nature Conservancy Council Contract report HF3/03/266.
- Fox, A. D., Yost, L., & Gilbert, D. 1986. *A preliminary appraisal of the intertidal sea-grass resource in the Moray Firth*. Edinburgh, Nature Conservancy Council South-east Scotland Region.
- Harding-Hill, R. 1993. *The Moray Firth review*. Inverness, Scottish Natural Heritage.
- Hunter, J., & Rendell, D. 1986. The sub-littoral fauna of the Inverness, Cromarty and Dornoch Firths. *Proceedings of the Royal Society of Edinburgh*, 91B: 263-274.
- Mudge, G. P., & Allen, D. S. 1980. Wintering seaducks in the Moray and Dornoch Firths. *Wildfowl*, 31: 123-130.
- Rendell, D., & Hunter, J. 1986. A study of the littoral fauna of some soft shore sediments of the Inverness, Cromarty and Dornoch Firths. *Proceedings of the Royal Society of Edinburgh*, 91B: 193-212.
- Scott, K., & Law, D. 1984. *Saltmarsh survey of North-west Scotland. Caithness and Sutherland*. Unpublished, Nature Conservancy Council.
- Smith, D. E., Firth, C. R., Turbayne, S. C., & Brooks, C. L. 1992. Holocene relative sea level changes and shoreline displacement in the Dornoch Firth area, Scotland. *Proceedings of the Geologist's Association*, 103: 237-255.
- Symonds, F. L., & Langslow, D. R. 1986. The distribution and local movements of shorebirds within the Moray Firth. *Proceedings of the Royal Society of Edinburgh*, 91B: 143-167.
- University of Aberdeen Department of Geography. 1972. *Moray Firth development ecological survey 1969-1974 – Cromarty Firth and Dornoch Firth*. (Contractor: University of Aberdeen, Department of Geography). Unpublished report to Highlands and Islands Development Board, Inverness. (Interim Report, No. 4).

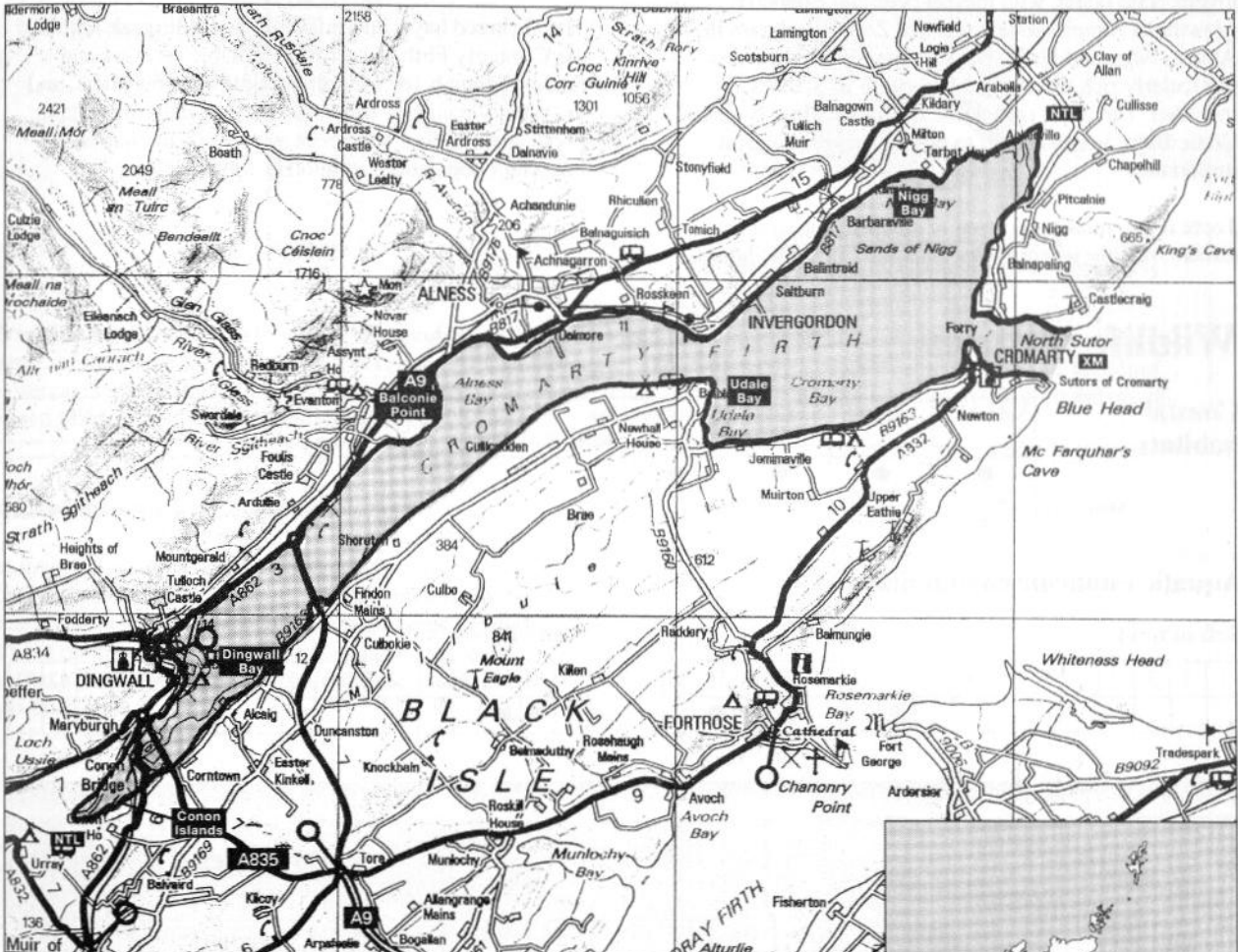
76

Cromarty Firth

Centre grid: NH6667
Region: Highland

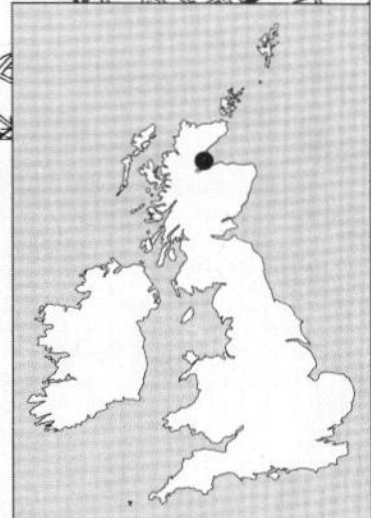
District: Ross & Cromarty
SNH region: North-west Scotland

Review site location



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Total area (ha)	Intertidal area (ha)	Shore length (km)	Channel length (km)	Tidal range (m)	Geomorph. type	Human population
9,232	3,642	120.5	32.7	3.7	Complex	6,000



XM = Across mouth

NTL = Normal tidal Limit

■ = Core site

Description

The Cromarty Firth is a relatively large estuary, with a deep channel that reaches almost as far upstream as Alness. Water quality within the Firth has been classified as grade 1.

The Cromarty Firth has the largest area of intertidal flats within the Moray Basin, which are muddy in the uppermost parts of the Firth and become predominantly sandy in Nigg and Udale Bays towards the mouth. The sand- and mudflats support a rich and abundant invertebrate fauna, with mussel beds and extensive growths of *Ruppia* tasselweed and *Zostera* eelgrass in Alness, Nigg and Udale Bays. Alness Bay supports a particularly rich macroalgal flora with 21 species recorded. The outer area of the Firth, including Nigg and Udale Bays, is considered to be of marine biological importance.

There are several large areas of saltmarsh around the estuary, mainly where rivers enter the Firth. The largest

single area is in Nigg Bay, with other large areas at Alness, Balconie Point, Dingwall Bay, Conon Islands and Udale Bay. The vegetation around Conon Islands shows the transition from lightly grazed saltings on the outer islands, through herb-rich grassland to woodland. Here the invertebrate fauna is rich and includes several scarce species.

Of further interest is the lagoon behind the shingle spit at Alness, which retains water at low tide.

The sheltered bays, intertidal flats and saltmarsh within the Cromarty Firth also provide suitable roosting and feeding grounds for wintering wildfowl and waders, and the estuary regularly supports internationally important populations of four species of waterfowl and nationally important populations of another four species.

Wildlife features

Coastal habitats

	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other
	●	●	●	●					●	
Area (ha)	5,591	227	3,415							

● = major habitat ● = minor habitat

Aquatic estuarine communities

Soft substrate

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
									●			●	●	●	

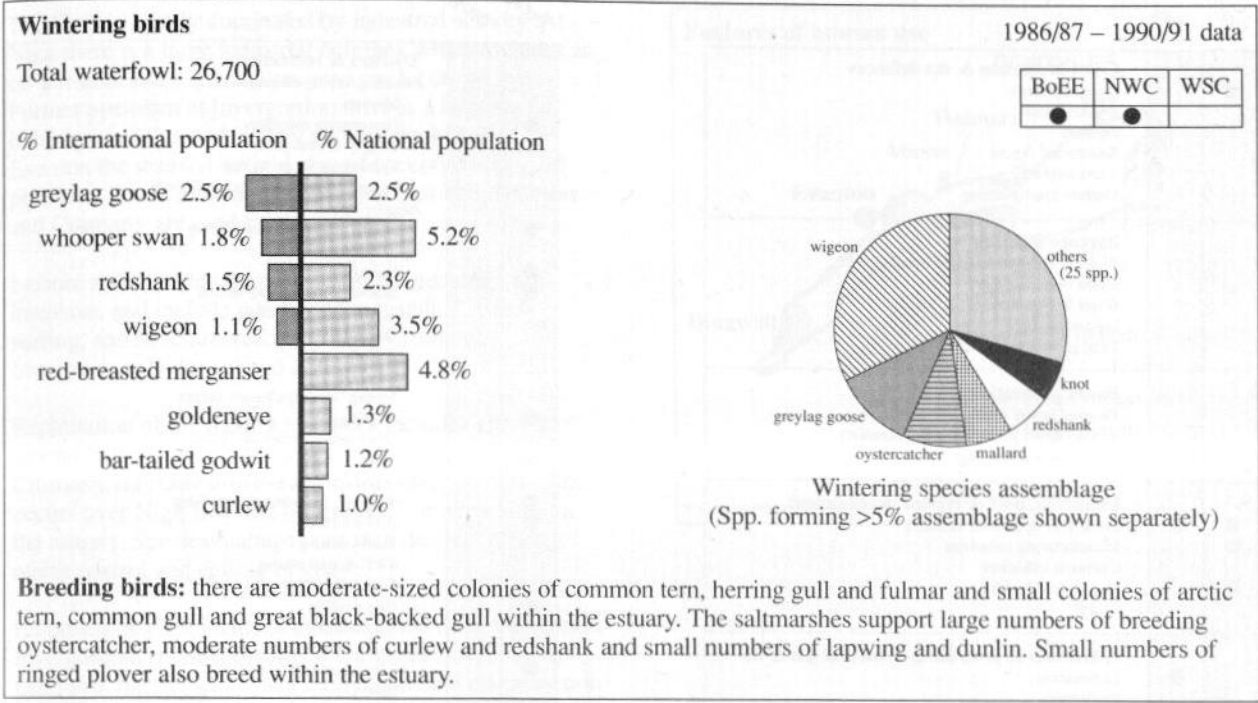
Hard substrate

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
	●	●														



An oil rig fabrication yard, Nigg Bay. (S.M. Atkins, SNH)

Birds



Additional wildlife features

The invertebrate fauna recently recorded on the estuary includes three Notable species. Otters are present on the estuary, and between 50 and 100 common seals regularly haul out on the sandbanks east of Cromarty bridge. In addition a population of bottle-nose dolphins occasionally visits the Cromarty Firth.

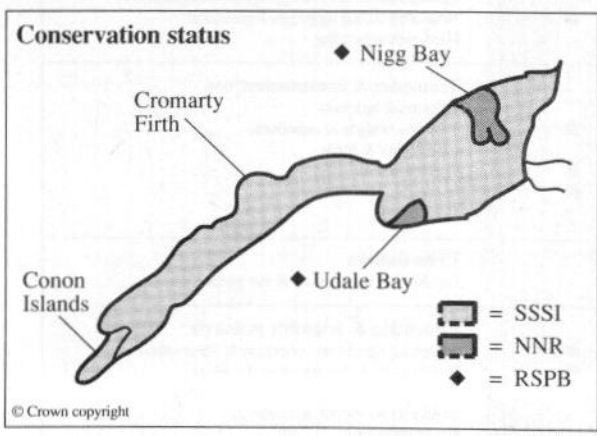
Conservation status

● = designated ● = proposed

	NCR	GCR	SSSI (B)	SSSI (G)	SSSI (M)	NNR	LNR	Ramsar	SPA	AONB	CWT	RSPB	ESA	NP	WWT	NT	NSA	HC	Other	
No.	2	1	2			1		1	1			2								1

Much of the estuary is covered by the Conon Islands (171 ha) and Cromarty Firth (3,585 ha) biological Sites of Special Scientific Interest, which are also Nature Conservation Review sites. Nigg and Udale Bays are a National Nature Reserve, and part of the Cromarty and Rosemarkie Inliers Geological Conservation Review site falls within the mouth of the Cromarty Firth.

There are two RSPB reserves on the Firth, at Nigg Bay and Udale Bay, and the Cromarty Firth is a preferred Coastal Conservation Zone. The estuary is part of the proposed Moray Basin, Firths and Bays Ramsar site and Special Protection Area.



Human activities

Present	Proposed	
●		Coast protection & sea defences Linear defences Training walls Groynes Brushwood fences <i>Spartina</i> planting Marram grass planting
		Barrage schemes Weirs & barrages for river management Storm surge barrages Water storage barrages & bunds Leisure barrages Tidal power barrages
		Power generation Thermal power stations Import/export jetties (power generation) Wind-power generation
● ● ●	●	Industrial, port & related development Dock, port & harbour facilities Manufacturing industries Chemical industries Ship & boat building Others
● ●	●	Extraction & processing of natural gas & oil Exploration Production Rig & platform construction Pipeline construction Pipeline installation Import/export jetties & single-point moorings Oil refineries Mothballing of rigs & tankers
● ●		Military activities Overflying by military aircraft Others
● ● ● ●	●	Waste discharge Domestic waste disposal Sewage discharge & outfalls Sewage treatment works Rubbish tips Industrial & agricultural waste discharge Thermal discharges (power stations) Dredge spoil Accidental discharges Aerial crop spraying Waste incinerators Others
● ●		Sediment extraction Capital dredging Maintenance dredging Commercial estuarine aggregates extraction Commercial terrestrial aggregates extraction Non-commercial aggregates extraction Hard-rock quarrying
● ● ●		Transport & communications Airports & helipads Tunnels, bridges & aqueducts Causeways & fords Road schemes Ferries Cables
		Urbanisation Land-claim for housing & car parks
● ●		Education & scientific research Sampling, specimen collection & observation Nature trails & interpretative facilities Seismic studies & geological test drilling Marine & terrestrial archaeology Fossil collecting

Present	Proposed	
● ●		Tourism & recreation Infrastructure developments Marinas Non-marina moorings Dinghy & boat parks Caravan parks & chalets Leisure centres, complexes & piers Aquatic-based recreation Power-boating & water-skiing Jet-skiing Sailing Sailboarding & wind-surfing SCUBA & snorkelling Canoeing Surfing Rowing Tourist boat trips/leisure barges Angling Other non-commercial fishing Bathing & general beach recreation Terrestrial & intertidal-based recreation Walking, including dog walking Bird-watching Sand-yachting 4WD & trial-biking Car sand-racing Horse-riding Rock-climbing Golf courses Clay-pigeon shooting Others Airborne recreation Overflying by light aircraft Radio-controlled model aircraft Others
●		Wildfowling & hunting Wildfowling Other hunting-related activities
●		Bait-collecting Digging & pumping for lugworms & ragworms Hydraulic dredging for worms Others
		Commercial fisheries Fish-netting & trawling Fyke-netting for eels Fish traps & other fixed devices & nets Crustacea Molluscs – Hand-gathering Dredging Hydraulic dredging
●	● ●	Cultivation of living resource Saltmarsh grazing Sand dune grazing Agricultural land-claim Fish-farming Shellfish farming Bottom & tray cultivation Suspended cultivation Crustacea farming Reeds for roofing <i>Salicornia</i> picking Others
● ● ●		Management & killing of birds & mammals Killing of mammals Killing of birds Adult fish-eating birds Adult shellfish-eating birds Gulls Geese
		Wildlife habitat management <i>Spartina</i> control Habitat creation & restoration Marine Intertidal Terrestrial Habitat management
		Others

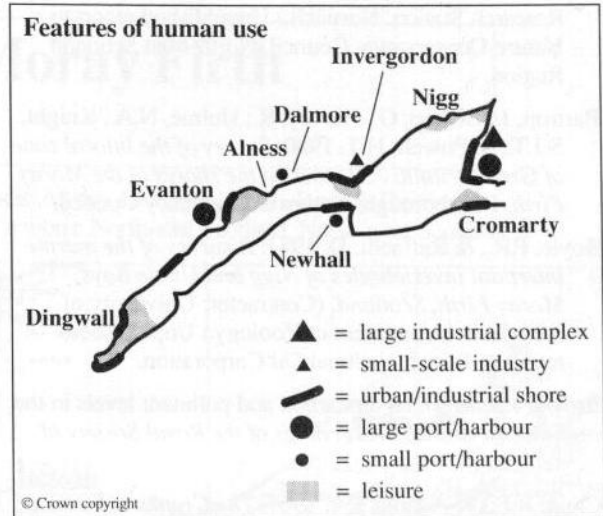
Features of human use

The Firth is largely dominated by industrial activity. At Nigg there is a large industrial complex which includes an oil terminal and a fabrication yard producing oil rigs. Further upstream at Invergordon there is a large metal industry complex with a jetty and dry dock, and at Evanton the disused airfield is used for constructing oil pipelines. Small piers and harbours at Newhall, Dalmore and Cromarty are used by fishing craft.

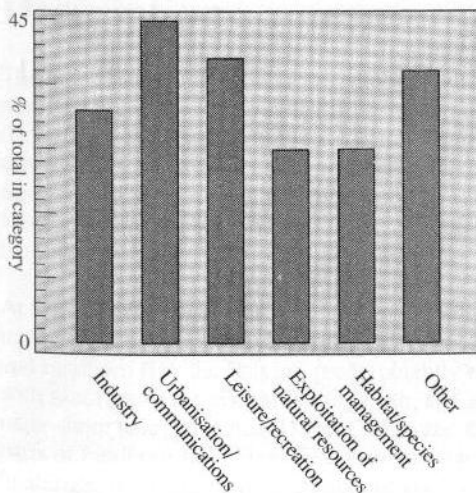
Leisure activities are numerous and are generally not intensive, and include power-boating, sailing, wind-surfing, and beach recreation around Cromarty, Invergordon, Dingwall and Alness.

Exploitation of the natural resources includes grazing of around half the saltmarsh area, mussel cultivation at Cromarty Bay and small-scale bait-digging. Wildfowling occurs over Nigg Bay and occasionally at other sites on the estuary. Species management includes seal culling, rabbit control and culling of geese.

Proposals in 1989 included extending the dock facilities at Invergordon, rubbish tipping at Dingwall Bay, a turbot fish farm, mussel and oyster cultivation, and oil extraction below Nigg. By 1993 the aluminium smelter had closed, the dock facilities at Invergordon had been extended, the proposal for oil extraction had been dropped, and suspended cultivation of mussels was under way. In 1992 there was a brief period of dredging for cockles, which was stopped because of local protests.



Categories of human use



Further reading

- Anderson, S.S. 1971. *Nigg and Udale Bays: a survey of intertidal invertebrates*. (Contractor: Coastal Ecology Research Station, Norwich.) Unpublished report to Nature Conservancy Council, North-west Scotland Region.
- Bartrop, J., Bishop, G., Harvey, R., Holme, N.A., Knight, S.J.T., & Powell, H.T. 1980. *Survey of the littoral zone of Great Britain. 7. Report on the shores of the Moray Firth*. Peterborough, Nature Conservancy Council.
- Boyle, P.R., & Raffaelli, D. 1981. *A survey of the marine intertidal invertebrates of Nigg and Udale Bays, Moray Firth, Scotland*. (Contractor: University of Aberdeen, Department of Zoology.) Unpublished report to British National Oil Corporation.
- Brown, J.S. 1986. Hydrocarbon and pollutant levels in the Cromarty Firth. *Proceedings of the Royal Society of Edinburgh, 91B*: 105-112.
- Craig, R.E., & Adams, J.A. 1967. *The Cromarty Firth*. Aberdeen, Department of Agriculture and Fisheries for Scotland.
- Currie, A. 1974. Oil pollution in the Cromarty Firth. *Marine Pollution Bulletin, 5*: 118-119.
- Fletcher, A., Coppins, B.J., Gilbert, O.L., James, P.W., & Lambley, P.W. 1984. *Lichen habitats - lowland heath, dune and machair. A survey and assessment by the British Lichen Society*. Nature Conservancy Council report HF3/03/266.
- Harding-Hill, R. 1993. *The Moray Firth review*. Inverness, Scottish Natural Heritage.
- Hunter, J., & Rendell, D. 1986. The sub-littoral fauna of the Inverness, Cromarty and Dornoch Firths. *Proceedings of the Royal Society of Edinburgh, 91B*: 263-274.
- Kesel, R.H., & Smith, J.S. 1978. Tidal creek and pan formation in intertidal saltmarshes, Nigg Bay, Scotland. *Scottish Geographical Magazine, 94*: 159-168.
- MacLennan, A.S. 1986. Oil pollution in the Cromarty Firth and inshore Moray Firth. *Proceedings of the Royal Society of Edinburgh, 91B*: 275-282.
- Nature Conservancy Council. 1978. *Nature conservation in the Moray Firth - a revised prospectus*. Unpublished, Nature Conservancy Council.
- Rendall, D., & Hunter, J. 1986. A study of the littoral fauna of some soft shores of the Inverness, Cromarty and Dornoch Firths. *Proceedings of the Royal Society of Edinburgh, 91B*: 193-212.
- Scott, K. 1985. *Saltmarsh survey of North-west Scotland. Easter Ross and Inverness*. Unpublished, Nature Conservancy Council.
- Shaw, D.M., & Batt, S. 1986. Pollution control and environmental planning for the Beatrice oilfield and Nigg oil terminal. *Proceedings of the Royal Society of Edinburgh, 91B*: 301-313.
- Smith, J.S. 1982. The *Spartina* communities of the Cromarty Firth. *Transactions of the Botanical Society of Edinburgh, 44*: 27-30.
- Symonds, F.L., & Langslow, D.R. 1986. The distribution and local movements of shorebirds within the Moray Firth. *Proceedings of the Royal Society of Edinburgh, 91B*: 143-167.
- Tibbetts, P.J.C. 1986. Hydrocarbons in Nigg Bay sediments. *Proceedings of the Royal Society of Edinburgh, 91B*: 329-339.

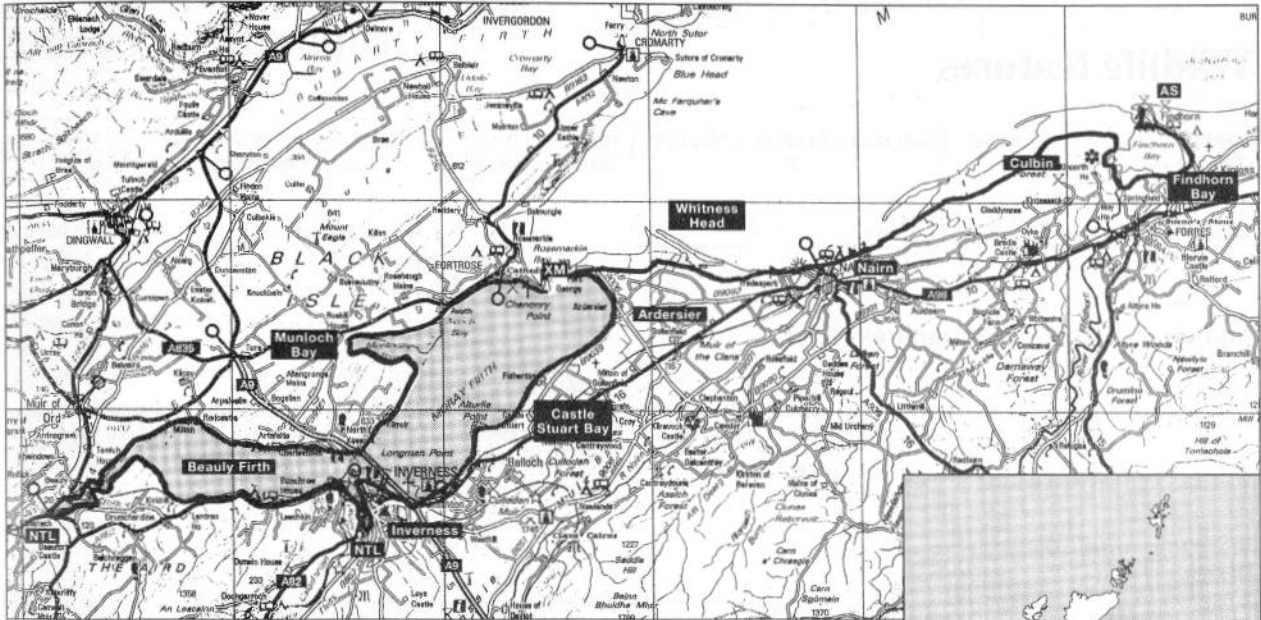
Centre grid: NH7152

Regions: Grampian, Highland

Districts: Moray, Inverness, Nairn, Ross & Cromarty

SNH regions: North-east Scotland, North-west Scotland

Review site location




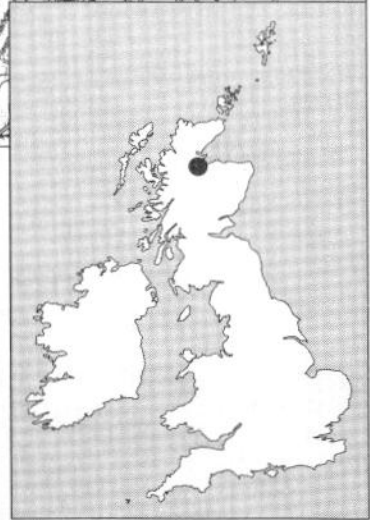
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Total area (ha)	Intertidal area (ha)	Shore length (km)	Channel length (km)	Tidal range (m)	Geomorph. type	Human population
11,150	4,783	169.6	32.3	4.1	Complex	54,000

NTL = Normal tidal limit

AS = Across shore

XM = Across mouth

 = Core site


Description

The Inner Moray Firth is a large, complex estuary on the north-east coast of Scotland. Three main sections make up the estuary, namely the innermost Beaulie Firth, the central Inner Moray Firth and the shore extending eastwards from Fort George which includes Whiteness Head, Culbin Bar and Findhorn Bay. Water quality within the Firth has been classified as grade 1.

At low water areas of intertidal flats are exposed. In the uppermost reaches of the Beaulie Firth, Munloch Bay and Findhorn Bay the flats are predominantly muddy, with sandflats in the central Beaulie Firth, and along the outer shore near Whiteness Head, Culbin and the outer parts of Findhorn Bay. Elsewhere there are intertidal flats of shingle, mud and sand. A number of sites of marine

biological importance have been identified in the Inner Moray Firth, which include Munloch Bay, Ardersier Bay, Culbin Bar and Findhorn Bay. Within the shallow Beaulie Firth there are substantial beds of eelgrass *Zostera* and tasselweed *Ruppia*.

There are various areas of saltmarsh within the estuary. The largest areas are within Findhorn Bay; along the Culbin shore, where the vegetation includes a range of saltmarsh communities; at Whiteness Head, where the saltmarsh is separated from the sea by a shingle spit; and in the Beaulie Firth, where a narrow band of saltmarsh fringes the bay. There are further areas of saltmarsh at Nairn, within Munloch Bay and in Castle Stuart Bay.

Further reading

The outermost shoreline that extends eastwards to Findhorn Bay has a long and complex history of landform evolution. Whiteness Head is a highly dynamic sand and shingle spit that encloses an accreting system of saltings, sand and mudflats. A wide range of plant communities is present here and includes a distinctive shingle flora, saltmarsh and large areas of dune and dune heath. This area supports an exceptional flora (over 550 recorded

flowering species) together with an outstanding variety of fungi and lichens and a diverse invertebrate fauna. Further east is the offshore Culbin shingle bar, a shingle structure of national importance that shelters intertidal flats, saltmarsh and dune landforms. Landward of the Culbin Bar many of the ancient dunes have been stabilised by afforestation.

Wildlife features

Coastal habitats

	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other
	●	●	●	●	●	●	●			
Area (ha)	6,367	516	4,267							

● = major habitat ● = minor habitat

Aquatic estuarine communities

Soft substrate

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
●		●		●								●	●	●	

Hard substrate

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
		●		●						●						

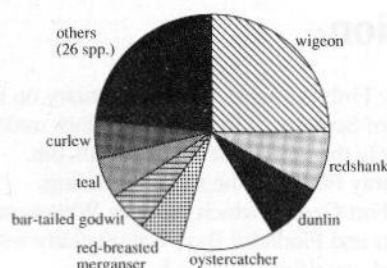
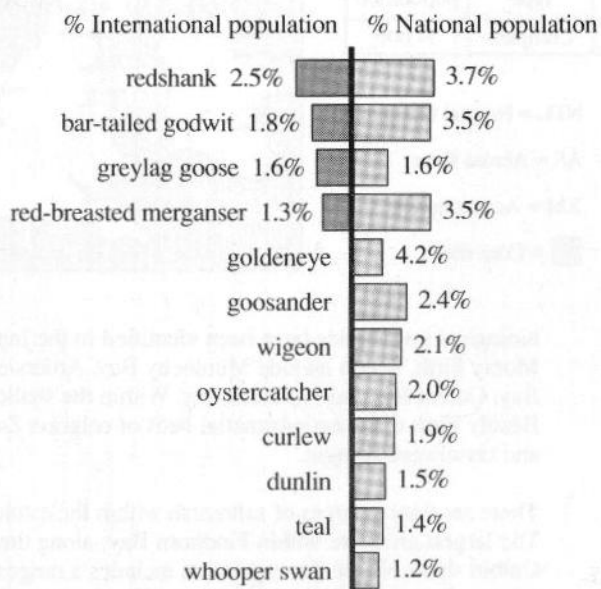
Birds

Wintering birds

Total waterfowl: 36,000

1986/87 – 1990/91 data

BoEE	NWC	WSC
●	●	



Wintering species assemblage
(Spp. forming >5% assemblage shown separately)

Breeding birds: there is a large colony of common tern, moderate-sized colonies of arctic tern and herring gull, and small colonies of sandwich tern, common gull, fulmar and great black-backed gull within the estuary. Moderate numbers of ringed plover are also known to breed within the Dornoch Firth.

Other: in summer the estuary is an important moulting sanctuary for up to 1000 Canada geese.

Additional wildlife features

The nationally rare estuarine sedge *Carex recta* grows on the saltmarsh and tidal flats.

The invertebrate fauna recently recorded from the estuary includes the RDB 2 beetle *Ochthebius lenensis*, the RDB 3 fly *Tipula nodicornis* and sixteen Notable species.

The Firth holds one of the largest known populations of resident bottle-nose dolphins *Tursiops truncatus* in Europe, and it is a breeding area for common seals. Otters are also present on the estuary.

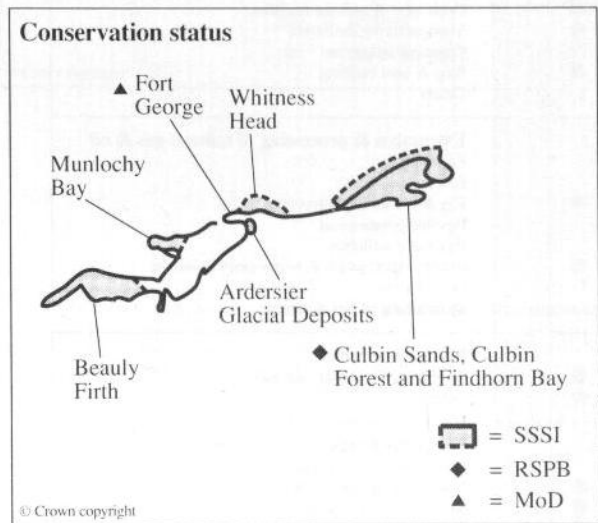
Conservation status

● = designated ● = proposed

	NCR	GCR	SSSI (B)	SSSI (G)	SSSI (M)	NNR	LNR	Ramsar	SPA	AONB	CWT	RSPB	ESA	NP	WWT	NT	NSA	HC	Other	
	●	●	●	●	●		●	●	●			●								●
No.	1	4	1	1	3		1	1	1			1								3

Around one third of the estuary is covered by Sites of Special Scientific Interest. Beaully Firth (1,262 ha) is a biological SSSI and Whithness Head (412 ha), Munloch Bay (267 ha) and Culbin Sands, Culbin Forest and Findhorn Bay (12,295 ha) are SSSIs for their biological and geological or geomorphological interest and are Geological Conservation Review sites. Culbin Sands, Culbin Forest and Findhorn Bay is also a Nature Conservation Review site. Ardersier Glacial Deposits (50 ha), adjacent to the estuary, is also a geological SSSI and GCR site.

The estuary lies within the proposed Moray Basin, Firths and Bays Ramsar site and Special Protection Area, and Munloch Bay is proposed as a Local Nature Reserve. In addition, the RSPB has a reserve at Culbin Sands, the Ministry of Defence own land around Fort George, the northern shore of the Moray Firth is a preferred Coastal Conservation Zone and the western part of the site is a Goose Sanctuary.



Saltmarsh on the Culbin shingle bar. (Pat Doody, JNCC)

Human activities

Present	Proposed	
●		Coast protection & sea defences Linear defences Training walls ● Groyne ● Brushwood fences ● <i>Spartina</i> planting Marram grass planting
		Barrage schemes Weirs & barrages for river management Storm surge barrages Water storage barrages & bunds Leisure barrages Tidal power barrages
		Power generation Thermal power stations Import/export jetties (power generation) Wind-power generation
●		Industrial, port & related development ● Dock, port & harbour facilities ● Manufacturing industries ● Chemical industries Ship & boat building Others
●		Extraction & processing of natural gas & oil ● Exploration ● Production Rig & platform construction Pipeline construction Pipeline installation ● Import/export jetties & single-point moorings Oil refineries Mothballing of rigs & tankers
●		Military activities ● Overflying by military aircraft ● Others
●	●	Waste discharge ● Domestic waste disposal ● Sewage discharge & outfalls ● Sewage treatment works ● Rubbish tips ● Industrial & agricultural waste discharge ● Thermal discharges (power stations) ● Dredge spoil ● Accidental discharges ● Aerial crop spraying ● Waste incinerators ● Others
●		Sediment extraction ● Capital dredging ● Maintenance dredging ● Commercial estuarine aggregates extraction ● Commercial terrestrial aggregates extraction ● Non-commercial aggregates extraction ● Hard-rock quarrying
●		Transport & communications ● Airports & helipads ● Tunnels, bridges & aqueducts ● Causeways & fords ● Road schemes ● Ferries ● Cables
		Urbanisation Land-claim for housing & car parks
●	●	Education & scientific research ● Sampling, specimen collection & observation ● Nature trails & interpretative facilities ● Seismic studies & geological test drilling ● Marine & terrestrial archaeology ● Fossil collecting

Present	Proposed	
●	●	Tourism & recreation Infrastructure developments ● Marinas ● Non-marina moorings ● Dinghy & boat parks ● Caravan parks & chalets ● Leisure centres, complexes & piers Aquatic-based recreation ● Power-boating & water-skiing ● Jet-skiing ● Sailing ● Sailboarding & wind-surfing ● SCUBA & snorkelling ● Canoeing ● Surfing ● Rowing ● Tourist boat trips/leisure barges ● Angling ● Other non-commercial fishing ● Bathing & general beach recreation Terrestrial & intertidal-based recreation ● Walking, including dog walking ● Bird-watching ● Sand-yachting ● 4WD & trial-biking ● Car sand-racing ● Horse-riding ● Rock-climbing ● Golf courses ● Clay-pigeon shooting ● Others Airborne recreation ● Overflying by light aircraft ● Radio-controlled model aircraft ● Others
●		Wildfowling & hunting ● Wildfowling Other hunting-related activities
●		Bait-collecting ● Digging & pumping for lugworms & ragworms ● Hydraulic dredging for worms ● Others
●	●	Commercial fisheries ● Fish-netting & trawling ● Fyke-netting for eels ● Fish traps & other fixed devices & nets ● Crustacea ● Molluscs – Hand-gathering ● Dredging ● Hydraulic dredging
●	●	Cultivation of living resource ● Saltmarsh grazing ● Sand dune grazing ● Agricultural land-claim ● Fish-farming ● Shellfish farming ● Bottom & tray cultivation ● Suspended cultivation ● Crustacea farming ● Reeds for roofing ● <i>Salicornia</i> picking ● Others
●		Management & killing of birds & mammals ● Killing of mammals ● Killing of birds ● Adult fish-eating birds ● Adult shellfish-eating birds ● Gulls ● Geese
●		Wildlife habitat management ● <i>Spartina</i> control ● Habitat creation & restoration ● Marine ● Intertidal ● Terrestrial ● Habitat management
		Others

Features of human use

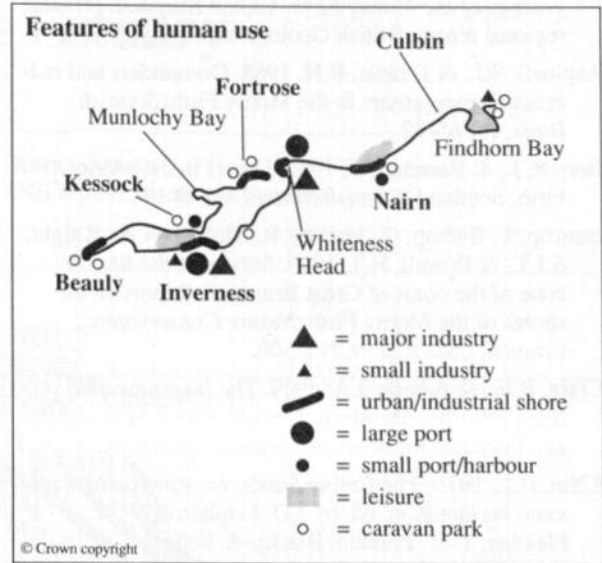
Leisure activities are numerous and occur at various locations around the estuary. Findhorn Bay is a popular site for beach recreation, sailing, power-boating and wind-surfing and, together with the Culbin shore, it is a focus for walking, 4WD, trial biking and horse-riding. Kessock, Fortrose, Nairn, Ardersier and Beaully are also used for recreational pursuits.

Exploitation of the natural resources includes grazing most of the saltmarsh and turf-cutting from the saltmarsh at Findhorn and Whiteness Head. Fish-netting occurs at Findhorn Bay, Ardersier and Whiteness Head, mussels are dredged and gathered by hand, and cockling occurs on a commercial basis. Digging or pumping for worms and mussel-collecting all occur for bait. With four wildfowling clubs and many unaffiliated members, wildfowling occurs over most of the estuary but most intensively over Findhorn Bay and the Culbin shore.

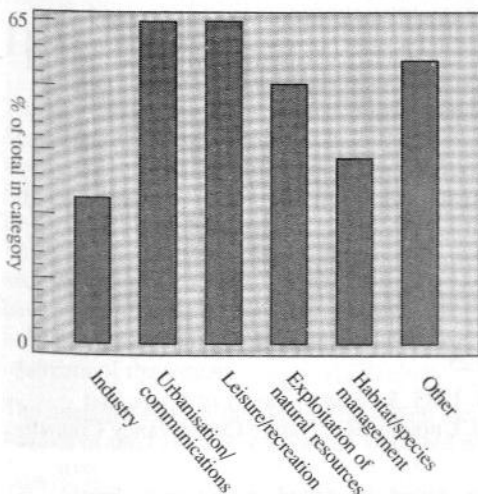
Industrial activity includes two large ports at Inverness and Whiteness Head, where there is a large construction yard for the oil rig industry. There are boat-building/repair yards at Findhorn and Inverness, and small harbours at Nairn, Beaully and Charleston Ferry.

Species and habitat management includes restoration work on the sand dunes at Findhorn and culling of several species, including cormorants, goosanders, red-breasted mergansers and greylag and pink-footed geese.

In 1989 proposals included a rubbish tip at Longman, a salmon farm, shellfish cultivation, commercial dredging for molluscs, and an increase in the number of moorings at Coulmore Point near Beaully. By 1993 a proposal for an ecological interpretative centre at Findhorn Bay had been consented, and there were further proposals to extend a rubbish tip, for a halibut farm, and to develop three marinas within the Firth.



Categories of human use



Further reading

- Andrew, I.J., Long, D., Richards, P.C., Thomson, A.R., Brown, S., Chesher, J.A., & McCorma, M. 1990. *The geology of the Moray Firth*. United Kingdom offshore regional report, British Geological Society. HMSO.
- Aspinall, S.J., & Dennis, R.H. 1988. Goosanders and red-breasted mergansers in the Moray Firth. *Scottish Birds*, 15: 65-70.
- Barrett, J., & Barrett, C.F. 1985. Divers in the Moray Firth, Scotland. *Scottish Birds*, 13: 149-154.
- Bartrop, J., Bishop, G., Harvey, R., Holme, N.A., Knight, S.J.T., & Powell, H.T. 1980. Survey of the littoral zone of the coast of Great Britain. 7. Report on the shores of the Moray Firth. *Nature Conservancy Council, CSD Report*, No. 308.
- Craig, R.E., & Adams, J.A. 1969. *The Inverness and Beaully Firths*. Aberdeen, Department of Agriculture and Fisheries for Scotland, Marine Laboratory.
- Edlin, H.L. 1976. The Culbin Sands. In: *Environment and man: reclamation*, ed. by J.D. Lenihan & W.W. Fletcher, 1-31. London, Blackie & Sons.
- Fletcher, A., Coppins, B.J., Gilbert, O.L., James, P.W., & Lambley, P.W. 1984. Lichen habitats - lowland heath, dune and machair. A survey and assessment by the British Lichen Society. *Nature Conservancy Council, CSD Report*, No. 522.
- Foster, G.N. 1988. The status of *Ochthebius lenensis* Poppius (Coleoptera: Hydraenidae) in the Moray Firth area. *Entomologist's Gazette*, 39: 77-81.
- Fox, A.D., Yost, L., & Gilbert, D. 1986. *A preliminary appraisal of the intertidal sea-grass resource in the Moray Firth*. Unpublished, Nature Conservancy Council, South-east Scotland Region.
- Fuller, R.M. 1975. The Culbin shingle bar and its vegetation. *Transactions of the Botanical Society of Edinburgh*, 42: 293-305.
- Gordon, G. 1852. A list of the fishes that have been found in the Moray Firth and in the fresh waters of the province of Moray. *Zoologist*, 10: 3,480-3,489.
- Hammond, P.S., & Thompson, P.M. 1991. Minimum estimate of the number of bottlenose dolphins *Tursiops truncatus* in the Moray Firth, North-east Scotland. *Biological Conservation*, 56: 79-87.
- Harding-Hill, R. 1993. *The Moray Firth review*. Inverness, Scottish Natural Heritage.
- Hunter, J., & Rendell, D. 1986. The sub-littoral fauna of the Inverness, Cromarty and Dornoch Firths. *Proceedings of the Royal Society of Edinburgh*, 91B: 263-273.
- MacIennan, A.J. 1986. Oil pollution in the Cromarty Firth and inshore Moray Firth. *Proceedings of the Royal Society of Edinburgh*, 91B: 275-282.
- McKay, D.W. 1977. Mollusc recording in the Moray Firth (Census area S5). *Conchologist's Newsletter*, 60: 562-567.
- Mudge, G.P., & Allen, D.S. 1980. Wintering sea ducks in the Moray and Dornoch Firths, Scotland. *Wildfowl*, 31: 123-130.
- Mudge, G.P., & Cadbury, C.J. 1987. The Moray Firth: its importance for seabirds and seaducks. *RSPB Conservation Review*, 1: 51-54.
- Nature Conservancy Council. 1972. *A prospectus for nature conservation within the Moray Firth*. Inverness, Nature Conservancy Council/Natural Environment Research Council.
- Nature Conservancy Council. 1978. *Nature conservation within the Moray Firth area*. Nature Conservancy Council, North-west Scotland Region.
- Ogilvie, A.G. 1914. The physical geography of the entrance of the Inverness Firth. *Scottish Geographic Magazine*, 30: 21-35.
- Palmer, C.P. 1977. Mollusc recording in the Moray Firth (Census area S5). *Conchologist's Newsletter*, 60: 567-570.
- Patton, D., & Stewart, E.J.A. 1917. The flora of Culbin Sands. *Transactions of the Botanical Society of Edinburgh*, 26: 345-374.
- Pierce, G.J., Thompson, P.M., Miller, A., Diack, J.S.W., Miller, D., & Boyle, P.R. 1991. Seasonal variation in the diet of common seals (*Phoca vitulina*) in the Moray Firth area of Scotland. *Journal of Zoology*, 223: 641-652.
- Ralph, R., ed. 1986. The marine environment of the Moray Firth. *Proceedings of the Royal Society of Edinburgh*, 91B.
- Saville, A. 1970. Inverness and Beaully Firth fisheries. *Scottish Fisheries Bulletin*, 34: 18-20.
- Scott, K. 1985. *Saltmarsh survey of North-west Scotland. Easter Ross and Inverness*. Unpublished, Nature Conservancy Council.
- Sneddon, P., & Randall, R. In prep. *Coastal shingle vegetation survey of Great Britain. Appendix 2, Report on sites in Scotland*. Peterborough, Joint Nature Conservation Committee.
- Steers, J.A. 1937. The Culbin Sands and Burghead Bay. *Geographical Journal*, 90: 498-528.
- Swann, R.L., & Mudge, G.P. 1989. Moray Basin wader populations. *Scottish Birds*, 15: 97-105.
- Symonds, F.L., & Langslow, D. 1985. Shorebirds in the Moray Firth (1981-1985) *Nature Conservancy Council, CSD report*, No. 603.
- Symonds, F.L., & Langslow, D. 1986. The distribution and local movements of shorebirds within the Moray Firth. *Proceedings of the Royal Society of Edinburgh*, 91B: 143-167.
- Terry, L.A., & Sell, D. 1986. Rocky shores in the Moray Firth. *Proceedings of the Royal Society of Edinburgh*, 91B: 169-191.
- Tilbrook, P.J. 1986. Nature conservation in the Moray Firth. *Proceedings of the Royal Society of Edinburgh*, 91B: 13-25.
- Urquhart, U. 1985. *Saltmarsh survey of North-east Scotland*. Unpublished, Nature Conservancy Council.
- Webster, M.M. 1978. *Flora of Moray, Nairn and east Inverness*. Aberdeen, Aberdeen University Press.

Wildlife features

Coastal habitats

	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other
	●	●	●	●						
Area (ha)	26	2	28							

● = major habitat ● = minor habitat

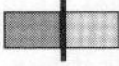
Birds

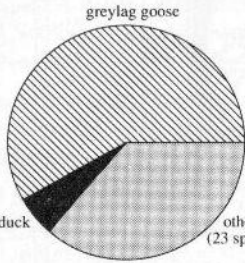
Wintering birds 1986/87 – 1990/91 data

Total waterfowl: 2,890

BoEE	NWC	WSC
●	●	

% International population % National population

greylag goose 4%  4%



greylag goose

long-tailed duck

others (23 spp.)

Wintering species assemblage
(Spp. forming >5% assemblage shown separately)

Breeding birds: small numbers of ringed plover breed within the estuary.

Aquatic estuarine communities

Soft substrate

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
												●			

Hard substrate

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33

Additional wildlife features

The invertebrate fauna recently recorded on Lossiemouth dunes include 2 Notable species. Otters also use the estuary.

Conservation status

There are no conservation designations on the Lossie Estuary.

Human activities

Present	Proposed	
●		Coast protection & sea defences Linear defences Training walls Groynes Brushwood fences <i>Spartina</i> planting Marram grass planting
●		Barrage schemes Weirs & barrages for river management Storm surge barrages Water storage barrages & bunds Leisure barrages Tidal power barrages
		Power generation Thermal power stations Import/export jetties (power generation) Wind-power generation
●		Industrial, port & related development Dock, port & harbour facilities Manufacturing industries Chemical industries Ship & boat building Others
		Extraction & processing of natural gas & oil Exploration Production Rig & platform construction Pipeline construction Pipeline installation Import/export jetties & single-point moorings Oil refineries Mothballing of rigs & tankers
●		Military activities Overflying by military aircraft Others
●		Waste discharge Domestic waste disposal Sewage discharge & outfalls Sewage treatment works Rubbish tips Industrial & agricultural waste discharge Thermal discharges (power stations) Dredge spoil Accidental discharges Aerial crop spraying Waste incinerators Others
		Sediment extraction Capital dredging Maintenance dredging Commercial estuarine aggregates extraction Commercial terrestrial aggregates extraction Non-commercial aggregates extraction Hard-rock quarrying
●		Transport & communications Airports & helipads Tunnels, bridges & aqueducts Causeways & fords Road schemes Ferries Cables
		Urbanisation Land-claim for housing & car parks
●		Education & scientific research Sampling, specimen collection & observation Nature trails & interpretative facilities Seismic studies & geological test drilling Marine & terrestrial archaeology Fossil collecting

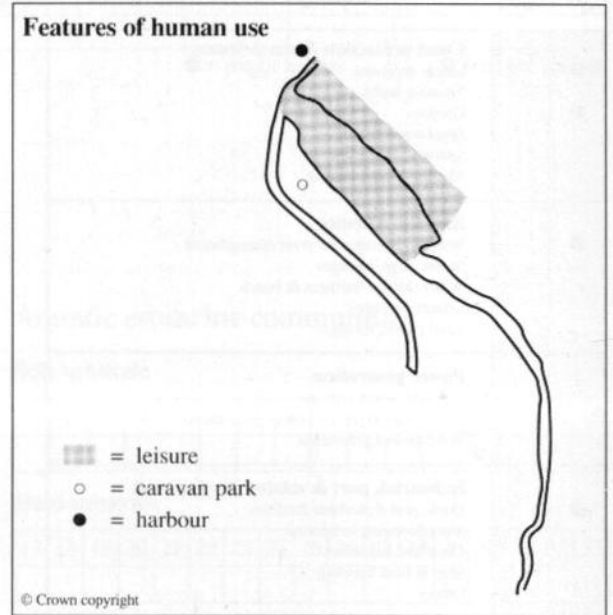
Present	Proposed	
●		Tourism & recreation Infrastructure developments Marinas Non-marina moorings Dinghy & boat parks Caravan parks & chalets Leisure centres, complexes & piers Aquatic-based recreation Power-boating & water-skiing Jet-skiing Sailing Sailboarding & wind-surfing SCUBA & snorkelling Canoeing Surfing Rowing Tourist boat trips/leisure barges Angling Other non-commercial fishing Bathing & general beach recreation Terrestrial & intertidal-based recreation Walking, including dog walking Bird-watching Sand-yachting 4WD & trial-biking Car sand-racing Horse-riding Rock-climbing Golf courses Clay-pigeon shooting Others Airborne recreation Overflying by light aircraft Radio-controlled model aircraft Others
		Wildfowling & hunting Wildfowling Other hunting-related activities
●		Bait-collecting Digging & pumping for lugworms & ragworms Hydraulic dredging for worms Others
●		Commercial fisheries Fish-netting & trawling Fyke-netting for eels Fish traps & other fixed devices & nets Crustacea Molluscs – Hand-gathering Dredging Hydraulic dredging
		Cultivation of living resource Saltmarsh grazing Sand dune grazing Agricultural land-claim Fish-farming Shellfish farming Bottom & tray cultivation Suspended cultivation Crustacea farming Reeds for roofing <i>Salicornia</i> picking Others
●		Management & killing of birds & mammals Killing of mammals Killing of birds Adult fish-eating birds Adult shellfish-eating birds Gulls Geese
		Wildlife habitat management <i>Spartina</i> control Habitat creation & restoration Marine Intertidal Terrestrial Habitat management
		Others

Features of human use

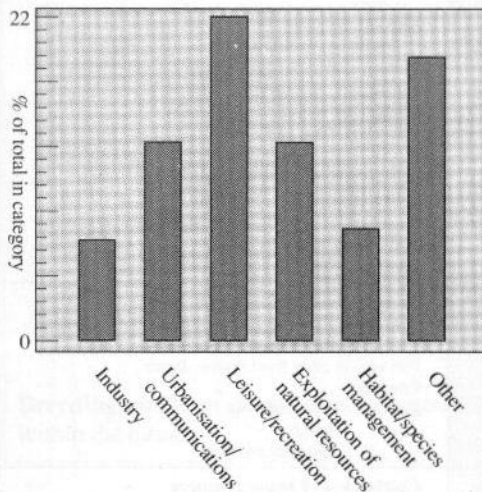
Activities on the Lossie are not intensive. Leisure pursuits are most numerous and centred around the sandflats within the estuary and along the spit to the east of the mouth. There is a single caravan park between the arms of the river and the canal.

Exploitation of the natural resources includes bait-digging and collection of mussels for bait, and occasional fyke-netting for eels. The water quality, fish and macrobenthos are regularly monitored for lindane and heavy metal content, for industrial wastes are discharged into the river upstream of the estuary.

There is one harbour at Lossiemouth just outside the review site and this is used mainly by fishing vessels. Other activities that occur include frequent overflying by military aircraft from the RAF base to the west of the site.



Categories of human use



Further reading

Angus, R. B. 1964. Some northern Scottish coleoptera. *Entomologist's Monthly Magazine*, 100: 172-182.

Brown, A. E. 1990. *The rivers and lochs of Scotland, a contribution to Operation Brightwater*. Nature Conservancy Council and Scottish Conservation Projects.

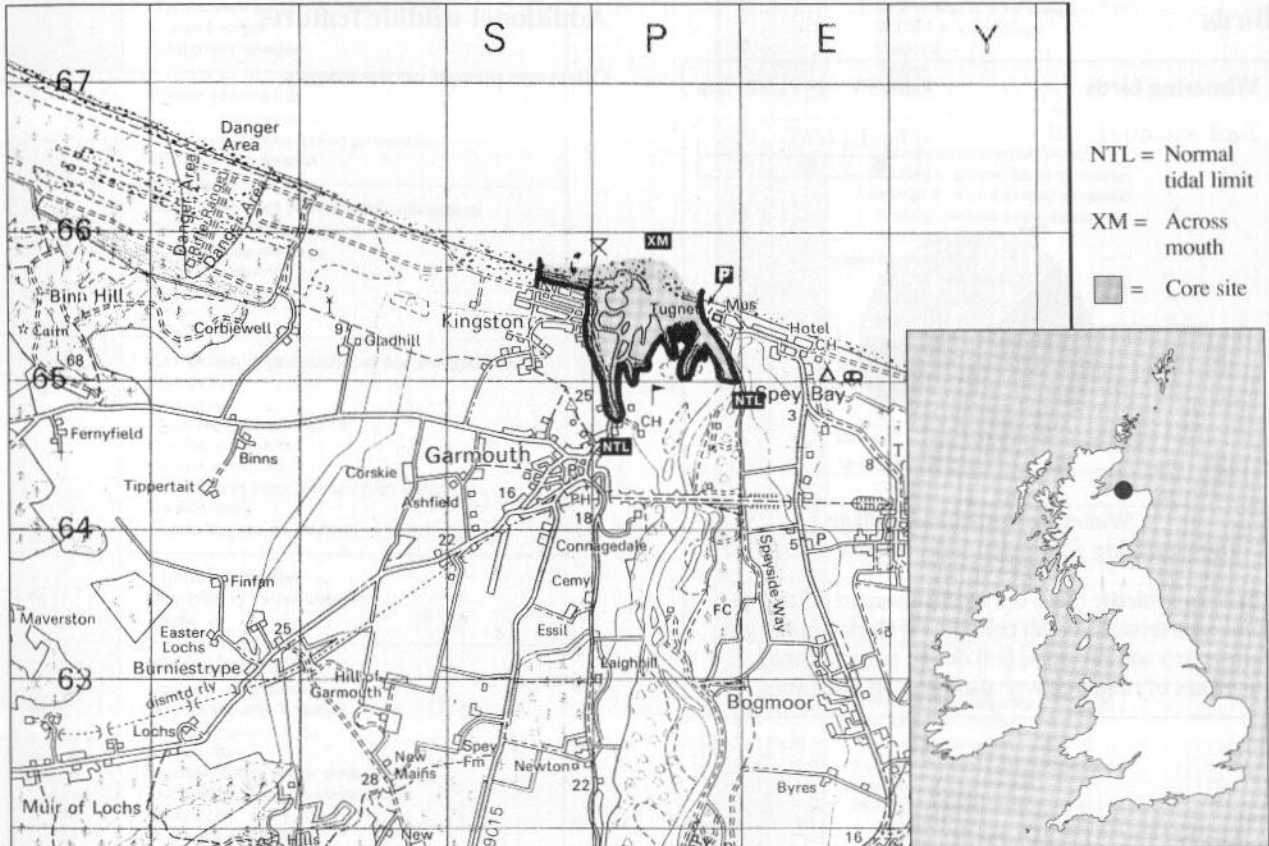
Institute of Terrestrial Ecology. 1979. *Report to the Nature Conservancy Council on invertebrate fauna of dune and machair sites in Scotland*. Vols 1 and 2. ITE project no. 469.

Urquhart, U. H. 1985. *Saltmarsh survey of North-east Scotland*. Unpublished, Nature Conservancy Council.

Centre grid: NJ3465
Region: Grampian

District: Moray
SNH region: North-east Scotland

Review site location



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Total area (ha)	Intertidal area (ha)	Shore length (km)	Channel length (km)	Tidal range (m)	Geomorph. type	Human population
49	29	4.9	0.9	3.4	Bar built	<5,000

Description

The Spey Bay estuary is the small delta of the mouth of the River Spey, the longest river in Scotland. Water quality within the estuary has been classified as grade 1.

This delta is part of the largest vegetated shingle complex in Scotland. Along this stretch of coast there is a series of mobile shingle ridges up to 8km long, backed by a strandplain of shingle ridges which record the history of coastal development in this area. Where the shingle has become vegetated there is a wide range of plant communities present, from pioneer shingle heath to birch and Scots pine woodland on drier ridges, and from

shingle slacks to fen and carr woodland in the damp hollows. Large areas of the shingle have been modified by gravel extraction, leaving artificial hollows with an outstanding slack and freshwater marsh vegetation. The delta at the mouth of the River Spey is particularly mobile and supports saltmarsh vegetation and scrub woodland along the riverbank.

The flora of this estuary is extremely rich with many local species, and the wide range of habitats support a diverse invertebrate community. Several species of birds are also known to breed within Spey Bay.

Wildlife features

Coastal habitats

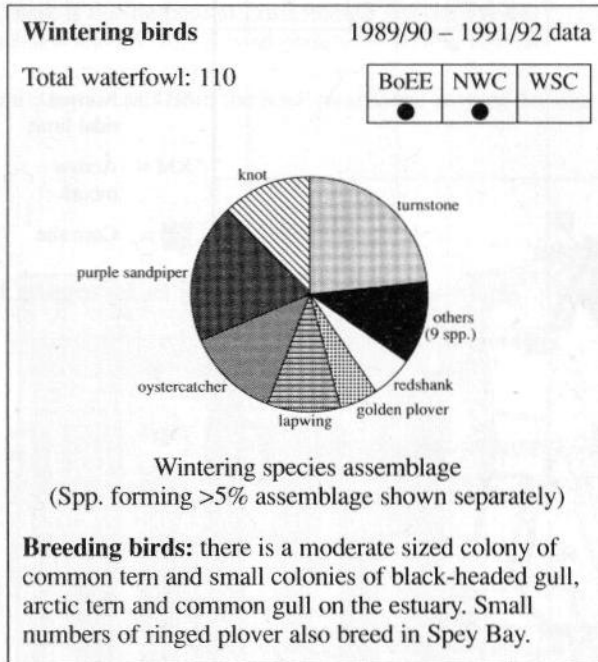
	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other
	●	●	●	●			●			
Area (ha)	20	22	7							

● = major habitat ● = minor habitat

Aquatic estuarine communities

Information unavailable.

Birds



Additional wildlife features

Otters are present on the estuary.

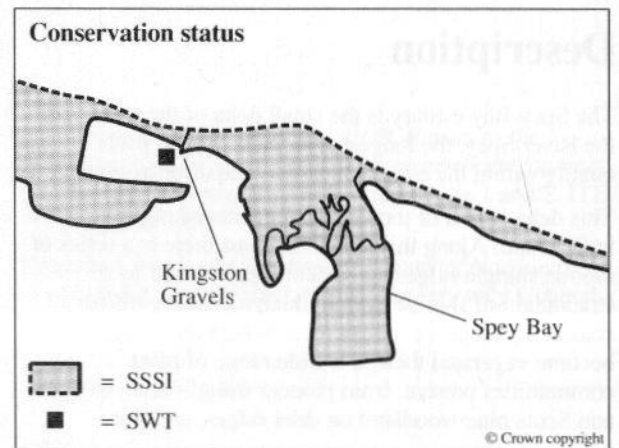
Conservation status

● = designated ● = proposed

	NCR	GCR	SSSI (B)	SSSI (G)	SSSI (M)	NNR	LNR	Ramsar	SPA	AONB	CWT	RSPB	ESA	NP	WWT	NT	NSA	HC	Other
No.	1	1			1			1	1		1								

The estuary lies within the Spey Bay Site of Special Scientific Interest (500ha), which has been designated for its biological and geomorphological interest. Spey Bay is also a Geological Conservation Review site and is part of the Kingston Shingle Nature Conservation Review site. The Scottish Wildlife Trust have a reserve at Kingston Gravels.

Spey Bay lies within the proposed Moray Basin, Firths and Bays Ramsar site and Special Protection Area.



Human activities

Present	Proposed	
●		Coast protection & sea defences Linear defences Training walls Groynes Brushwood fences <i>Spartina</i> planting Marram grass planting
		Barrage schemes Weirs & barrages for river management Storm surge barrages Water storage barrages & bunds Leisure barrages Tidal power barrages
		Power generation Thermal power stations Import/export jetties (power generation) Wind-power generation
		Industrial, port & related development Dock, port & harbour facilities Manufacturing industries Chemical industries Ship & boat building Others
		Extraction & processing of natural gas & oil Exploration Production Rig & platform construction Pipeline construction Pipeline installation Import/export jetties & single-point moorings Oil refineries Mothballing of rigs & tankers
●		Military activities Overflying by military aircraft Others
●		Waste discharge Domestic waste disposal Sewage discharge & outfalls Sewage treatment works Rubbish tips Industrial & agricultural waste discharge Thermal discharges (power stations) Dredge spoil Accidental discharges Aerial crop spraying Waste incinerators Others
●		Sediment extraction Capital dredging Maintenance dredging Commercial estuarine aggregates extraction Commercial terrestrial aggregates extraction Non-commercial aggregates extraction Hard-rock quarrying
		Transport & communications Airports & helipads Tunnels, bridges & aqueducts Causeways & fords Road schemes Ferries Cables
		Urbanisation Land-claim for housing & car parks
●	●	Education & scientific research Sampling, specimen collection & observation Nature trails & interpretative facilities Seismic studies & geological test drilling Marine & terrestrial archaeology Fossil collecting

Present	Proposed	
●		Tourism & recreation Infrastructure developments Marinas Non-marina moorings Dinghy & boat parks Caravan parks & chalets Leisure centres, complexes & piers Aquatic-based recreation Power-boating & water-skiing Jet-skiing Sailing Sailboarding & wind-surfing SCUBA & snorkelling Canoeing Surfing Rowing Tourist boat trips/leisure barges Angling Other non-commercial fishing Bathing & general beach recreation Terrestrial & intertidal-based recreation Walking, including dog walking Bird-watching Sand-yachting 4WD & trial-biking Car sand-racing Horse-riding Rock-climbing Golf courses Clay-pigeon shooting Others Airborne recreation Overflying by light aircraft Radio-controlled model aircraft Others
●		Wildfowling & hunting Wildfowling Other hunting-related activities
		Bait-collecting Digging & pumping for lugworms & ragworms Hydraulic dredging for worms Others
●		Commercial fisheries Fish-netting & trawling Fyke-netting for eels Fish traps & other fixed devices & nets Crustacea Molluscs – Hand-gathering Dredging Hydraulic dredging
		Cultivation of living resource Saltmarsh grazing Sand dune grazing Agricultural land-claim Fish-farming Shellfish farming Bottom & tray cultivation Suspended cultivation Crustacea farming Reeds for roofing <i>Salicornia</i> picking Others
●	●	Management & killing of birds & mammals Killing of mammals Killing of birds Adult fish-eating birds Adult shellfish-eating birds Gulls Geese
		Wildlife habitat management <i>Spartina</i> control Habitat creation & restoration Marine Intertidal Terrestrial Habitat management
		Others

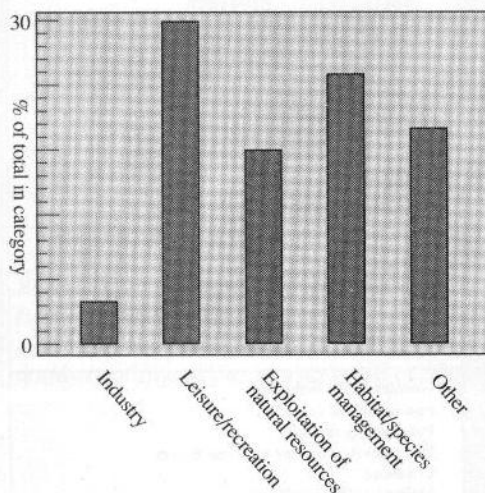
Features of human use

Leisure pursuits are the most numerous activities present with sailing in the mouth of the estuary and out into the open sea, angling and canoeing. Land-based recreation includes walking along the Speyside Way long-distance footpath, bird-watching, trial biking and there is a golf course at Kingston.

Exploitation of the natural resources involves seine-netting for salmon, turf-cutting from the higher saltmarsh for the golf course, and wildfowling on the intertidal area. Research into the geomorphology of the site and salmon also occurs, and there is an interpretive centre at Tugnet.

Species management includes culling grey seals and gulls, and there is a licence to cull mergansers and goosanders but this occurs mainly upstream of the estuary.

Categories of human use



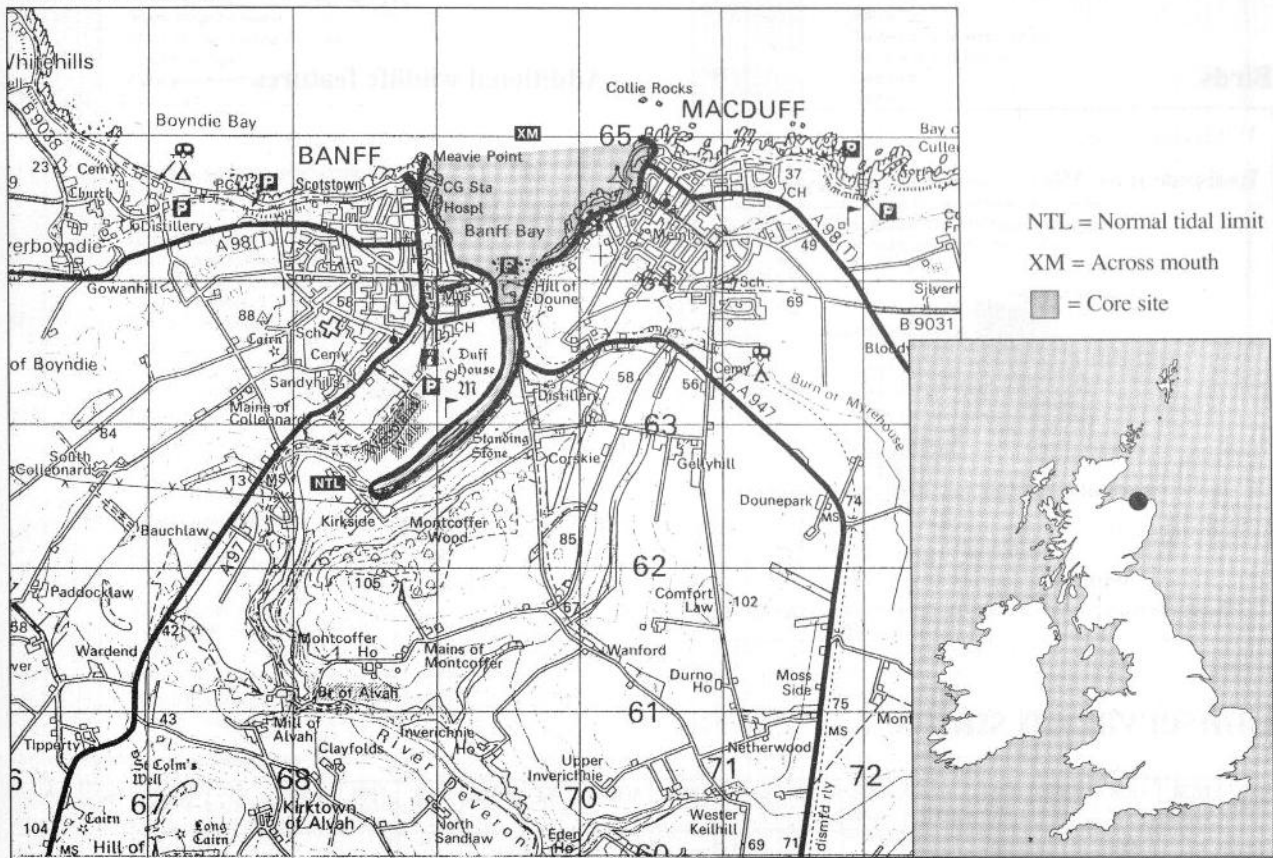
Further reading

- Mudge, G., & Allen, D. S. 1980. Wintering seaducks in the Moray and Dornoch Firths, Scotland. *Wildfowl*, 31: 123-130.
- Sneddon, P., & Randall, R. E. In prep. *Coastal vegetated shingle structures of Great Britain. Appendix 2.* Scotland. Peterborough, Joint Nature Conservation Committee.
- Urquhart, U. H. 1985. *Saltmarsh survey of North-East Scotland.* Unpublished, Nature Conservancy Council.

Centre grid: NJ6964
Region: Grampian

District: Banff & Buchan
SNH region: North-east Scotland

Review site location



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Total area (ha)	Intertidal area (ha)	Shore length (km)	Channel length (km)	Tidal range (m)	Geomorph. type	Human population
102	16	8.6	2.8	3.1	Embayment	< 5,000

Description

Banff Bay is the small estuary of the River Deveron, that opens out into the small bay between the towns of Banff and MacDuff. Water quality within the estuary has been classified as grade 1.

The upper parts of the estuary are a narrow channel with fringes of saltmarsh along the lower reaches of the banks. Further downstream a small shingle bar constricts the channel and is backed by a small intertidal sandflat. The estuary opens out into a small bay, which is lined by rocky shores.

Wildlife features

Coastal habitats

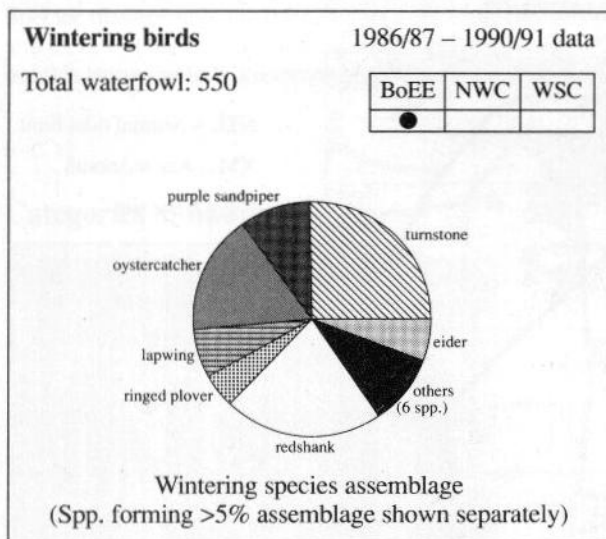
	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other
	●	●	●	●		●	●			
Area (ha)	80	1	20							

● = major habitat ● = minor habitat

Aquatic estuarine communities

Information unavailable.

Birds



Additional wildlife features

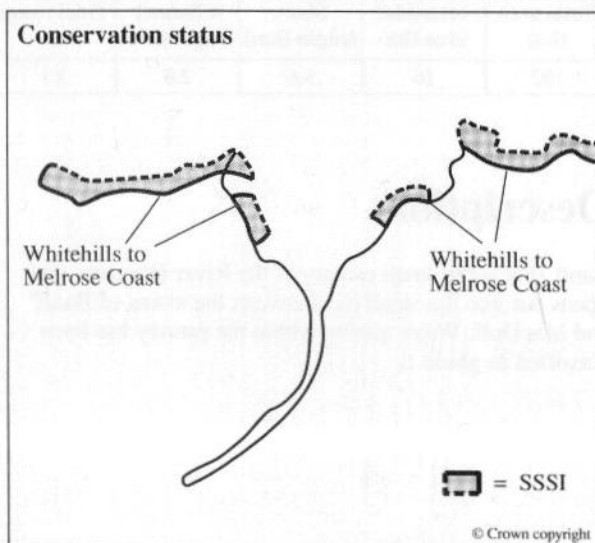
Otters are present on the estuary.

Conservation status

	NCR	GCR	SSSI (B)	SSSI (G)	SSSI (M)	NNR	LNR	Ramsar	SPA	AONB	CWT	RSPB	ESA	NP	WWT	NT	NSA	HC	Other	
No.		●		●																

● = designated ● = proposed

The outermost shores of Banff Bay lie within the Whitehills to Melrose geological Site of Special Scientific Interest (94 ha), which extends beyond the estuary. Parts of the estuary also lie within the Cullen-Troup Head Banffshire Coast Geological Conservation Review site.



Human activities

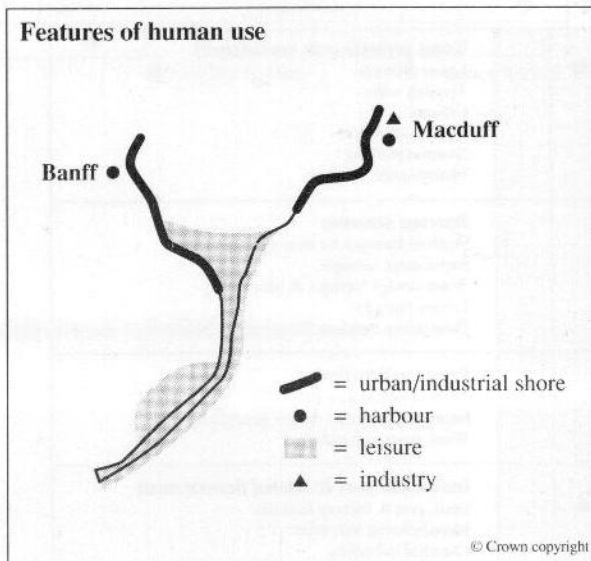
Present	Proposed	
●		Coast protection & sea defences Linear defences Training walls Groynes Brushwood fences <i>Spartina</i> planting Marram grass planting
		Barrage schemes Weirs & barrages for river management Storm surge barrages Water storage barrages & bunds Leisure barrages Tidal power barrages
		Power generation Thermal power stations Import/export jetties (power generation) Wind-power generation
●	●	Industrial, port & related development Dock, port & harbour facilities Manufacturing industries Chemical industries Ship & boat building Others
		Extraction & processing of natural gas & oil Exploration Production Rig & platform construction Pipeline construction Pipeline installation Import/export jetties & single-point moorings Oil refineries Mothballing of rigs & tankers
		Military activities Overflying by military aircraft Others
●		Waste discharge Domestic waste disposal Sewage discharge & outfalls Sewage treatment works Rubbish tips Industrial & agricultural waste discharge Thermal discharges (power stations) Dredge spoil Accidental discharges Aerial crop spraying Waste incinerators Others
		Sediment extraction Capital dredging Maintenance dredging Commercial estuarine aggregates extraction Commercial terrestrial aggregates extraction Non-commercial aggregates extraction Hard-rock quarrying
●		Transport & communications Airports & helipads Tunnels, bridges & aqueducts Causeways & fords Road schemes Ferries Cables
		Urbanisation Land-claim for housing & car parks
		Education & scientific research Sampling, specimen collection & observation Nature trails & interpretative facilities Seismic studies & geological test drilling Marine & terrestrial archaeology Fossil collecting

Present	Proposed	
●	●	Tourism & recreation Infrastructure developments Marinas Non-marina moorings Dinghy & boat parks Caravan parks & chalets Leisure centres, complexes & piers Aquatic-based recreation Power-boating & water-skiing Jet-skiing Sailing Sailboarding & wind-surfing SCUBA & snorkelling Canoeing Surfing Rowing Tourist boat trips/leisure barges Angling Other non-commercial fishing Bathing & general beach recreation Terrestrial & intertidal-based recreation Walking, including dog walking Bird-watching Sand-yachting 4WD & trial-biking Car sand-racing Horse-riding Rock-climbing Golf courses Clay-pigeon shooting Others Airborne recreation Overflying by light aircraft Radio-controlled model aircraft Others
		Wildfowling & hunting Wildfowling Other hunting-related activities
		Bait-collecting Digging & pumping for lugworms & ragworms Hydraulic dredging for worms Others
		Commercial fisheries Fish-netting & trawling Fyke-netting for eels Fish traps & other fixed devices & nets Crustacea Molluscs – Hand-gathering Dredging Hydraulic dredging
		Cultivation of living resource Saltmarsh grazing Sand dune grazing Agricultural land-claim Fish-farming Shellfish farming Bottom & tray cultivation Suspended cultivation Crustacea farming Reeds for roofing <i>Salicornia</i> picking Others
		Management & killing of birds & mammals Killing of mammals Killing of birds Adult fish-eating birds Adult shellfish-eating birds Gulls Geese
		Wildlife habitat management <i>Spartina</i> control Habitat creation & restoration Marine Intertidal Terrestrial Habitat management
		Others

Features of human use

There are few activities taking place on the estuary. MacDuff harbour is used by fishing vessels and there is also a ship repair yard and dry dock, while Banff harbour is used by leisure craft. Leisure activities include moorings and a dinghy park in Banff harbour, beach recreation on the sandflats, and walking on the beach and along the banks. Angling also occurs for the Deveron is a good salmon river. There is a golf course at Banff.

Recently there has been a proposal for a storm overflow into the estuary.



Further reading

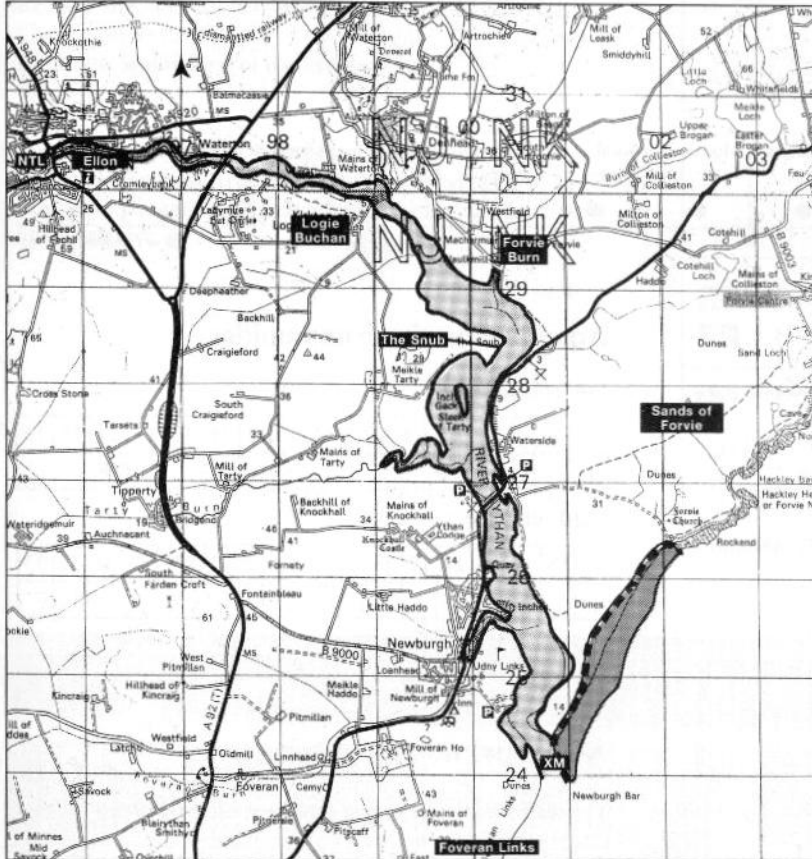
Summers, R.W., Atkinson, N.K., & Nicoll, M. 1975. Wintering wader populations on the rocky shore of Eastern Scotland. *Scottish Birds*, 8: 299-308.

Urquhart, U.H. 1985. *Saltmarsh survey of North-east Scotland*. Unpublished, Nature Conservancy Council.

Centre grid: NK0026
Region: Grampian

District: Gordon
SNH region: North-east Scotland

Review site location



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Total area (ha)	Intertidal area (ha)	Shore length (km)	Channel length (km)	Tidal range (m)	Geomorph. type	Human population
282	201 (83)*	28.2 (2.8)*	10.9	3.7	Bar built	< 10,000

* = Associated intertidal/shoreline

Description

The Ythan Estuary is one of the least modified estuaries in Scotland. The mouth of the estuary is constricted by a sand spit, which extends south-westwards from the Sands of Forvie and is still prograding, further altering the mouth of the estuary and dominating the geomorphological processes of the estuary. The water quality of the Ythan has been classified as grade 1 in its upper reaches, becoming grade 2 in its lower reaches. The estuary is suffering from eutrophication as a result of sewage discharges and agricultural run-off further upstream.

At low water a narrow channel flows across the intertidal

flats of the Ythan, which are muddy throughout most of the estuary but become sandier further downstream. Towards the sea the sediments are coarse gravels which support mussel beds.

There are two small areas of saltmarsh within the estuary, one where the Forvie Burn flows into the estuary and a larger area on the east bank of the estuary opposite the Snub. The vegetation consists largely of mid/upper saltmarsh vegetation, and is an important example of northern saltmarsh. In addition there is a small tidal reedbed at Logie Buchan in the upper reaches of the estuary.

On either side of the estuary mouth there are extensive areas of highly mobile sand dunes. To the south-west of the estuary are the Foveran Links, part of a series of sand dune systems that extends along this section of the North-east Scotland coast. To the north-west of the estuary mouth are the Sands of Forvie, the fifth largest expanse of sand dunes in Britain and possibly the least disturbed by man. The dunes here include mobile and fixed dunes, and the vegetation present ranges from mobile to fixed dune vegetation and dune pasture to acidic dune heath and

large areas of lichen-rich heath. The area is known to be of international importance for its lowland heath vegetation.

The Ythan Estuary and Sands of Forvie also support a diversity of breeding seabirds that includes large tern colonies and the largest concentration of breeding eider in Britain. The estuary also supports large numbers of wintering pink-footed goose, whose numbers are much larger in spring.

Wildlife features

Coastal habitats

	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other
	●	●	●	●	●					
Area (ha)	81	25	176							

● = major habitat ● = minor habitat

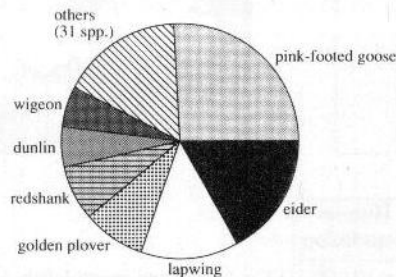
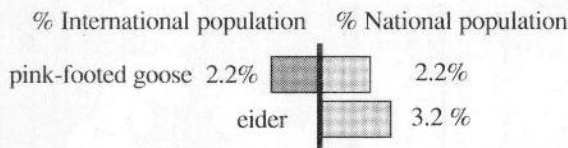
Birds

Wintering birds

1986/87 – 1990/91 data

Total waterfowl: 7,410

BoEE	NWC	WSC
●	●	



Wintering species assemblage

(Spp. forming >5% assemblage shown separately)

Breeding birds: there are a number of seabird colonies within the estuary and the Sands of Forvie, including large colonies of sandwich tern and herring gull, moderate-sized colonies of black-headed gull, common tern, little tern, fulmar and kittiwake and small numbers of arctic tern, lesser black-backed gull, shag, great black-backed gull and razorbill. The estuary also supports the largest breeding concentration of eider in Britain, together with shelduck and small numbers of breeding ringed plover.

Other: the inshore waters at the mouth of the estuary are a major moulting and wintering ground for seaducks and divers.

Aquatic estuarine communities

Soft substrate

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
				●									●		

Hard substrate

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33

Additional wildlife features

The terrestrial invertebrate fauna recently recorded on the estuary includes one Notable species.

Large populations of sand goby *Pomatoschistus minutus* are present in the estuary during summer and autumn, before migrating to the sea in winter. In addition otters and grey and common seals are regular visitors to the estuary.

Conservation status

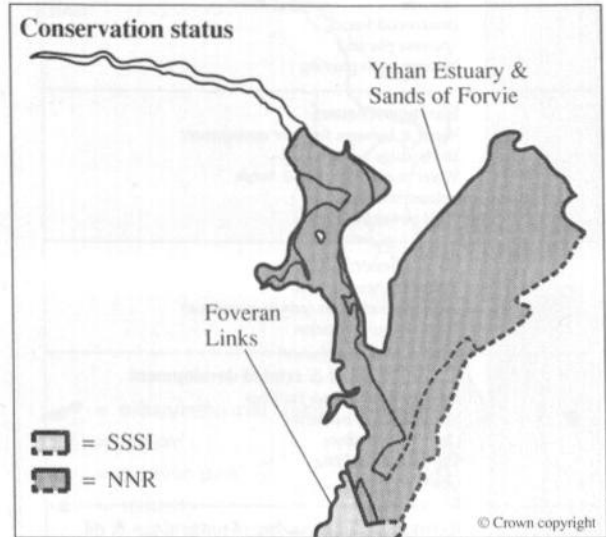
Human activities

● = designated ● = proposed

No.	NCR	GCR	SSSI (B)	SSSI (G)	SSSI (M)	NNR	LNR	Ramsar	SPA	AONB	CWT	RSPB	ESA	NP	WWT	NT	NSA	HC	Other	
1	●	●			●	●		●	●											●
	1	1			2	1		1	1											1

Much of the estuary lies within the Sands of Forvie and Ythan Estuary Site of Special Scientific Interest (976 ha), which was designated because of its biological and geomorphological interest. Much of the estuary is a National Nature Reserve and is a Nature Conservation Review site, and contains the Forvie Geological Conservation Review site. Foveran Links SSSI (203 ha) lies to the south-west of the estuary.

The estuary also lies within the Ythan Estuary, Sands of Forvie and Meikle Loch proposed Ramsar site and Special Protection Area. The Sands of Forvie is a European Biogenetic Reserve because of its lowland heath interest.



Dune vegetation on Foveran Links, to the south-west of the estuary mouth. (Pat Doody, JNCC)

Human activities

Present	Proposed	
		Coast protection & sea defences Linear defences Training walls Groynes Brushwood fences <i>Spartina</i> planting Marram grass planting
		Barrage schemes Weirs & barrages for river management Storm surge barrages Water storage barrages & bunds Leisure barrages Tidal power barrages
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●	●	Sediment extraction Capital dredging Maintenance dredging Commercial estuarine aggregates extraction Commercial terrestrial aggregates extraction Non-commercial aggregates extraction Hard-rock quarrying
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●	●	Urbanisation Land-claim for housing & car parks
●		Education & scientific research Sampling, specimen collection & observation Nature trails & interpretative facilities Seismic studies & geological test drilling Marine & terrestrial archaeology Fossil collecting

Present	Proposed	
●	●	Tourism & recreation Infrastructure developments Marinas Non-marina moorings Dinghy & boat parks Caravan parks & chalets Leisure centres, complexes & piers Aquatic-based recreation Power-boating & water-skiing Jet-skiing Sailing Sailboarding & wind-surfing SCUBA & snorkelling Canoeing Surfing Rowing Tourist boat trips/leisure barges Angling Other non-commercial fishing Bathing & general beach recreation Terrestrial & intertidal-based recreation Walking, including dog walking Bird-watching Sand-yachting 4WD & trial-biking Car sand-racing Horse-riding Rock-climbing Golf courses Clay-pigeon shooting Others Airborne recreation Overflying by light aircraft Radio-controlled model aircraft Others
●		Wildfowling & hunting Wildfowling Other hunting-related activities
●		Bait-collecting Digging & pumping for lugworms & ragworms Hydraulic dredging for worms Others
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		Wildlife habitat management <i>Spartina</i> control Habitat creation & restoration Marine Intertidal Terrestrial Habitat management
		Others

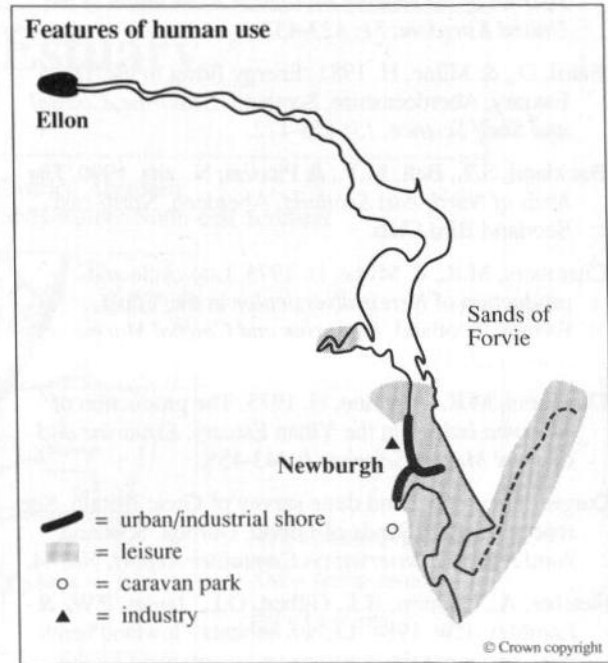
Features of human use

Leisure pursuits take place mainly in the lower reaches of estuary and on the dunes. Beach recreation and walking occurs at the mouth of the estuary and along the shore, and walkers follow nature trails through the Sands of Forvie. The dunes and shore are also a focus for horse-riding and trial-biking, and water-based pursuits include wind-surfing and occasional canoeing and jet-skiing.

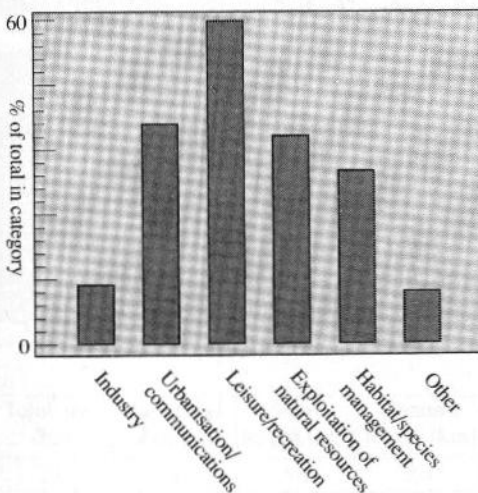
Exploitation of the natural resources is also a feature, for the estuary is an important sea trout and salmon angling fishery from February to October. Wildfowling and bait-collecting also occur but are not intensive. With the close proximity of the Culterty Field Station that conducts extensive research projects on the estuary, the Ythan has been described as one of the best understood estuaries in the world.

There is little industry on the estuary apart from a small shot-blasting works near Newburgh.

In 1989 there was a proposal for a caravan park, but by 1992 this had been turned down.



Categories of human use



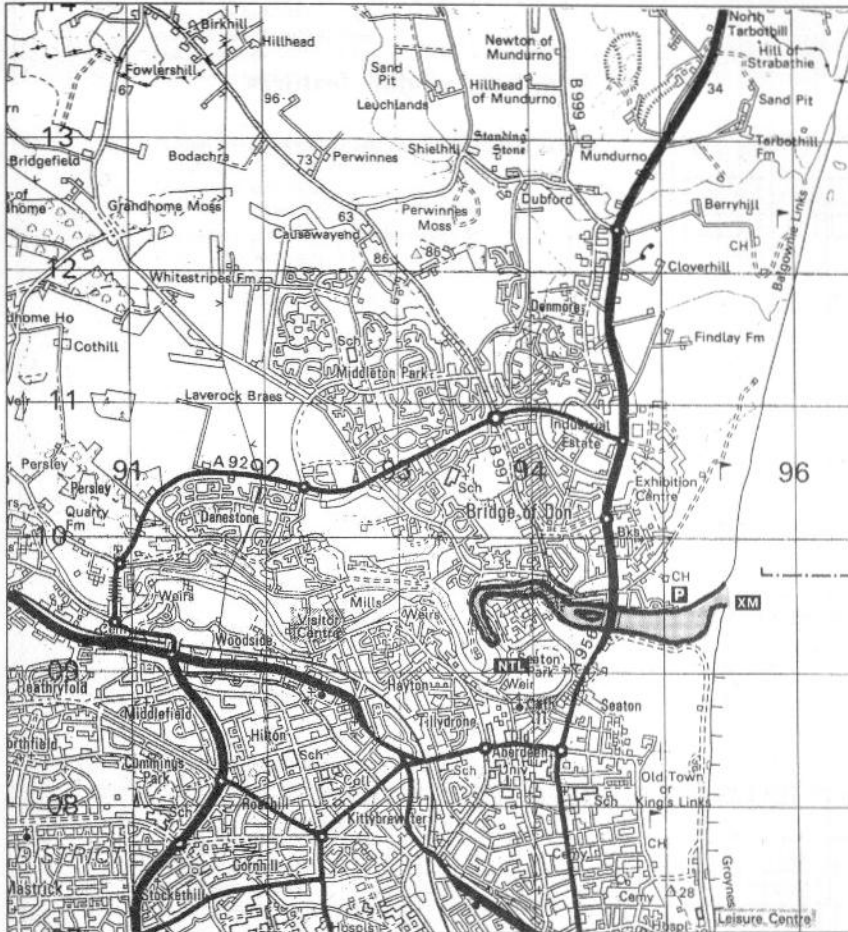
Further reading

- Anderson, A. 1971. Intertidal activity, breeding and the floating habit of *Hydrobia ulvae* in the Ythan Estuary. *Journal of the Marine Biological Association of the United Kingdom*, 51: 423-437.
- Baird, D., & Milne, H. 1981. Energy flows in the Ythan Estuary, Aberdeenshire, Scotland. *Estuarine, Coastal and Shelf Science*, 13: 455-472.
- Buckland, S.T., Bell, M.V., & Picozzi, N., eds. 1990. *The birds of North-east Scotland*. Aberdeen, North-east Scotland Bird Club.
- Chambers, M.R., & Milne, H. 1975. Life cycle and production of *Nereis diversicolor* in the Ythan Estuary, Scotland. *Estuarine and Coastal Marine Science*, 3: 133-134.
- Chambers, M.R., & Milne, H. 1975. The production of *Macoma baltica* in the Ythan Estuary. *Estuarine and Coastal Marine Science*, 3: 443-455.
- Dargie, T. In prep. Sand dune survey of Great Britain. Site report No. 137, Sands of Forvie, Gordon, Scotland. *Joint Nature Conservation Committee Report*, No. 44.
- Fletcher, A., Coppins, B.J., Gilbert, O.L., James, P.W., & Lambley, P.W. 1984. Lichen habitats - lowland heath, dune and machair. A survey and assessment by the British Lichen Society. *Nature Conservancy Council, CSD Report*, No. 522.
- Gorman, M., & Raffaelli, D. 1983. Classic sites. The Ythan Estuary. *Biologist*, 40: 10-13.
- Hardy, F.G. 1990. Littoral survey of the coast of south east Scotland. (Contractor: F.G. Hardy.) *Nature Conservancy Council, CSD Report*, No. 1,159.
- Healy, M.C. 1971. The distribution and abundance of sand gobies, *Gobius minutus*, in the Ythan Estuary. *Journal of Zoology*, 163: 177-229.
- Leach, J.H. 1971. Hydrology of the Ythan Estuary with reference to distribution of major nutrients and detritus. *Journal of the Marine Biological Association of the United Kingdom*, 51: 137-157.
- Milne, H., & Dunnett, G. 1972. Standing crop, productivity and trophic relations in the fauna of the Ythan Estuary. In: *The estuarine environment*, ed. by R. Barnes & J. Green, 86-106. London, Applied Science Publishers Ltd.
- North, S. 1981. *Sands of Forvie and Ythan Estuary National Nature Reserve*. Unpublished, Nature Conservancy Council, North-east Scotland Region.
- Raven, P. [1977]. *Preliminary bibliography of Sands of Forvie and Ythan Estuary*. Unpublished, Nature Conservancy Council North-east Scotland Region.
- Raffaelli, D., Richner, H., & Summers, R.W. 1988. Feeding and activity of the flounder *Platichthys flesus* in the Ythan Estuary. In: *Fish in estuaries conference abstracts. Fish in estuaries. July 1988*. Southampton, University of Southampton for the Fisheries Society of the British Isles.
- Summers, R.W. 1974. *Studies on the flounders of the Ythan Estuary*. Ph.D. thesis, University of Aberdeen. University of Aberdeen Department of Zoology. [1992]. *Culterty publications and theses relating to the Ythan Estuary, 1957 to 1991*. Unpublished, University of Aberdeen, Department of Zoology (Culterty Field Station).
- Urquhart, U.H. 1985. *The saltmarsh survey of North-east Scotland*. Unpublished, Nature Conservancy Council.

Centre grid: NJ9509
Region: Grampian

District: Aberdeen
SNH region: North-east Scotland

Review site location



NTL = Normal tidal limit

XM = Across mouth

■ = Core site



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Total area (ha)	Intertidal area (ha)	Shore length (km)	Channel length (km)	Tidal range (m)	Geomorph. type	Human population
23	9	5.5	2.4	3.7	Coastal plain	187,000

Description

The Don is a small, narrow estuary that flows through the northern parts of the city of Aberdeen and discharges into the North Sea. Water quality has been classified as grade 2; a paper mill once heavily polluted the estuary, but since the installation of a biological treatment plant the water quality has greatly improved.

The mouth of the estuary is very mobile, with the river channel regularly shifting course. A broad sand spit

projecting from the south narrows the estuary mouth, and intertidal sand and mudflats lie in the shelter of this spit. There are narrow fringes of saltmarsh along both banks of the estuary, and the vegetation here is dominated by upper marsh swamp vegetation.

On either side of the mouth of the estuary are sandy beaches and dunes, which extend northwards and southwards along the coast.

Wildlife features

Coastal habitats

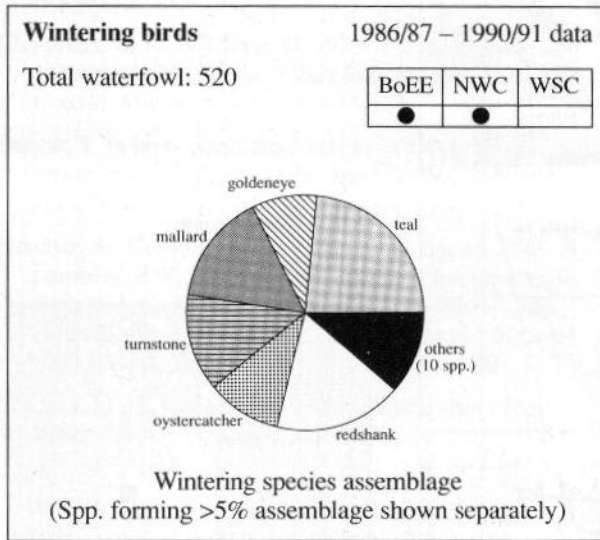
	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other
	●	●	●	●						
Area (ha)	14	1	8							

● = major habitat ● = minor habitat

Aquatic estuarine communities

Information unavailable.

Birds



Additional wildlife features

Otters are present on the estuary.

Conservation status

● = designated ● = proposed

	NCR	GCR	SSSI (B)	SSSI (G)	SSSI (M)	NNR	LNR	Ramsar	SPA	AONB	CWT	RSPB	ESA	NP	WWT	NT	NSA	HC	Other
No.							●												

The Don Estuary has recently been designated as a Local Nature Reserve.

Human activities

Present	Proposed	
●		Coast protection & sea defences Linear defences Training walls Groynes Brushwood fences <i>Spartina</i> planting Marram grass planting
		Barrage schemes Weirs & barrages for river management Storm surge barrages Water storage barrages & bunds Leisure barrages Tidal power barrages
		Power generation Thermal power stations Import/export jetties (power generation) Wind-power generation
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		Military activities Overflying by military aircraft Others
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		Sediment extraction Capital dredging Maintenance dredging Commercial estuarine aggregates extraction Commercial terrestrial aggregates extraction Non-commercial aggregates extraction Hard-rock quarrying
●		Transport & communications Airports & helipads Tunnels, bridges & aqueducts Causeways & fords Road schemes Ferries Cables
●		Urbanisation Land-claim for housing & car parks
●	●	Education & scientific research Sampling, specimen collection & observation Nature trails & interpretative facilities Seismic studies & geological test drilling Marine & terrestrial archaeology Fossil collecting

Present	Proposed	
		Tourism & recreation Infrastructure developments Marinas Non-marina moorings Dinghy & boat parks Caravan parks & chalets Leisure centres, complexes & piers Aquatic-based recreation Power-boating & water-skiing Jet-skiing Sailing Sailboarding & wind-surfing SCUBA & snorkelling Canoeing Surfing Rowing Tourist boat trips/leisure barges Angling Other non-commercial fishing Bathing & general beach recreation Terrestrial & intertidal-based recreation Walking, including dog walking Bird-watching Sand-yachting 4WD & trial-biking Car sand-racing Horse-riding Rock-climbing Golf courses Clay-pigeon shooting Others Airborne recreation Overflying by light aircraft Radio-controlled model aircraft Others
●		Wildfowling & hunting Wildfowling Other hunting-related activities
●		Bait-collecting Digging & pumping for lugworms & ragworms Hydraulic dredging for worms Others
●		Commercial fisheries Fish-netting & trawling Fyke-netting for eels Fish traps & other fixed devices & nets Crustacea Molluscs – Hand-gathering Dredging Hydraulic dredging
●		Cultivation of living resource Saltmarsh grazing Sand dune grazing Agricultural land-claim Fish-farming Shellfish farming Bottom & tray cultivation Suspended cultivation Crustacea farming Reeds for roofing <i>Salicornia</i> picking Others
●		Management & killing of birds & mammals Killing of mammals Killing of birds Adult fish-eating birds Adult shellfish-eating birds Gulls Geese
●		Wildlife habitat management <i>Spartina</i> control Habitat creation & restoration Marine Intertidal Terrestrial Habitat management
●		Others

Wildlife features

Features of human use

There are few activities taking place on the Don Estuary. Leisure pursuits include walking and bird-watching on either side of the estuary mouth and along the shore, and there is a bird hide on the south bank of the estuary. Angling also occurs and there are two golf courses on either side of the estuary mouth. In addition jet-skiing, wind-surfing and sailboarding occur mainly on the open coast on either side of the estuary mouth. In 1989 there was also a rubbish tip covering 1 ha on the spit south of the estuary mouth, which is no longer in use.

There has also been recent work to protect the sand dunes and to rationalise access to them.

Further reading

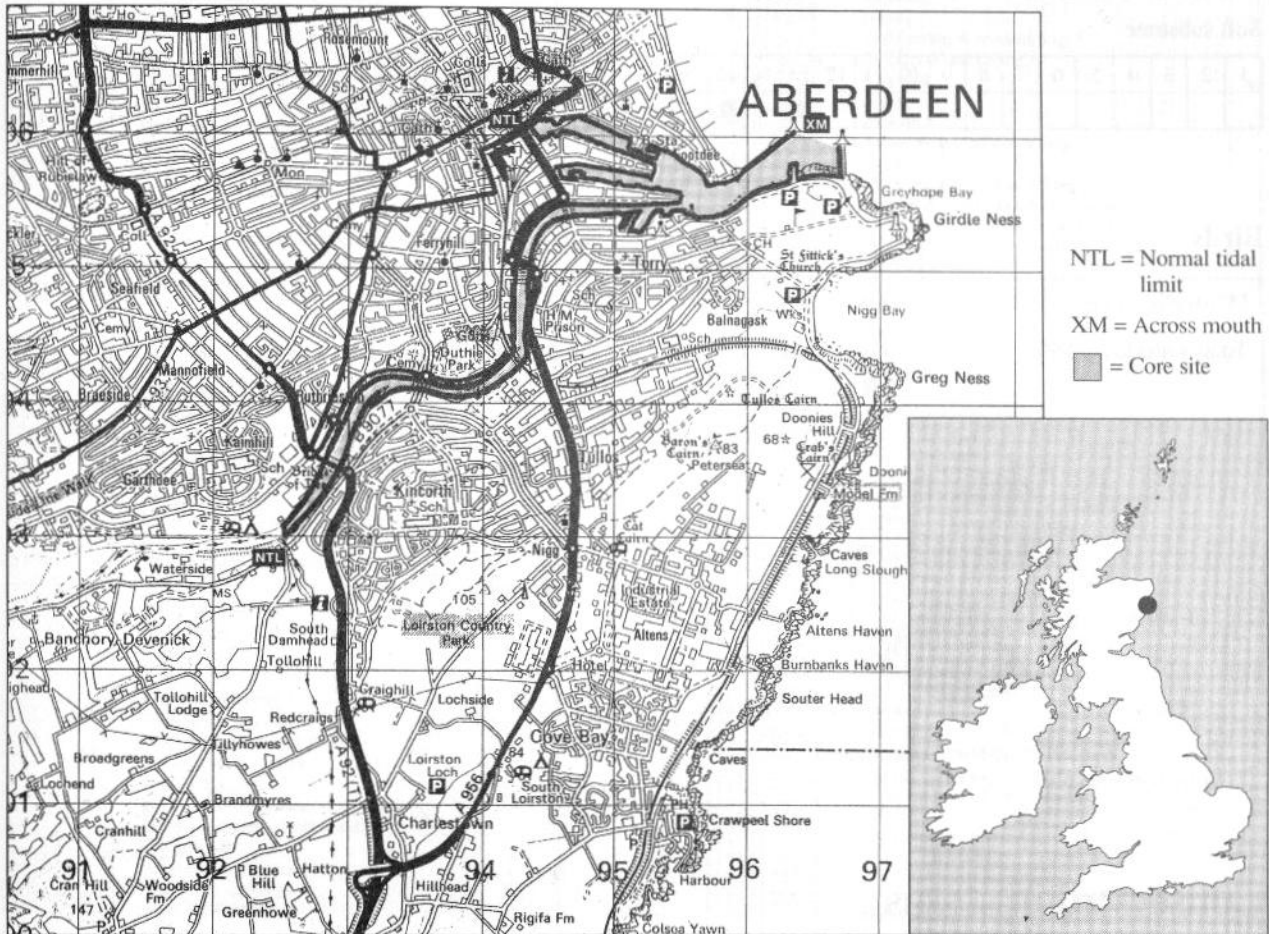
- Bell, M.V. 1989. Wintering wildfowl and waders at Aberdeen, 1975-1986. *Scottish Birds*, 15: 106-113.
- Urquhart, U.H. 1985. *Saltmarsh survey of North-east Scotland*. Unpublished, Nature Conservancy Council.

Dee Estuary (Grampian)

Centre grid: NJ9405
Region: Grampian

District: Aberdeen
SNH region: North-east Scotland

Review site location



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Total area (ha)	Intertidal area (ha)	Shore length (km)	Channel length (km)	Tidal range (m)	Geomorph. type	Human population
97	7	18.7	5.8	3.7	Coastal plain	187,000

Description

The estuary of the River Dee, one of the most famous salmon rivers in Scotland, flows through the city of Aberdeen into the North Sea. The whole of the estuary mouth is dominated by the urban shores of Aberdeen and the harbour. Water quality within the estuary has been classified as grade 1.

The estuary is almost wholly subtidal, with three aquatic estuarine communities recorded within the estuary; a

normal/variable salinity muddy sand community, a variable/reduced salinity mud community, and a variable (reduced) salinity rock shore community recorded from the small area of rocky shore that lies on the southern shore just within the estuary mouth.

There are only very small intertidal areas within the estuary, which are dominated by shingle.

Wildlife features

Coastal habitats

	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other
	●		●	●		●	●			
Area (ha)	90		7							

● = major habitat ● = minor habitat

Aquatic estuarine communities

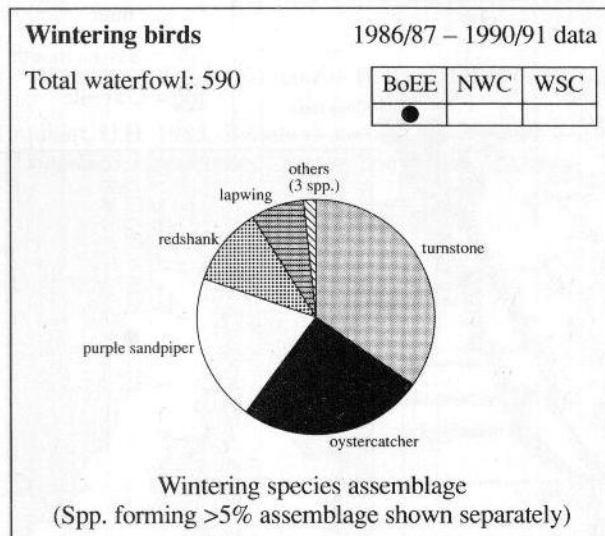
Soft substrate

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
												●		●	

Hard substrate

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
				●												

Birds



Additional wildlife features

Otters are present on the estuary, and a salmon spawning ground lies just upstream of the normal tidal limit of the estuary, above Brig o' Dee.

Conservation status

There are no conservation designations present on the Dee.

Human activities

Present	Proposed	
●		Coast protection & sea defences Linear defences Training walls Groynes Brushwood fences <i>Spartina</i> planting Marram grass planting
		Barrage schemes Weirs & barrages for river management Storm surge barrages Water storage barrages & bunds Leisure barrages Tidal power barrages
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●		Bait-collecting Digging & pumping for lugworms & ragworms Hydraulic dredging for worms Others
●		Commercial fisheries Fish-netting & trawling Fyke-netting for eels Fish traps & other fixed devices & nets Crustacea Molluscs – Hand-gathering Dredging Hydraulic dredging
●		Cultivation of living resource Saltmarsh grazing Sand dune grazing Agricultural land-claim Fish-farming Shellfish farming Bottom & tray cultivation Suspended cultivation Crustacea farming Reeds for roofing <i>Salicornia</i> picking Others
●		Management & killing of birds & mammals Killing of mammals Killing of birds Adult fish-eating birds Adult shellfish-eating birds Gulls Geese
		Wildlife habitat management <i>Spartina</i> control Habitat creation & restoration Marine Intertidal Terrestrial Habitat management
		Others

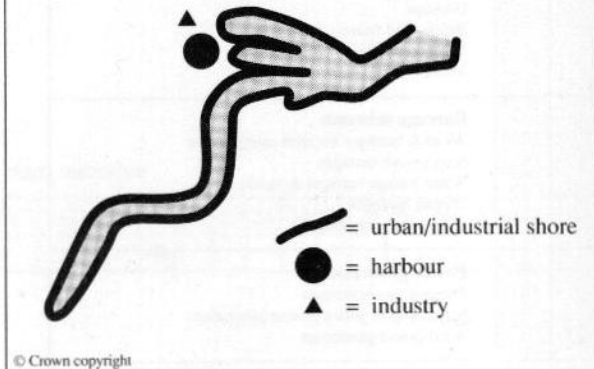
Wildlife features

Features of human use

There are a small number of activities occurring on the Dee. The harbour walls dominate the outer parts of the estuary, and the harbour is a busy site which services the North Sea oilfields. Industrial activities on the estuary include a boat-building/repair works and a fish processing plant.

Leisure pursuits on the Dee include sailing and canoeing in the upper parts of the estuary, rowing occurs along most of the channel, and walkers use the banks of the estuary. Bird-watching occurs mostly from the harbour walls, and anglers use the banks in the upper part of the site.

Features of human use



Further reading

- Hawkins, A. D., & Smith, G. W. 1986. Radio-tracking observations on Atlantic salmon ascending the Aberdeenshire Dee. *Scottish Fisheries Research Report*, No. 36.
- Hawkins, A. D., Smith, G. W., Johnstone, A. D. F., Webb, J., & Laughton, R. 1988. Temperature gradients in the estuary of the Aberdeenshire Dee, and their significance for the entry of adult Atlantic salmon. *In: Fish in estuaries: abstracts*. Southampton University.
- Jenkins, D., (Ed.) 1985. *The biology and management of the River Dee*. Institute of Terrestrial Ecology/Natural Environment Research Council.
- Milne, A. Some ecological aspects of the intertidal area of the estuary of the Aberdeenshire Dee. *Transactions of the Royal Society of Edinburgh*, 60: 107-140.

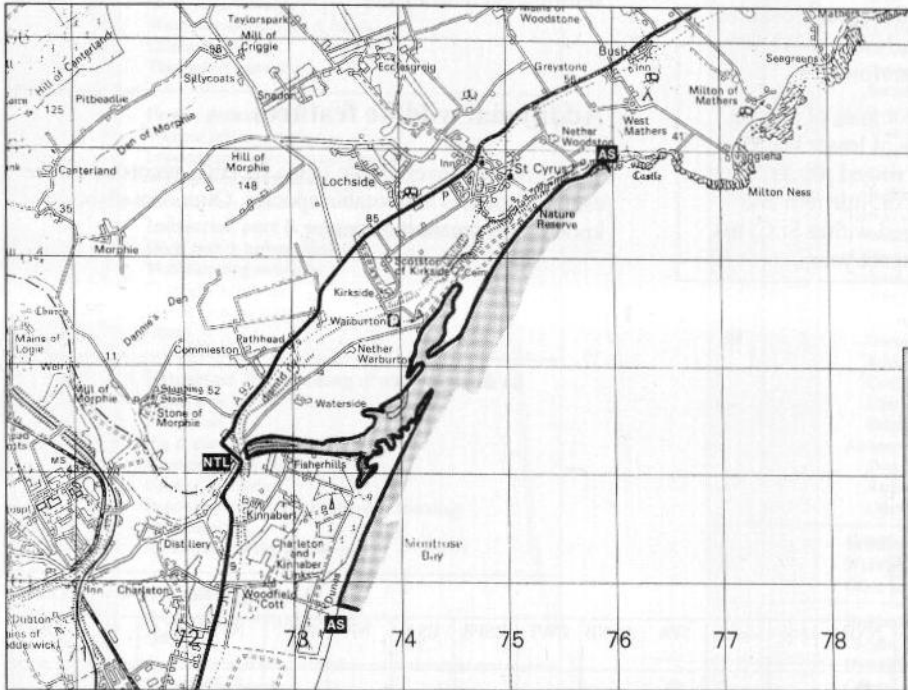
Centre grid: NO7362

Districts: Angus, Kincardine & Deeside

Regions: Grampian, Tayside

SNH regions: South-east Scotland, North-east Scotland

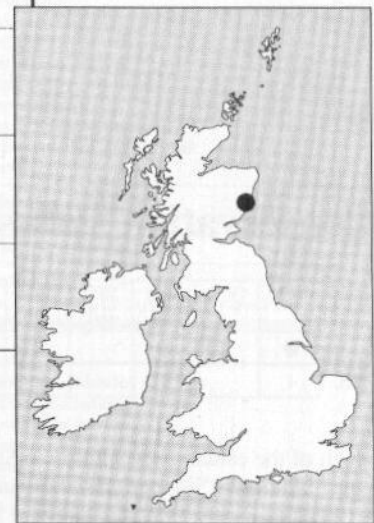
Review site location



NTL = Normal tidal limit

AS = Along shore

■ = Core site



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Total area (ha)	Intertidal area (ha)	Shore length (km)	Channel length (km)	Tidal range (m)	Geomorph. type	Human population
156	136	12.8	2.1	4.1	Bar built	< 5,000

Description

St Cyrus is the small estuary of the North Esk River, which flows into the sea at the northernmost part of Montrose Bay. Water quality within the estuary has been classified as grade 1.

The mouth of the estuary is constricted by a sand and shingle spit, and the dynamic nature of the lower parts of the North Esk River frequently changes the pattern of the estuary mouth, sand banks and intertidal flats. The intertidal flats in the upper parts of the estuary are predominantly muddy, but become sandy towards the mouth.

Due to the dynamic nature of the estuary mouth and encroachment of sand, the area of saltmarsh within the estuary is now much smaller than formerly. The saltmarsh that remains is the only saltmarsh in Kincardine, and the vegetation consists largely of low-mid marsh and some mid-upper marsh communities.

The seaward shores of the estuary are fine sandy beaches backed by dunes. To the south of the estuary mouth is Kinnaber Links, a dune ridge backed by a large area of lichen-rich dune heath. This area supports a notable and luxuriant lichen flora, with over 70 species recorded that include 27 species of reindeer moss *Cladonia* spp., and a well-developed lichen assemblage on pebbles. To the north of the estuary mouth is an extensive lime-rich system of sand dunes and dune pasture.

St Cyrus is an interesting estuary for it is composed of a mosaic of habitats and is one of the richest sites for wild plants and animals on the coast of North-east Scotland. The estuary supports a rich and diverse invertebrate fauna that includes all five Scottish species of grasshopper and cricket, together with the most diverse moth and butterfly fauna in eastern Scotland.

Wildlife features

Coastal habitats

	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other
	●	●	●	●	●					
Area (ha)	20	8	128							

● = major habitat ● = minor habitat

Birds

Wintering birds: St Cyrus is not a regularly counted site, and there are no recent BoEE, NWC or WSC records available for wintering waterfowl.

Breeding birds: moderate-sized colonies of herring gull and fulmar and a small colony of lesser black-backed gull and small numbers of ringed plover breed within the estuary. Small numbers of little tern and arctic tern have been known to breed within St Cyrus, but these colonies have failed in recent years.

Aquatic estuarine communities

Information unavailable.

Additional wildlife features

The terrestrial invertebrate fauna recently recorded on the estuary includes 40 Notable species. Otters are also known to frequent the estuary.

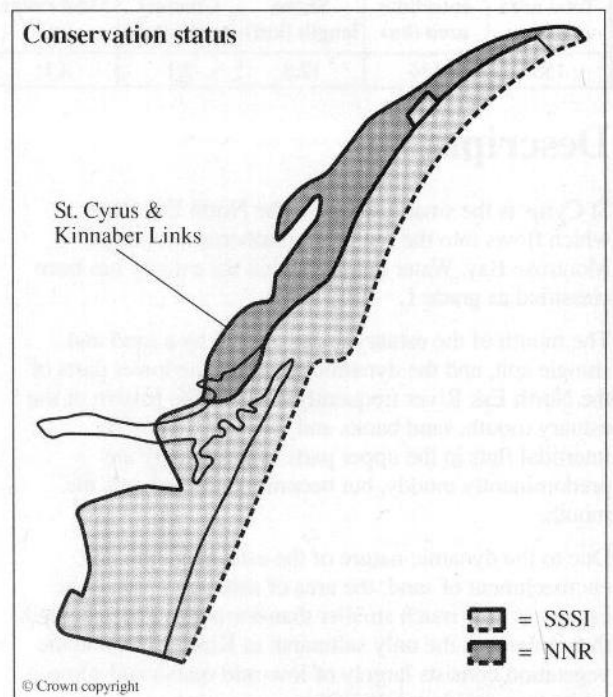
Conservation status

● = designated ● = proposed

	NCR	GCR	SSSI (B)	SSSI (G)	SSSI (M)	NNR	LNR	Ramsar	SPA	AONB	CWT	RSPB	ESA	NP	WWT	NT	NSA	HC	Other	
No.	1		1			1			1											

Much of the estuary lies within the St Cyrus and Kinnaber Links biological Site of Special Scientific Interest (312 ha), part of which is a National Nature Reserve. The estuary is also a Nature Conservation Review site.

St Cyrus is also a proposed Special Protection Area.



Human activities

Present
Proposed

●	<p>Coast protection & sea defences Linear defences Training walls Groynes Brushwood fences <i>Spartina</i> planting Marram grass planting</p>
	<p>Barrage schemes Weirs & barrages for river management Storm surge barrages Water storage barrages & bunds Leisure barrages Tidal power barrages</p>
	<p>Power generation Thermal power stations Import/export jetties (power generation) Wind-power generation</p>
	<p>Industrial, port & related development Dock, port & harbour facilities Manufacturing industries Chemical industries Ship & boat building Others</p>
	<p>Extraction & processing of natural gas & oil Exploration Production Rig & platform construction Pipeline construction Pipeline installation Import/export jetties & single-point moorings Oil refineries Mothballing of rigs & tankers</p>
	<p>Military activities Overflying by military aircraft Others</p>
	<p>Waste discharge Domestic waste disposal Sewage discharge & outfalls Sewage treatment works Rubbish tips Industrial & agricultural waste discharge Thermal discharges (power stations) Dredge spoil Accidental discharges Aerial crop spraying Waste incinerators Others</p>
	<p>Sediment extraction Capital dredging Maintenance dredging Commercial estuarine aggregates extraction Commercial terrestrial aggregates extraction Non-commercial aggregates extraction Hard-rock quarrying</p>
●	<p>Transport & communications Airports & helipads Tunnels, bridges & aqueducts Causeways & fords Road schemes Ferries Cables</p>
	<p>Urbanisation Land-claim for housing & car parks</p>
● ●	<p>Education & scientific research Sampling, specimen collection & observation Nature trails & interpretative facilities Seismic studies & geological test drilling Marine & terrestrial archaeology Fossil collecting</p>

Present
Proposed

●	<p>Tourism & recreation Infrastructure developments Marinas Non-marina moorings Dinghy & boat parks Caravan parks & chalets Leisure centres, complexes & piers Aquatic-based recreation Power-boating & water-skiing Jet-skiing Sailing Sailboarding & wind-surfing SCUBA & snorkelling Canoeing Surfing Rowing Tourist boat trips/leisure barges Angling Other non-commercial fishing Bathing & general beach recreation Terrestrial & intertidal-based recreation Walking, including dog walking Bird-watching Sand-yachting 4WD & trial-biking Car sand-racing Horse-riding Rock-climbing Golf courses Clay-pigeon shooting Others Airborne recreation Overflying by light aircraft Radio-controlled model aircraft Others</p>
	<p>Wildfowling & hunting Wildfowling Other hunting-related activities</p>
	<p>Bait-collecting Digging & pumping for lugworms & ragworms Hydraulic dredging for worms Others</p>
●	<p>Commercial fisheries Fish-netting & trawling Fyke-netting for eels Fish traps & other fixed devices & nets Crustacea Molluscs – Hand-gathering Dredging Hydraulic dredging</p>
●	<p>Cultivation of living resource Saltmarsh grazing Sand dune grazing Agricultural land-claim Fish-farming Shellfish farming Bottom & tray cultivation Suspended cultivation Crustacea farming Reeds for roofing <i>Salicornia</i> picking Others</p>
● ●	<p>Management & killing of birds & mammals Killing of mammals Killing of birds Adult fish-eating birds Adult shellfish-eating birds Gulls Geese</p>
●	<p>Wildlife habitat management <i>Spartina</i> control Habitat creation & restoration Marine Intertidal Terrestrial Habitat management</p>
	<p>Others</p>

Features of human use

There are few activities occurring on St Cyrus. Leisure pursuits include beach recreation and walking north of the estuary mouth, and horse-riding occurs on the outer beach and dunes. Exploitation of the natural resources includes grazing over a small area of saltmarsh and netting of salmon. Culling of seals and cormorants to protect the salmon nets occurs, but is not intensive.

A small area of blow-out in the dunes has been successfully replanted with lyme grass to aid restoration. There is a visitor centre on the National Nature Reserve.

Further reading

- Green, J. 1984. *Saltmarshes of North-east Scotland. A literature search and map study*. Unpublished, Nature Conservancy Council.
- Lee, K. 1986. *A vegetation survey of a part of St Cyrus NNR*. Peterborough, Nature Conservancy Council.
- Marren, P. *The natural history of St Cyrus*. Inverness, Nature Conservancy Council.
- Urquhart, U.H. 1985. *Saltmarsh survey of North-east Scotland*. Unpublished, Nature Conservancy Council.

Centre grid: NO6957
Region: Tayside

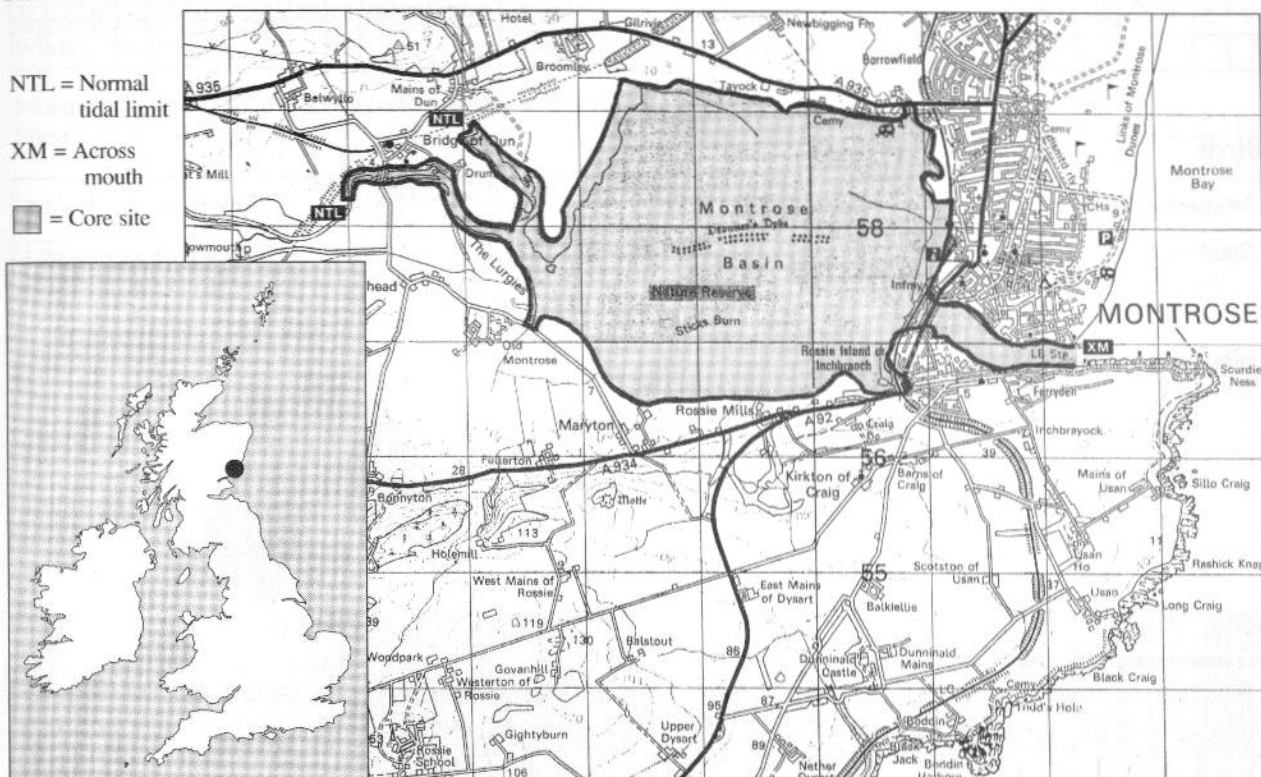
District: Angus
SNH region: South-east Scotland

Review site location

NTL = Normal
tidal limit

XM = Across
mouth

■ = Core site



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Total area (ha)	Intertidal area (ha)	Shore length (km)	Channel length (km)	Tidal range (m)	Geomorph. type	Human population
842	739	21.9	8.0	4.1	Bar built	12,000

Description

Montrose Basin is the estuary of the River South Esk, which discharges into the sea at the southern end of Montrose Bay. The estuary widens from a narrow river channel into a large basin, which is enclosed at the mouth by a broad spit. Montrose Basin is one of the finest enclosed estuary basins on the east coast of Scotland, with a wide range of habitats and is virtually untouched by industrial development or pollution. Water quality within the estuary has been classified for the most part as class 1, declining to class 2 near the mouth.

The basin dries out almost completely at low tide, exposing extensive intertidal flats which grade from sandy flats to mud and shingle. This area supports a rich invertebrate fauna which shows a marked zonation according to salinity and type of substrate. There are also

beds of *Zostera* eelgrass and mussels in the south-east corner of the estuary basin.

The shores of Montrose Basin are fringed with saltmarsh, with rich and varied plant communities. Pioneer vegetation communities dominate, but the vegetation grades through mid-upper marsh, upper marsh swamps and freshwater marshes. Along the northern shore the saltmarsh is showing signs of erosion by wave action.

Montrose Basin is known to support large numbers of wintering waterfowl, that regularly includes internationally populations of pink-footed goose, redshank and greylag goose, and nationally important populations of eider, wigeon, whooper swan, oystercatcher and knot. The estuary also supports nationally important population of breeding eider.

Wildlife features

Coastal habitats

	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other
	●	●	●	●		●				
Area (ha)	103	58	681							

● = major habitat ● = minor habitat

Aquatic estuarine communities

Soft substrate

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
												●	●	●	

Hard substrate

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
	●															

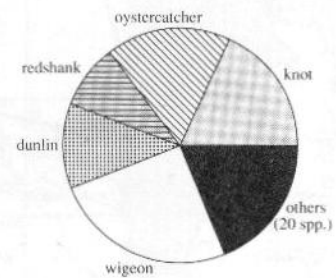
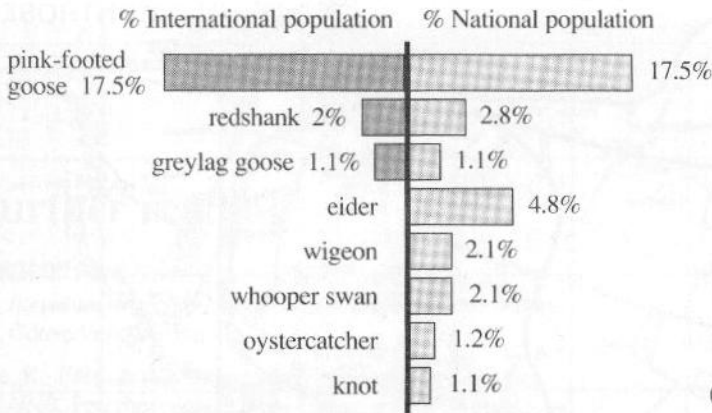
Birds

Wintering birds

Total waterfowl: 44,400

1986/87 – 1990/91 data

BoEE	NWC	WSC
●	●	



Wintering species assemblage (Spp. forming >5% assemblage shown separately)

Breeding birds: the estuary supports nationally important numbers of breeding eider, and the saltmarsh supports moderate densities of breeding oystercatcher, lapwing and redshank and low numbers of curlew.

Other: Montrose Basin is an important site for moulting mute swans and there is a large autumn roost of terns.

Additional wildlife features

Otters regularly use the estuary.

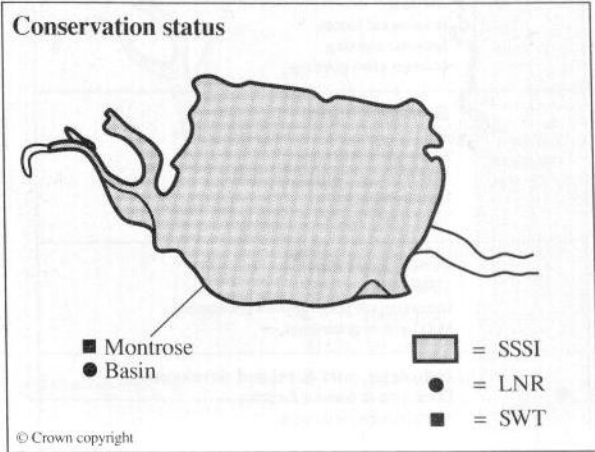
Conservation status

● = designated ● = proposed

No.	NCR	GCR	SSSI (B)	SSSI (G)	SSSI (M)	NNR	LNR	Ramsar	SPA	AONB	CWT	RSPB	ESA	NP	WWT	NT	NSA	HC	Other	
	●	●			●		●	●	●		●									
	1	1			1		1	1	1		1									

Most of the estuary lies within the Montrose Basin Site of Special Scientific Interest (889 ha), which was designated for its biological and geological interest. The estuary is also a Nature Conservation Review site, contains a Geological Conservation Review site, has been designated as a Local Nature Reserve and is a Scottish Wildlife Trust reserve.

Montrose Basin is also proposed as a Ramsar site and Special Protection Area.



There are beds of *Zostera eelgrass* in Montrose Basin. (Pat Doody, JNCC)

Human activities

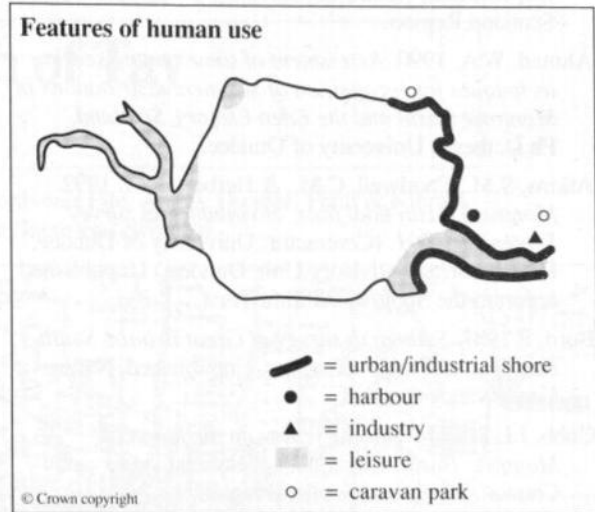
Present	Proposed	
●		Coast protection & sea defences Linear defences Training walls Groynes Brushwood fences <i>Spartina</i> planting Marram grass planting
		Barrage schemes Weirs & barrages for river management Storm surge barrages Water storage barrages & bunds Leisure barrages Tidal power barrages
		Power generation Thermal power stations Import/export jetties (power generation) Wind-power generation
●		Industrial, port & related development Dock, port & harbour facilities Manufacturing industries Chemical industries Ship & boat building Others
		Extraction & processing of natural gas & oil Exploration Production Rig & platform construction Pipeline construction Pipeline installation Import/export jetties & single-point moorings Oil refineries Mothballing of rigs & tankers
		Military activities Overflying by military aircraft Others
●		Waste discharge Domestic waste disposal Sewage discharge & outfalls Sewage treatment works Rubbish tips Industrial & agricultural waste discharge Thermal discharges (power stations) Dredge spoil Accidental discharges Aerial crop spraying Waste incinerators Others
●		Sediment extraction Capital dredging Maintenance dredging Commercial estuarine aggregates extraction Commercial terrestrial aggregates extraction Non-commercial aggregates extraction Hard-rock quarrying
●		Transport & communications Airports & helipads Tunnels, bridges & aqueducts Causeways & fords Road schemes Ferries Cables
		Urbanisation Land-claim for housing & car parks
●		Education & scientific research Sampling, specimen collection & observation Nature trails & interpretative facilities Seismic studies & geological test drilling Marine & terrestrial archaeology Fossil collecting

Present	Proposed	
		Tourism & recreation Infrastructure developments Marinas Non-marina moorings Dinghy & boat parks Caravan parks & chalets Leisure centres, complexes & piers Aquatic-based recreation Power-boating & water-skiing Jet-skiing Sailing Sailboarding & wind-surfing SCUBA & snorkelling Canoeing Surfing Rowing Tourist boat trips/leisure barges Angling Other non-commercial fishing Bathing & general beach recreation Terrestrial & intertidal-based recreation Walking, including dog walking Bird-watching Sand-yachting 4WD & trial-biking Car sand-racing Horse-riding Rock-climbing Golf courses Clay-pigeon shooting Others Airborne recreation Overflying by light aircraft Radio-controlled model aircraft Others
●		Wildfowling & hunting Wildfowling Other hunting-related activities
●		Bait-collecting Digging & pumping for lugworms & ragworms Hydraulic dredging for worms Others
●		Commercial fisheries Fish-netting & trawling Fyke-netting for eels Fish traps & other fixed devices & nets Crustacea Molluscs – Hand-gathering Dredging Hydraulic dredging
●		Cultivation of living resource Saltmarsh grazing Sand dune grazing Agricultural land-claim Fish-farming Shellfish farming Bottom & tray cultivation Suspended cultivation Crustacea farming Reeds for roofing <i>Salicornia</i> picking Others
		Management & killing of birds & mammals Killing of mammals Killing of birds Adult fish-eating birds Adult shellfish-eating birds Gulls Geese
●		Wildlife habitat management <i>Spartina</i> control Habitat creation & restoration Marine Intertidal Terrestrial Habitat management
		Others

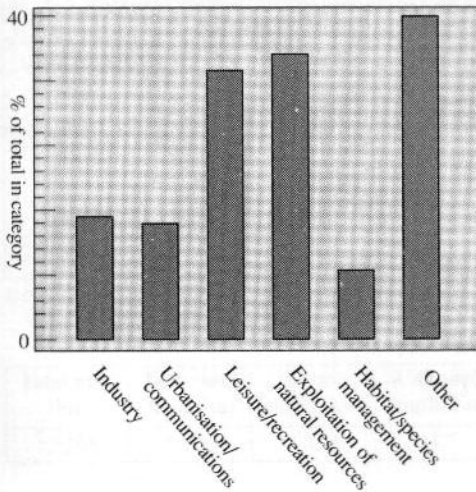
Features of human use

Leisure activities are numerous, with a small number of moorings in the south-east corner of the basin from which sailing is based, and occasional wind-surfing and canoeing. There are also harbour facilities at Montrose. Bird-watching is centred around the north-west of the site, and angling for salmon and sea trout occurs in the channel of the river South Esk. There are two caravan parks on the north shore.

Exploitation of the natural resources includes wildfowling over the western half of Montrose Basin which takes place under permit, and the eastern half of the estuary is a sanctuary area. Bait-digging also occurs but is not intensive and there is a mussel farm present on the estuary.



Categories of human use



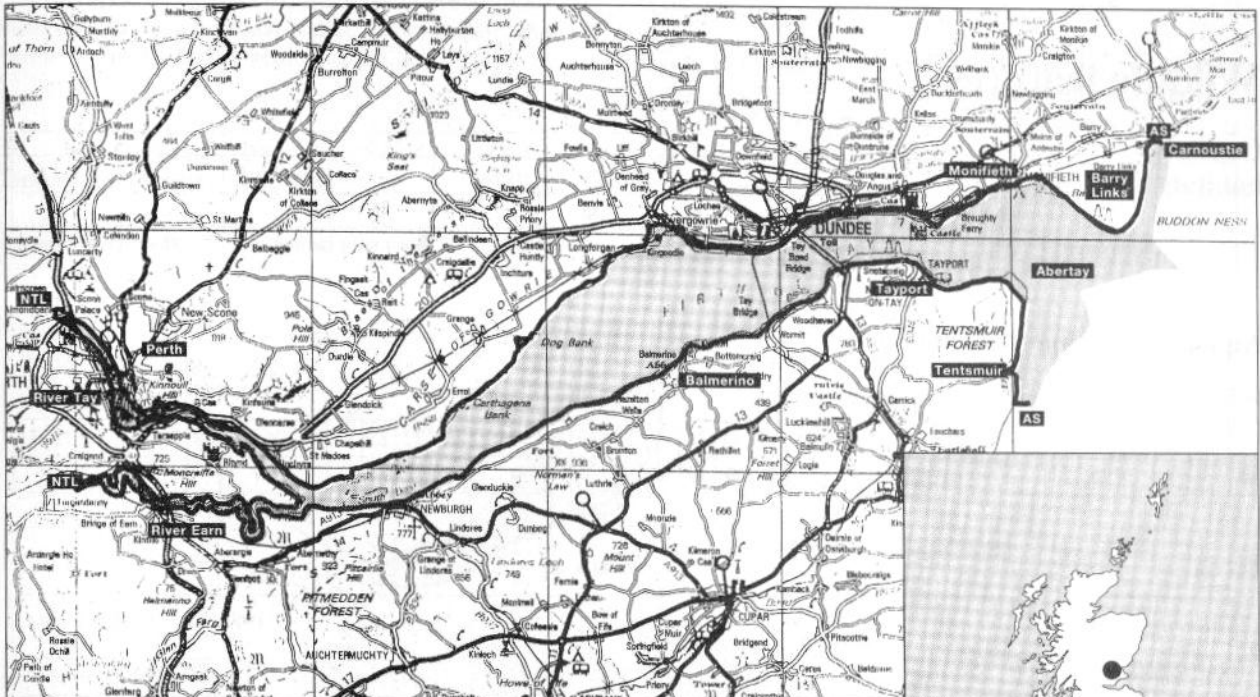
Further reading

- Ackroyd, J. 1972. *Montrose Basin - Zostera*. Unpublished, Nature Conservancy Council, South-east Scotland Region.
- Ahmad, W.A. 1990. *Assessment of some remote sensing techniques for recognition of sediment distributions in Montrose Basin and the Eden Estuary, Scotland*. Ph.D. thesis, University of Dundee.
- Atkins, S.M., Caudwell, C.M., & Herbert, R.A. 1992. *Montrose Basin tidal flats: environmental survey September 1991*. (Contractor: University of Dundee, Environmental Advisory Unit, Dundee.) Unpublished report to the Scottish Wildlife Trust.
- Burd, F. 1987. *Saltmarsh survey of Great Britain. South-east Scotland regional report*. Unpublished, Nature Conservancy Council.
- Cobb, J.L.S. 1974. *Interim report on the fauna of Montrose Basin*. Unpublished, Nature Conservancy Council, South-east Scotland region.
- Duncan, W. 1890. *Montrose Basin faunal list*. Unpublished, Montrose Natural History and Antiquarian Society.
- Forth River Purification Board. 1982. *A biological and sedimentological study of the northern shore of the South Esk Estuary, Montrose*. Unpublished, Forth River Purification Board, Edinburgh. (Estuary survey section report, no. ES4/82.)
- Fox, P. 1991. Studies within sites of distribution effects of shooting on overwintering waterfowl. In: *Shooting disturbance*, ed. by D.V. Bell and P.J.A. Fox. WWT/BASC report to NCC/RSPB.
- Fullarton, J.H. 1894. On the history of mussel culture at Montrose during the past six years. *Annual Report of the Fishery Board for Scotland*, 13: 137-146.
- Fullarton, J.H., & Scott, T. 1888. Mussel-farming at Montrose. *Annual Report of the Fishery Board for Scotland (Scientific Investigation)*, 7: 327-341.
- McLusky, D., & Roddie, K. 1982. *Montrose Basin survey 1982*. (Contractor: University of Stirling, Department of Biological Science, Stirling.) Unpublished report to Nature Conservancy Council, South-east Scotland region (Internal report, No. NC 199 L).
- Milligan, J. 1984. *Quantitative study of the intertidal invertebrate communities of the Montrose Basin September 1983*. B.Sc. dissertation, University of Stirling, Department of Biological Sciences.
- Montrose Basin Reclamation Company Ltd. 1954. *Report on the investigation into the reclamation of Montrose Basin 1952-1954*. Unpublished, Directors of the Montrose Basin Reclamation Company Ltd.
- Nature Conservancy Council. 1980. *Montrose Basin*. Unpublished, Nature Conservancy Council South-east Scotland Region.
- Scottish Wildlife Trust. 1991. *Montrose Basin Local Nature Reserve management plan 1991-1996*. Unpublished, Scottish Wildlife Trust.
- Walker, C.N. 1968. *A preliminary investigation into the distribution of the polychaete Arenicola marina on Rossie Island, Montrose*. B.Sc. dissertation, University of Aberdeen, Department of Zoology.

Centre grid: NO3527
Regions: Fife, Tayside

Districts: North-east Fife, Angus, Dundee, Perth & Kinross
SNH region: South-east Scotland

Review site location



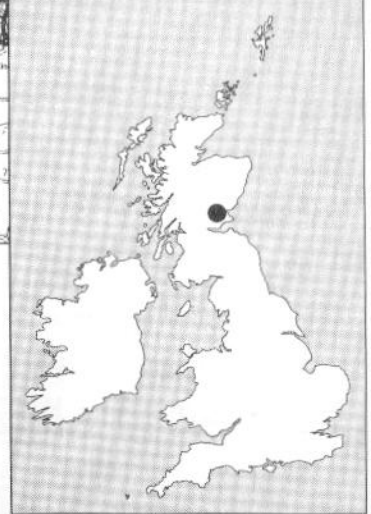
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NTL = Normal tidal limit

AS = Along shore

■ = Core site

Total area (ha)	Intertidal area (ha)	Shore length (km)	Channel length (km)	Tidal range (m)	Geomorph. type	Human population
12,265	5,720	170.3	53.7	3.7	Complex	214,000



Description

The Tay Estuary flows from Perth down to the North Sea, and is adjacent to the Eden Estuary to the south. The fresh waters of the Rivers Tay and Earn provide the highest freshwater inflow into an estuary in the UK. Water quality within the Tay Estuary has been classified as grade 1 in the River Earn, and grade 2 in the Tay.

At low tide the uppermost parts of the estuary form extensive mudflats, particularly on the northern shore. In places these mudflats support a naturally impoverished fauna due to the unstable nature of the coarse sediments. Mussels form the most prominent sublittoral population in the middle/outer estuary. Fringing the shores of the inner estuary is one of the largest areas of saltmarsh on the east

coast of Scotland, particularly on the northern shore where there is one of the most extensive continuous stands of brackish *Phragmites* reedswamp in Britain. There are also smaller, more isolated patches of saltmarsh at Balmerino, Tayport, Monifieth and Carnoustie. Along part of the southern coast there is a narrow strip of shingle beach fringing the shore.

Towards the mouth of the estuary the intertidal flats and banks become more sandy, and there are sand dunes to the north and south of the estuary mouth (Barry Links and Tentsmuir). This area is a site of great geomorphological interest, for large amounts of sediment downstream are deposited at the estuary mouth and are actively building

Further reading

extensive bar and spit systems. The Abertay sand bars and shoal banks play a fundamental role in this accretion, and at Tentsmuir the sandy beach is actively building out to sea at an exceptional rate. The sand dunes at Tentsmuir are also rapidly accreting, and support an extraordinary diversity of dune vegetation and a rich invertebrate fauna.

North of the estuary mouth is the Barry Links peninsula of blown sand. The sand dunes here have a unique elongated 'hairpin' form, and support a full range of

characteristic, relatively undisturbed plant communities. A large number of vascular plants have been recorded from Barry Links, including scarce species, together with a large number of rare mosses and liverworts, and several invertebrates which are very local in their distribution.

The Tay Estuary also regularly supports internationally important populations of wintering redshank and bar-tailed godwit and nationally important populations of eider, sanderling and grey plover.

Wildlife features

Coastal habitats

	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other
	●	●	●	●	●		●			
Area (ha)	6,545	502	5,218							

● = major habitat ● = minor habitat

Aquatic estuarine communities

Soft substrate

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
●				●				●	●				●	●	●

Hard substrate

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
		●														

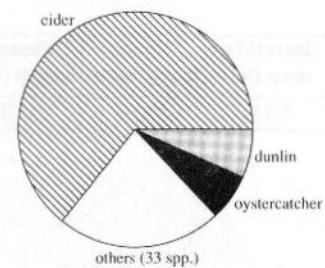
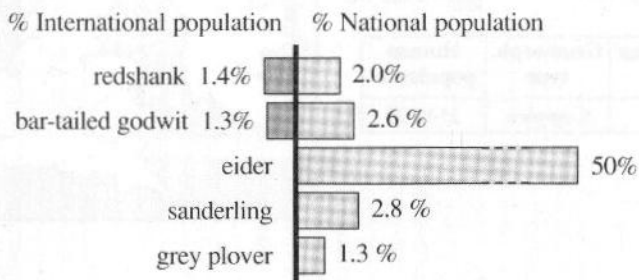
Birds

Wintering birds

Total waterfowl: 33,600

1986/87 – 1990/91 data

BoEE	NWC	WSC
●	●	



Wintering species assemblage
(Spp. forming >5% assemblage shown separately)

Breeding birds: there is a moderate-sized colony of black-headed gull and small colonies of arctic tern and herring gull within the estuary. Small numbers of ringed plover are also known to breed within the Firth of Tay.

Other: the Firth of Tay is also a major roosting site for pink-footed goose.

Additional wildlife features

The invertebrate fauna recently recorded within the estuary includes the RDB 3 beetle *Arena tabida* and fifteen Notable species, and the first UK record of the polychaete worm *Marenzelleria viridis*. Fish populations

in the Firth of Tay include salmon and smelt (sparring) *Osmerus eperlanus*.

Otters are known to frequent the estuary, and grey and common seals regularly haul-out on the outer sandflats.

Conservation status

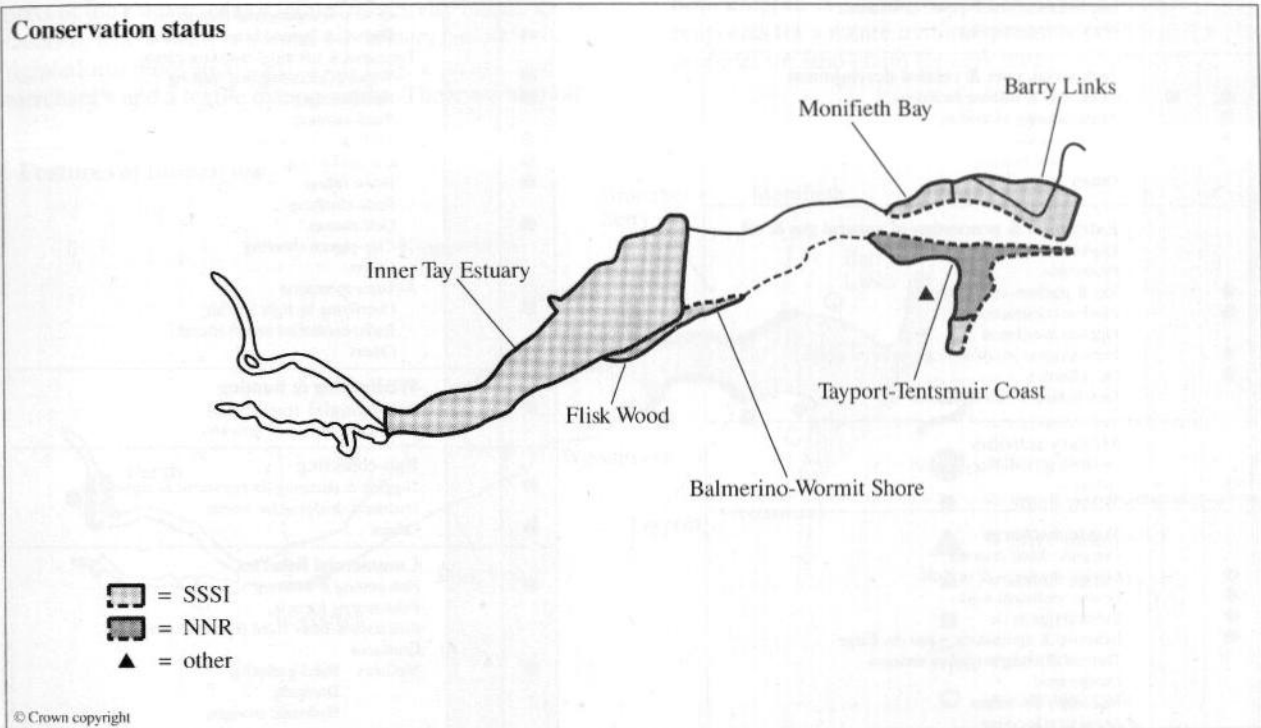
● = designated ● = proposed

No.	NCR	GCR	SSSI (B)	SSSI (G)	SSSI (M)	NNR	LNR	Ramsar	SPA	AONB	CWT	RSPB	ESA	NP	WWT	NT	NSA	HC	Other	
	●	●	●	●	●	●	●	●	●											●
	2	4	3	1	2	1	1	1	1											1

Much of the estuary is covered by Sites of Special Scientific Interest. Biological SSSIs include Monifieth Bay (213 ha), Flisk Wood (63 ha) and the Inner Tay Estuary (5,400 ha). Barry Links (1,041 ha) and Tayport-Tentsmuir Coast (1,044 ha) are SSSIs for their biological and geomorphological interest, and most of the Tayport-Tentsmuir Coast is a National Nature Reserve. Balmerino-Wormit Shore (85 ha) is a geological SSSI.

Tentsmuir Point and the Inner Tay Estuary are also Nature Conservation Review sites, and there are four Geological Conservation Review sites within the estuary: Barry Links, Tentsmuir, Balmerino-Wormit and Carey. In addition, Tentsmuir is owned by the Forestry Commission.

There is also a proposal to designate part of the estuary as a Local Nature Reserve, and the Firth of Tay is proposed as both a Ramsar site and Special Protection Area.



Human activities

Present	Proposed	
●		Coast protection & sea defences Linear defences Training walls Groynes Brushwood fences <i>Spartina</i> planting Marram grass planting
		Barrage schemes Weirs & barrages for river management Storm surge barrages Water storage barrages & bunds Leisure barrages Tidal power barrages
		Power generation Thermal power stations Import/export jetties (power generation) Wind-power generation
●	●	Industrial, port & related development Dock, port & harbour facilities Manufacturing industries Chemical industries Ship & boat building Others
●		Extraction & processing of natural gas & oil Exploration Production Rig & platform construction Pipeline construction Pipeline installation Import/export jetties & single-point moorings Oil refineries Mothballing of rigs & tankers
●		Military activities Overflying by military aircraft Others
●		Waste discharge Domestic waste disposal Sewage discharge & outfalls Sewage treatment works Rubbish tips Industrial & agricultural waste discharge Thermal discharges (power stations) Dredge spoil Accidental discharges Aerial crop spraying Waste incinerators Others
●		Sediment extraction Capital dredging Maintenance dredging Commercial estuarine aggregates extraction Commercial terrestrial aggregates extraction Non-commercial aggregates extraction Hard-rock quarrying
●		Transport & communications Airports & helipads Tunnels, bridges & aqueducts Causeways & fords Road schemes Ferries Cables
●		Urbanisation Land-claim for housing & car parks
●		Education & scientific research Sampling, specimen collection & observation Nature trails & interpretative facilities Seismic studies & geological test drilling Marine & terrestrial archaeology Fossil collecting

Present	Proposed	
●	●	Tourism & recreation Infrastructure developments Marinas Non-marina moorings Dinghy & boat parks Caravan parks & chalets Leisure centres, complexes & piers Aquatic-based recreation Power-boating & water-skiing Jet-skiing Sailing Sailboarding & wind-surfing SCUBA & snorkelling Canoeing Surfing Rowing Tourist boat trips/leisure barges Angling Other non-commercial fishing Bathing & general beach recreation Terrestrial & intertidal-based recreation Walking, including dog walking Bird-watching Sand-yachting 4WD & trial-biking Car sand-racing Horse-riding Rock-climbing Golf courses Clay-pigeon shooting Others Airborne recreation Overflying by light aircraft Radio-controlled model aircraft Others
●		Wildfowling & hunting Wildfowling Other hunting-related activities
●		Bait-collecting Digging & pumping for lugworms & ragworms Hydraulic dredging for worms Others
●		Commercial fisheries Fish-netting & trawling Fyke-netting for eels Fish traps & other fixed devices & nets Crustacea Molluscs – Hand-gathering Dredging Hydraulic dredging
●	●	Cultivation of living resource Saltmarsh grazing Sand dune grazing Agricultural land-claim Fish-farming Shellfish farming Bottom & tray cultivation Suspended cultivation Crustacea farming Reeds for roofing <i>Salicornia</i> picking Others
●		Management & killing of birds & mammals Killing of mammals Killing of birds Adult fish-eating birds Adult shellfish-eating birds Gulls Geese
●		Wildlife habitat management <i>Spartina</i> control Habitat creation & restoration Marine Intertidal Terrestrial Habitat management
●		Others

Features of human use

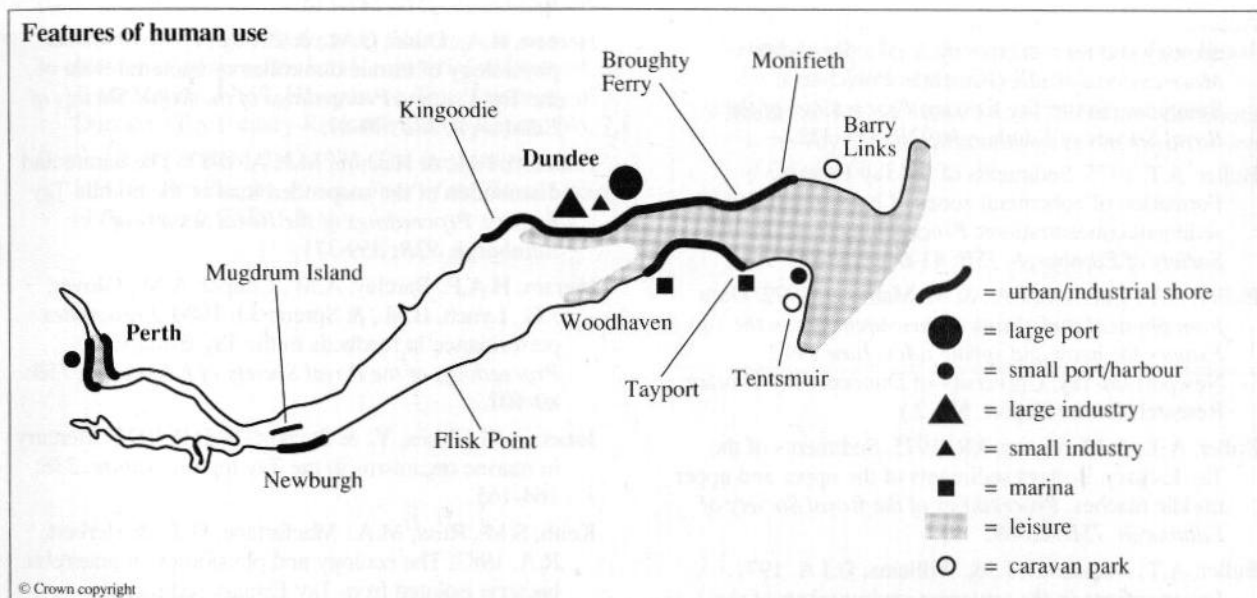
Leisure activities are numerous on the Firth of Tay, with aquatic-based sports centred around the mouth of the estuary and Broughty Ferry, where there are moorings, dinghy parks, and a water sports centre. There are also marinas on the southern shore at Woodhaven and Tayport. Land-based pursuits are more widespread, but occur most intensively around Tentsmuir. Such leisure pursuits include beach recreation, walking, 4WD, trial-biking, sand-racing and horse-riding. In addition, there are two golf courses adjacent to the estuary.

Industrial activity includes a large dock at Dundee and small harbours at Perth and Tayport, and dredging for commercial extraction of sediments occurs in several parts of the estuary. Major industrial activity is focused on Dundee, where there is a small oil refinery, an oil rig/platform renovation yard, a gas jetty, a scrap-metal merchant's and a textile dyeing works. There are also oil

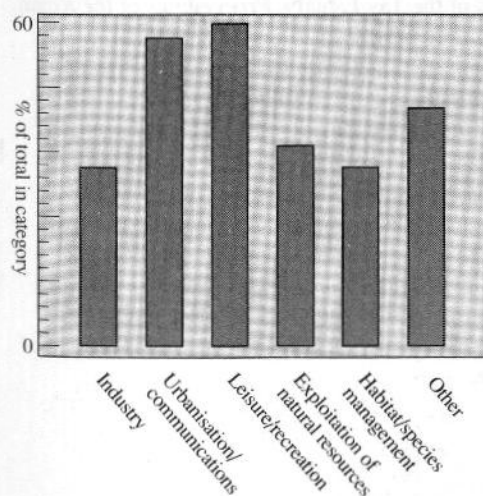
and gas pipelines which cross the Rivers Tay and Earn, and a gas pipe which crosses the estuary mouth.

Exploitation of the natural resources includes saltmarsh grazing at Mugdrum Island and Kingoodie, sand dune grazing at Barry Links and Tentsmuir, and cutting reeds (around 200 ha) for roofing. Seine-netting for salmon also occurs and there is bait-digging at Tayport and Monifieth. Wildfowling shoots over parts of the estuary.

In 1989 there was a proposal for a marina at Newburgh with development of the quays; for using Flisk Point as a dock; for tourist boat trips; for a leisure centre on the sea front at Dundee; and for bird-watching hides at Kingoodie on the proposed Local Nature Reserve. By 1993 the proposals for a leisure centre and for tourist boat trips had been dropped or withdrawn, but there were further proposals for a nature trail/interpretative facility and a proposal for land-claim for agriculture in Tayport Bay.



Categories of human use



Further reading

- Al-Dabbas, M.A.M., & McManus, J. 1987. Shell fragments as indicators of bed sediment transport in the Tay Estuary. *Proceedings of the Royal Society of Edinburgh*, 92B: 335-344.
- Alexander, W.B. 1930. The natural history of the Firth of Tay. *Transactions of the Perthshire Society for Natural Science*, 9: 35-51.
- Alizai, S.A.K., & McManus, J. 1980. The significance of reedbeds on siltation in the Tay Estuary. *Proceedings of the Royal Society of Edinburgh*, 78B: 1-13.
- Al-Jabbari, M.H., McManus, J., & Al-Ansari, N.A. 1980. Sediment and solute discharge into the Tay Estuary from the river system. *Proceedings of the Royal Society of Edinburgh*, 78B: 15-32.
- Anon., ed. 1972. The Forth-Tay Estuaries (an environmental assessment). *Proceedings of the Royal Society of Edinburgh*, 71.
- Anon., ed. 1975. Physical and biological aspects of the Tay Estuary. *Proceedings of the Royal Society of Edinburgh*, 75.
- Atkins, S.M., Jones, A.M., & Garwood, P.R. 1987. The ecology and reproductive cycle of a population of *Marenzelleria viridis* (Annelida: Polychaeta: Spionidae) in the Tay Estuary. *Proceedings of the Royal Society of Edinburgh*, 92B: 311-322.
- Buller, A.T. 1975. Sediments of the Tay Estuary. Formation of ephemeral zones of high suspended sediment concentrations. *Proceedings of the Royal Society of Edinburgh*, 75B: 41-64.
- Buller, A.T., Charlton, J.A., & McManus, J. 1972. *Data from physical and chemical measurements in the Tay Estuary for neap and spring tides, June 1972*. Newport-on-Tay, University of Dundee. (Tay Estuary Research Centre Report, No. 2.)
- Buller, A.T., & McManus, J.R. 1975. Sediments of the Tay Estuary. Bottom sediments of the upper and upper middle reaches. *Proceedings of the Royal Society of Edinburgh*, 75B: 65-89.
- Buller, A.T., McManus, J., & Williams, D.J.A. 1971. *Investigations in the estuarine environments of the Tay. Physical aspects: an interim report*. Newport-on-Tay, University of Dundee. (Tay Estuary Research Centre Report, No. 1.)
- Charlton, J.A. 1981. *Tidal atlas of the outer Tay Estuary*. Newport-on-Tay, University of Dundee. (Tay Estuary Research Centre Report, No. 5.)
- Charlton, J.A., McNicoll, W., & West, J.R. 1975. Tidal and freshwater circulation in the Tay Estuary. *Proceedings of the Royal Society of Edinburgh*, 75B: 11-27.
- Cracknell, A.P., Hayes, L.W.B., & Keltie, G.F. 1987. Remote sensing of the Tay Estuary using visible and near-infrared data: mapping of the intertidal zone. *Proceedings of the Royal Society of Edinburgh*, 92B: 223-236.
- Cunningham, D. 1985. The estuary of the Tay. *Proceedings of the Institution of Civil Engineers*, 120: 299-313.
- Dunn, G.M., Wardell, J.N., Herbert, R.A., & Brown, C.M. 1980. Enrichment, enumeration and characterisation of nitrate-reducing bacteria present in sediments of the River Tay Estuary. *Proceedings of the Royal Society of Edinburgh*, 78B: 47-56.
- Gaertner, A. 1980. Quantitative studies on the marine phycocyanes, chytrids and higher mycelial fungi of the upper Tay Estuary. *Proceedings of the Royal Society of Edinburgh*, 78B: 57-78.
- Green, C.D. 1975. A study of hydraulics and bedforms at the mouth of the Tay Estuary, Scotland. In: *Estuarine Research Vol II: Geology and Engineering*, ed. by le Cronin, 323-344.
- Green, C.D. 1975. Sediments of the Tay Estuary. III. Sedimentological and faunal relationships on the southern shore at the entrance to the Tay. *Proceedings of the Royal Society of Edinburgh*, 75B: 91-112.
- Herbert, R.A. 1975. A preliminary investigation of the effects of salinity on the bacterial flora on the Tay Estuary. *Proceedings of the Royal Society of Edinburgh*, 75B: 137-144.
- Herbert, R.A., Dunn, G.M., & Brown, C.M. 1980. The physiology of nitrate dissimilatory bacterial flora of the Tay Estuary. *Proceedings of the Royal Society of Edinburgh*, 78B: 79-87.
- Hubbard, F.H., & Hashim, M.H.A. 1987. The nature and distribution of the suspended load of the middle Tay Estuary. *Proceedings of the Royal Society of Edinburgh*, 92B: 359-371.
- Ingram, H.A.P., Barclay, A.M., Coupar, A.M., Glover, J.G., Lynch, B.M., & Sprent, J.I. 1980. *Phragmites* performance in reedbeds in the Tay Estuary. *Proceedings of the Royal Society of Edinburgh*, 75B: 89-107.
- Jones, A.M., Jones, Y., & Stewart, W.D.P. 1972. Mercury in marine organisms in the Tay region. *Nature*, 238: 164-165.
- Keith, S.M., Russ, M.A., Macfarlane, G.T., & Herbert, R.A. 1987. The ecology and physiology of anaerobic bacteria isolated from Tay Estuary sediments. *Proceedings of the Royal Society of Edinburgh*, 92B: 323-333.
- Khayrallah, N., & Jones, A.M. 1975. A survey of the benthos of the Tay Estuary. *Proceedings of the Royal Society of Edinburgh*, 75B: 113-135.
- Maitland, P.S., & Smith, I.R. 1987. The river Tay: ecological changes from source to estuary. *Proceedings of the Royal Society of Edinburgh*, 92B: 373-392.
- McManus, J. 1966. Bottom structures of the Tay and other estuaries. *Scottish Geographic Magazine*, 82: 194-197.
- McManus, J. 1968. The hydrology of the Tay basin. In: *Dundee and district*, ed. by S.V. Jones, 107-124. Dundee, British Association for the Advancement of Science.

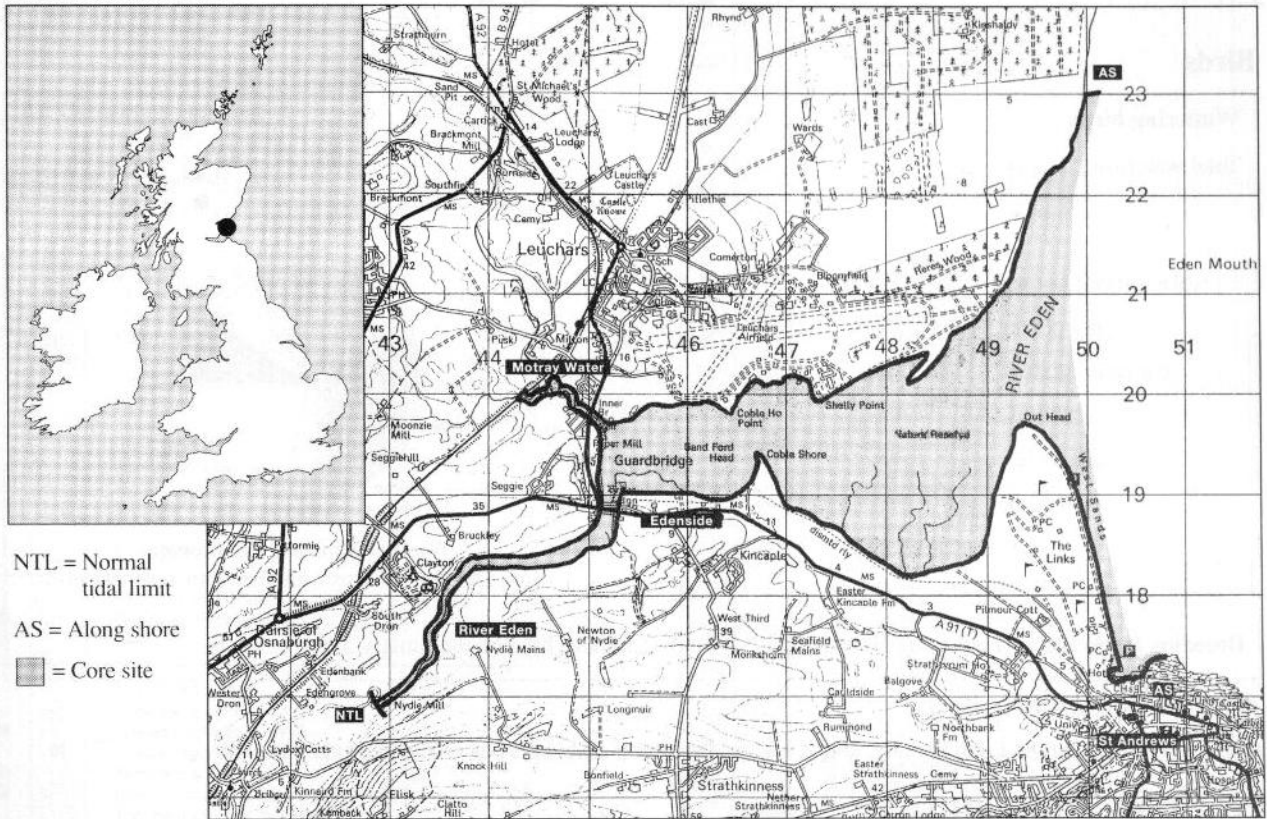
- McManus, J. 1972. Estuarine development and sediment distribution with particular reference to the Tay. *Proceedings of the Royal Society of Edinburgh*, 71B: 97-113.
- McManus, J., & Alizai, S.A.K. 1987. Variations in marsh surface levels in the upper Tay Estuary. *Proceedings of the Royal Society of Edinburgh*, 92B: 345-358.
- Mill, H.R. 1885. Note on the salinity of the Tay Estuary and of St Andrews Bay. *Proceedings of the Royal Society of Edinburgh*, 13: 347-350.
- Nashehi, V., & Williams, D.J.A. 1987. A mathematical model for salt intrusion in the Tay Estuary. *Proceedings of the Royal Society of Edinburgh*, 92B: 285-295.
- Peek, R.J. 1982. Zonation and recolonisation of seaweeds on Newport pier, Tay Estuary, Scotland. In: *Sedimentological, hydrological and biological papers, Blicharski memorial volume*, ed. by J. McManus, 83-90. Newport-on-Tay, University of Dundee. (Tay Estuary Research Centre Report, No. 7.)
- Peek, R.J. 1982. An investigation of copepods in the Tay Estuary. In: *Sedimentological, hydrological and biological papers, Blicharski memorial volume*, ed. by J. McManus, 47-59. Newport-on-Tay, University of Dundee. (Tay Estuary Research Centre Report, No. 7.)
- Pontin, R.A., & Reid, J.A. 1975. The freshwater input into the Tay Estuary. *Proceedings of the Royal Society of Edinburgh*, 75B: 1-9.
- Pounder, B. 1974. Breeding and moulting eiders in the Tay region. *Scottish Birds*, 8: 89-107.
- Ulken, A. 1980. Chytrids in the estuary of the River Tay. *Proceedings of the Royal Society of Edinburgh*, 78B: 155-159.
- Ward, S., & Bullock, D.J. 1988. The winter feeding ecology of the black-tailed godwit - a preliminary study. *Wader Study Group Bulletin*, 53: 11-15.
- Webb, J. 1989. *The movements of adult Atlantic salmon in the River Tay*. Aberdeen, Department of Agriculture and Fisheries for Scotland for Atlantic Salmon Trust. (Scottish Fisheries Research Report, No. 44.)
- Webb, J. 1992. *The behaviour of adult salmon (Salmo salar) in the River Tay as determined by radio telemetry*. Aberdeen, Scottish Office Agriculture and Fisheries Department for Atlantic Salmon Trust. (Scottish Fisheries Research Report, No. 52.)
- West, J.R. 1972. Water movements in the Tay Estuary. *Proceedings of the Royal Society of Edinburgh*, 71: 115-129.
- Williams, D.J.A., & Nassehi, V. 1980. Mathematical tidal model of the Tay Estuary. *Proceedings of the Royal Society of Edinburgh*, 75: 171-182.
- Williams, D.J.A., & West, J.R. 1975. Salinity distribution in the Tay Estuary. *Proceedings of the Royal Society of Edinburgh*, 75B: 29-39.

Description

Centre grid: NO4819
Region: Fife

District: North-east Fife
SNH region: South-east Scotland

Review site location



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Total area (ha)	Intertidal area (ha)	Shore length (km)	Channel length (km)	Tidal range (m)	Geomorph. type	Human population
1,041	937	27.7	11.1	3.7	Bar built	11,000

Description

The Eden is a relatively small estuary south of the Firth of Tay, and receives its freshwater from the River Eden and Motray Water. Water quality within the estuary has been classified as grade 2.

At low tide a narrow subtidal channel meanders across a wide expanse of intertidal flats that are predominantly muddy but become sandy towards the mouth. In the western parts of the estuary the mud is quite glutinous and supports large concentrations of invertebrates, including mussel beds, and eelgrass *Zostera* beds.

There are patches of saltmarsh along the shores of the estuary, with the largest continuous area of saltmarsh at Edenside. A wide range of saltmarsh vegetation

communities are present within the estuary, including a transition to freshwater communities in the upper reaches of the Eden. The cord-grass *Spartina* is invading the saltmarsh in some areas.

The mouth of the estuary is dominated by a spit on the southern shore, and seaward of this spit the intertidal flats become sandy. Sand dune systems flank both shores of the estuary mouth, and the sandflats and dunes of the northern shore are contiguous with the dune systems of Tentsmuir. In addition, the estuary abuts an area of rocky shore at St Andrews.

The Eden Estuary regularly supports nationally important populations of six species of wintering waterfowl.

Wildlife features

Coastal habitats

	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other
	●	●	●	●	●	●				
Area (ha)	104	32	905							

● = major habitat ● = minor habitat

Aquatic estuarine communities

Soft substrate

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
			●	●								●	●	●	

Hard substrate

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33

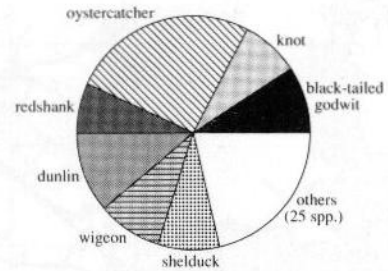
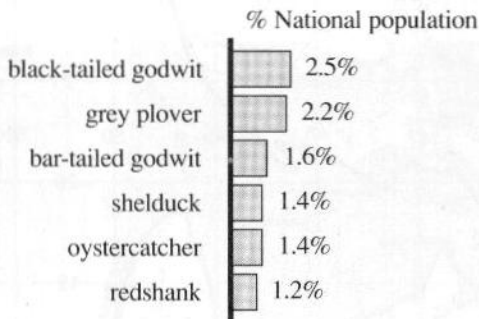
Birds

Wintering birds

Total waterfowl: 16,000

1986/87 – 1990/91 data

BoEE	NWC	WSC
●	●	



Wintering species assemblage
(Spp. forming >5% assemblage shown separately)

Breeding birds: small numbers of ringed plover are known to have bred on the estuary in recent years.

Additional wildlife features

Otters are present on the Eden Estuary, and at low tide common seals haul out on the intertidal flats.

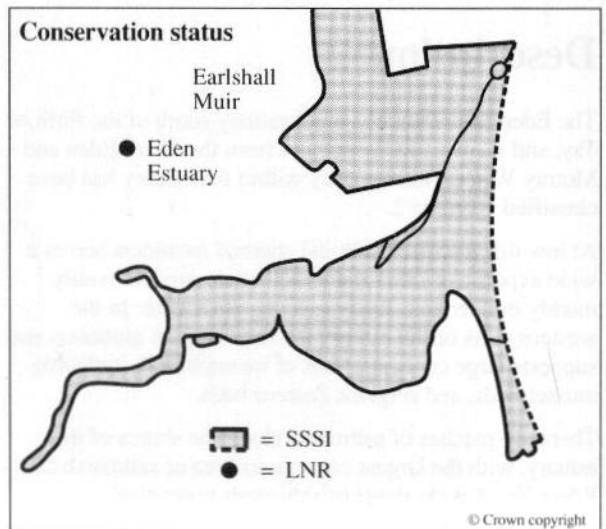
Conservation status

● = designated ● = proposed

No.	NCR	GCR	SSSI (B)	SSSI (G)	SSSI (M)	NNR	LNR	Ramsar	SPA	AONB	CWT	RSPB	ESA	NP	WWT	NT	NSA	HC	Other
1	●		●				●	●	●										

The estuary lies within the Eden Estuary biological Site of Special Scientific Interest (1,161 ha) which in part is a Nature Conservation Review site, and overlaps in part with the Earlshall Muir biological SSSI (370 ha). The estuary is also a Local Nature Reserve.

The Eden Estuary forms part of the proposed Eden Estuary, Tentsmuir Point and Abertay Sands Ramsar site and proposed Special Protection Area.



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Human activities

Present	Proposed	
●		Coast protection & sea defences Linear defences Training walls Groynes Brushwood fences <i>Spartina</i> planting Marram grass planting
●		Barrage schemes Weirs & barrages for river management Storm surge barrages Water storage barrages & bunds Leisure barrages Tidal power barrages
		Power generation Thermal power stations Import/export jetties (power generation) Wind-power generation
●		Industrial, port & related development Dock, port & harbour facilities Manufacturing industries Chemical industries Ship & boat building Others
		Extraction & processing of natural gas & oil Exploration Production Rig & platform construction Pipeline construction Pipeline installation Import/export jetties & single-point moorings Oil refineries Mothballing of rigs & tankers
●		Military activities Overflying by military aircraft Others
●	●	Waste discharge Domestic waste disposal Sewage discharge & outfalls Sewage treatment works Rubbish tips Industrial & agricultural waste discharge Thermal discharges (power stations) Dredge spoil Accidental discharges Aerial crop spraying Waste incinerators Others
●		Sediment extraction Capital dredging Maintenance dredging Commercial estuarine aggregates extraction Commercial terrestrial aggregates extraction Non-commercial aggregates extraction Hard-rock quarrying
●		Transport & communications Airports & helipads Tunnels, bridges & aqueducts Causeways & fords Road schemes Ferries Cables
		Urbanisation Land-claim for housing & car parks
●	●	Education & scientific research Sampling, specimen collection & observation Nature trails & interpretative facilities Seismic studies & geological test drilling Marine & terrestrial archaeology Fossil collecting

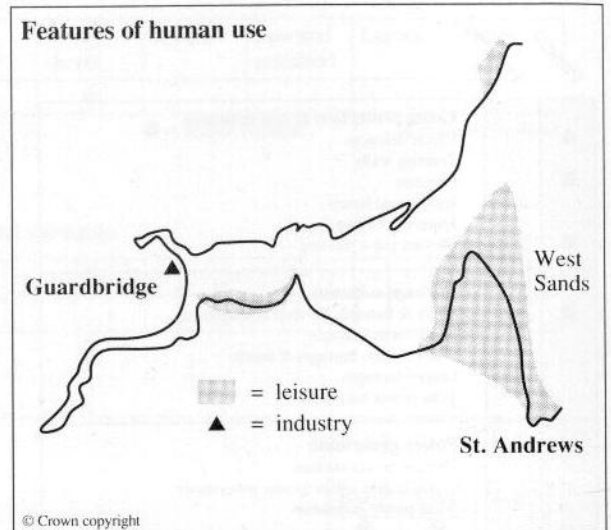
Present	Proposed	
		Tourism & recreation Infrastructure developments Marinas Non-marina moorings Dinghy & boat parks Caravan parks & chalets Leisure centres, complexes & piers Aquatic-based recreation Power-boating & water-skiing Jet-skiing Sailing Sailboarding & wind-surfing SCUBA & snorkelling Canoeing Surfing Rowing Tourist boat trips/leisure barges Angling Other non-commercial fishing Bathing & general beach recreation Terrestrial & intertidal-based recreation Walking, including dog walking Bird-watching Sand-yachting 4WD & trial-biking Car sand-racing Horse-riding Rock-climbing Golf courses Clay-pigeon shooting Others Airborne recreation Overflying by light aircraft Radio-controlled model aircraft Others
●		Wildfowling & hunting Wildfowling Other hunting-related activities
●		Bait-collecting Digging & pumping for lugworms & ragworms Hydraulic dredging for worms Others
●	●	Commercial fisheries Fish-netting & trawling Fyke-netting for eels Fish traps & other fixed devices & nets Crustacea Molluscs - Hand-gathering Dredging Hydraulic dredging
●		Cultivation of living resource Saltmarsh grazing Sand dune grazing Agricultural land-claim Fish-farming Shellfish farming Bottom & tray cultivation Suspended cultivation Crustacea farming Reeds for roofing <i>Salicornia</i> picking Others
●		Management & killing of birds & mammals Killing of mammals Killing of birds Adult fish-eating birds Adult shellfish-eating birds Gulls Geese
●		Wildlife habitat management <i>Spartina</i> control Habitat creation & restoration Marine Intertidal Terrestrial Habitat management
		Others

Features of human use

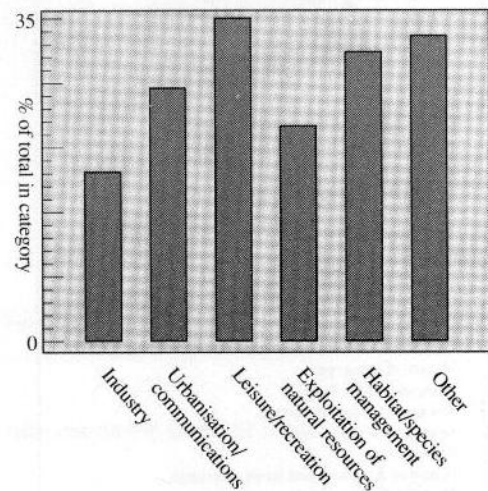
Leisure activities are numerous on the Eden Estuary. All water sports (except canoeing) are prohibited within the Local Nature Reserve, and so these occur only on West Sands outside the estuary mouth. Most beach recreation also occurs here along with sand-yachting, and horse-riding occurs along the shore around Guardbridge. There are also several golf courses on the dune systems around the estuary, including the St Andrews' golf course.

Industrial activities on the Eden Estuary include a paper mill at Guardbridge which discharges effluent into the estuary, and small-scale sand and gravel extraction by landowners. Exploitation of the natural resources includes grazing by horses over 10 ha of saltmarsh, bait-digging over the lower reaches of the estuary, and in 1989 an application for bottom/tray cultivation of mussels had been consented. Wildfowling also occurs in the Local Nature Reserve, but there are two sanctuary areas within the estuary where no shooting is permitted.

Military activities also take place on and adjacent to RAF Leuchars on the northern shore and in St Andrews Bay.



Categories of human use



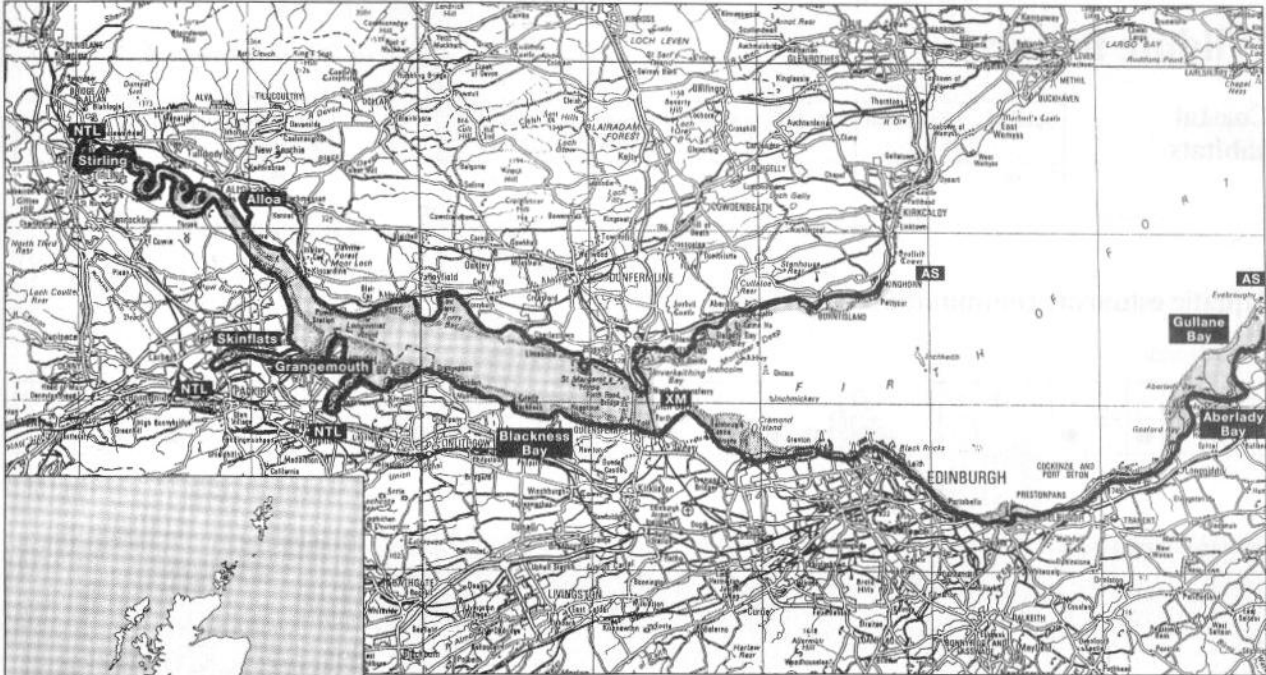
Further reading

- Adams, J.A., & Grierson, R.J. 1974. *The Eden Estuary*. Unpublished, Department of Agriculture and Fisheries for Scotland, Aberdeen. (Marine Laboratory Internal Report, New Series, No. 4.)
- Ahmad, W.A. 1990. *Assessment of some remote sensing techniques for recognition of sediment distributions in Montrose Basin and the Eden Estuary, Scotland*. Ph.D. thesis, University of Dundee.
- Burd, F. 1987. *Saltmarsh survey of Great Britain. South-east Scotland regional report*. Unpublished, Nature Conservancy Council.
- Jarvis, J. 1989. Sediment transport in St Andrews Bay and the mouth of the Eden Estuary. In: *Developments in estuarine and coastal study techniques*. Fredensborg, Olsen & Olsen.
- Johnston, J.P., Cobb, J.L.S., & Bell, P. 1979. *Survey of the shorebird feeding distribution and movements on the Eden estuary, North-East Fife, including a study of the invertebrate food source*. (Contractor: University of St Andrews, Gatty Marine Laboratory, St Andrews.) Unpublished report to the Nature Conservancy Council South-east Scotland Region, Edinburgh.
- North-east Fife District Council. 1992. *Eden Estuary Local Nature Reserve Management Plan 1987 - March 1992*. North-east Fife District Council.
- Tay River Purification Board. 1989. *Biological survey of the inner Eden Estuary*. Unpublished, Tay River Purification Board.
- Ward, S., & Bullock, D.J. 1988. The winter feeding ecology of the black-tailed godwit - a preliminary study. *Wader Study Group Bulletin*, 53: 11-15.

Centre grid: NT0182
Regions: Central,
Fife, Lothian

Districts: Clackmannan, Falkirk, Sterling, Dunfermline,
Kirkcaldy, East Lothian, Edinburgh, West Lothian
SNH region: South-east Scotland

Review site location



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NTL = Normal tidal limit
XM = Across mouth
AS = Along shore
■ = Core site

Total area (ha)	Intertidal area (ha)	Shore length (km)	Channel length (km)	Tidal range (m)	Geomorph. type	Human population
8,401	4,798	272.5	54.8	4.8	Complex	612,000

Description

The Firth of Forth is the largest estuary on the east coast of Scotland, and flows eastwards past the cities of Stirling and Edinburgh. The shores of the estuary are heavily developed in parts, for example at Grangemouth and Edinburgh, and the estuary has suffered severe industrial pollution. Water quality within the estuary is varied, for the upper parts of the Forth have been classified as grade 4, with various other tributaries classified in parts as grades 2 or 4.

The Firth of Forth is complex estuary, with a narrow meandering channel in its upper parts that opens into a

sheltered area of bays and extensive intertidal mudflats that support a rich invertebrate fauna. In places there are scattered mussel beds and rocky outcrops, such as in Blackness Bay, where there are also patches of the eelgrass *Zostera*.

At various locations within the estuary there are small areas of saltmarsh, particularly where freshwater tributaries enter the Firth. The most extensive areas of saltmarsh lie along the shore between Alloa and Grangemouth, and within Aberlady Bay. A variety of saltmarsh vegetation communities are present in many of

the saltmarshes, ranging from pioneer and low-mid marsh communities through to upper marsh and freshwater transition. Also of note is a tidal reedbed on the Alloa Inches, in the upper reaches of the estuary, and a series of brackish lagoons at Skinflats.

Eastwards of the Forth Bridge the estuary widens into a series of varied, more exposed bays. Here the intertidal flats are predominantly sandy and the shoreline more varied, with rocky outcrops, sand-and-shingle intertidal flats, mussel beds and artificial sea walls. On the

easternmost part of the southern shore is Aberlady Bay, an extensive complex of mudflat, saltmarsh and sand dune. Further north lies Gullane Bay, the largest and most complex dune system in the Lothians. This area is known to support an unusually large number of plants that includes many Scottish rarities, and to sustain a diverse invertebrate fauna.

The Firth of Forth also supports very large numbers of wintering waterfowl, which include five internationally important and fifteen nationally important populations.

Wildlife features

Coastal habitats

	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other
	●	●	●	●	●	●	●	●	●	
Area (ha)	3,603	173	4,325							

● = major habitat ● = minor habitat

Aquatic estuarine communities

Soft substrate

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	●		●		●							●	●	●	

Hard substrate

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
	●			●	●							●				



The Firth of Forth is one of the few estuaries in North and east Scotland with a relatively large area of intertidal flats. (S.M. Atkins, SNH)

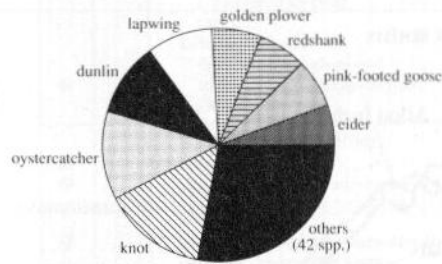
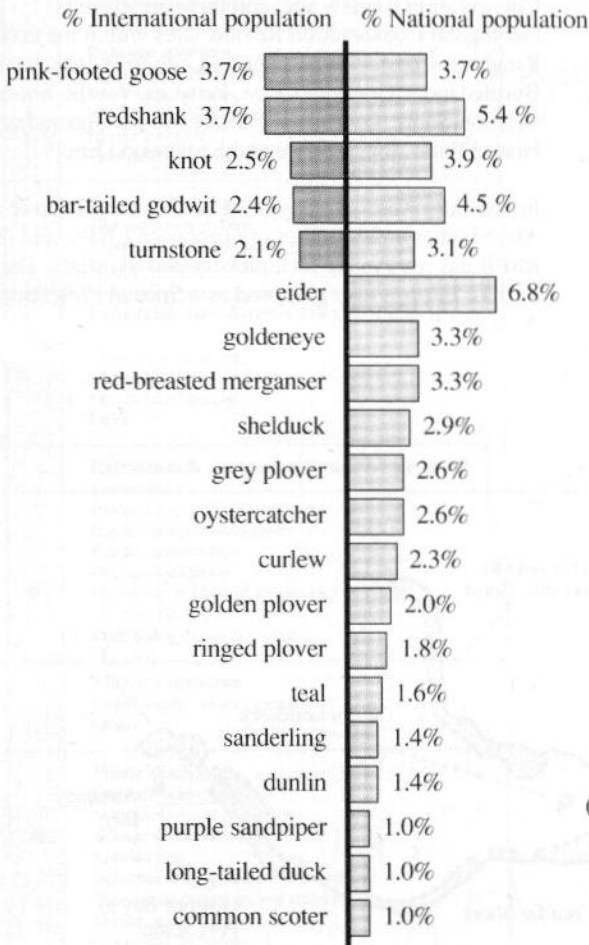
Birds

Wintering birds

1986/87 – 1990/91 data

Total waterfowl: 60,100

BoEE	NWC	WSC
●	●	



Breeding birds: there are small colonies of little tern and arctic tern within the Firth of Forth. The saltmarshes support high densities of breeding redshank, moderate densities of lapwing and low densities of breeding oystercatcher. In addition low numbers of ringed plover breed within the estuary.

Other: the Firth of Forth is known to regularly support a large flock of post-breeding shelduck, which is a rare feature in Britain.

Additional wildlife features

The invertebrate fauna recently recorded within the estuary includes eight Notable species.

Conservation status

● = designated ● = proposed

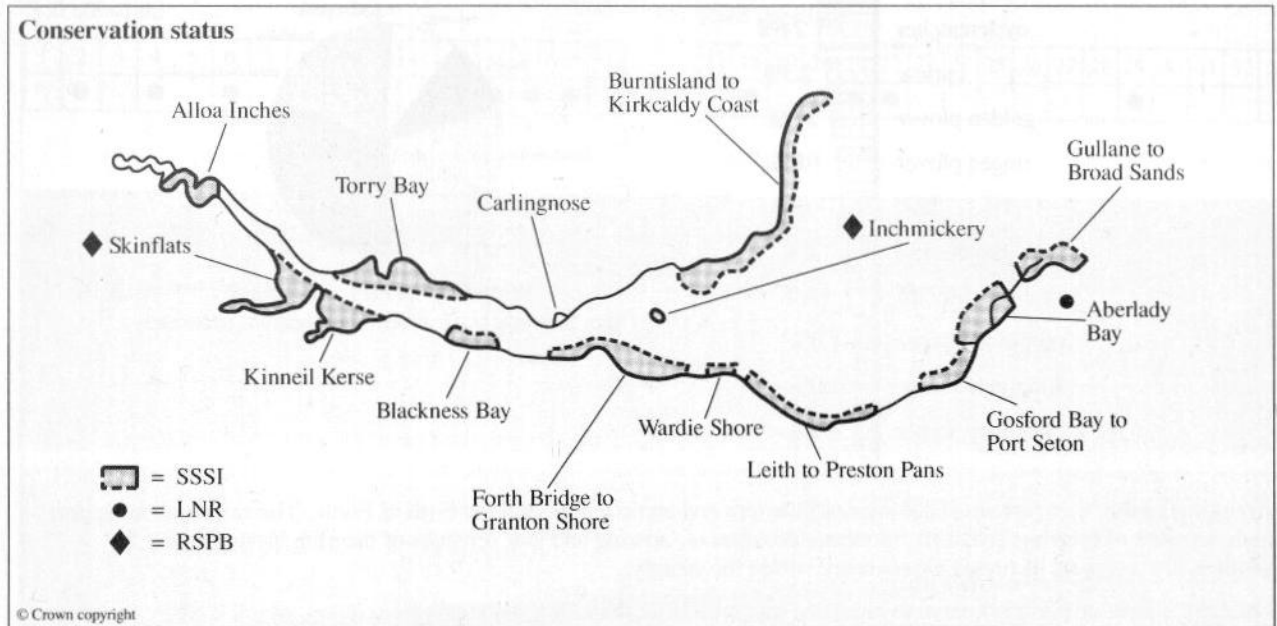
No.	NCR	GCR	SSSI (B)	SSSI (G)	SSSI (M)	NNR	LNR	Ramsar	SPA	AONB	CWT	RSPB	ESA	NP	WWT	NT	NSA	HC	Other
	●	●	●	●	●		●	●	●			●							
	2	11	8	1	5		1	1	1			2							

A large proportion of the estuary lies within Sites of Special Scientific Interest. Biological SSSIs include Alloa Inches (316 ha), Torry Bay (620 ha), Carlingnose (6 ha), Skinflats (543 ha), Kinneil Kerse (786 ha), Blackness Bay (190 ha), Inchmickery (5 ha) and Gosford Bay to Port Seton (318 ha).

Burntisland to Kirkcaldy Coast (372 ha), Forth Bridge to Granton Shore (742 ha), Leith to Prestonpans (287 ha), Aberlady Bay (866 ha) and Gullane to Broad Sands (294 ha) are SSSIs for their biological and geological interest, and Wardie Shore (12 ha) is a geological SSSI. The Upper Firth Saltmarshes are proposed as an SSSI.

Several of these SSSIs make up the Firth of Forth Nature Conservation Review site, and there are eleven Geological Conservation Review sites within the estuary: Kinghorn Coast, Granton Shore, Leith to Prestonpans, Burntisland - Kinghorn Coast, Pettycur, Wardie Shore, Granton Shore, Queensferry Shore, South Queensferry - Hound Point, Joppa Shore and Kingswood End.

In addition, Aberlady Bay is a Local Nature Reserve and Alloa Inches and Skinflats are proposed LNRs, and the RSPB has reserves at Inchmickery and Skinflats. The Firth of Forth is also proposed as a Special Protection Area and Ramsar site.

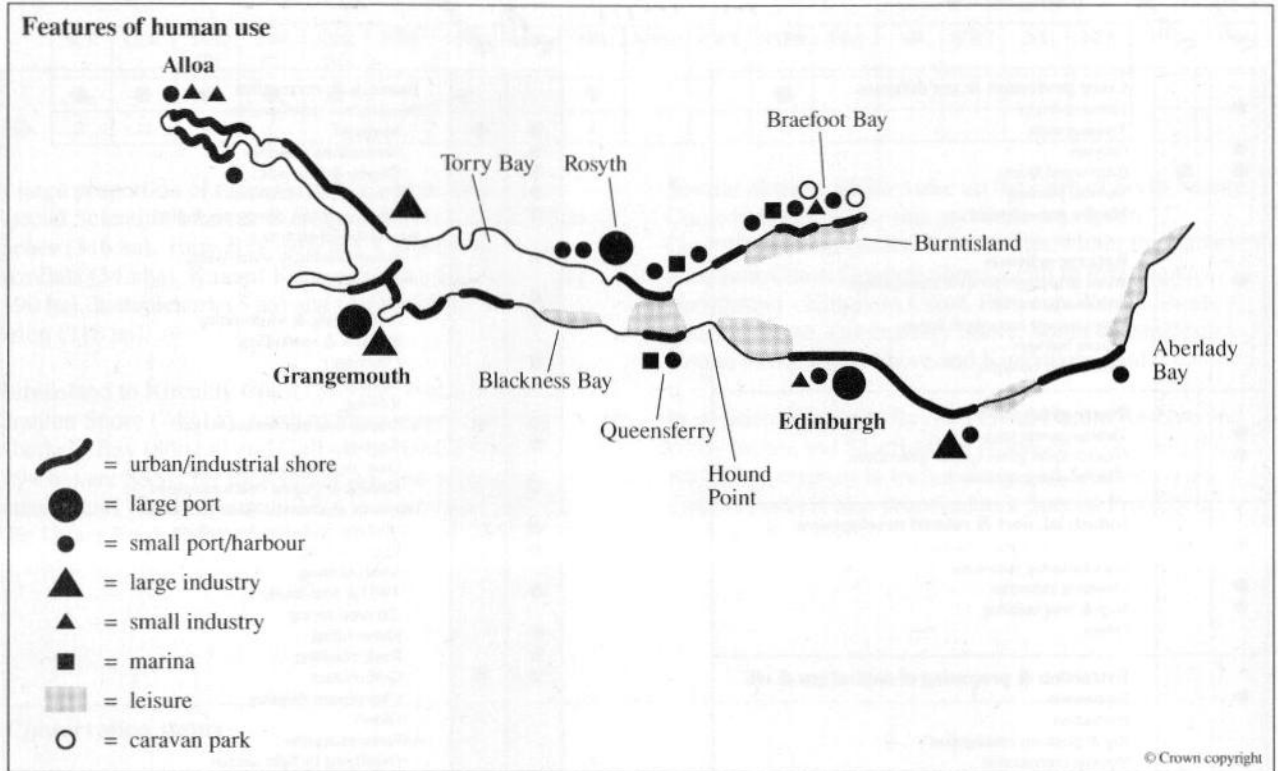


Human activities

Present	Proposed	
●		Coast protection & sea defences Linear defences Training walls Groyne Brushwood fences <i>Spartina</i> planting Marram grass planting
●		Barrage schemes Weirs & barrages for river management Storm surge barrages Water storage barrages & bunds Leisure barrages Tidal power barrages
●		Power generation Thermal power stations Import/export jetties (power generation) Wind-power generation
●	●	Industrial, port & related development Dock, port & harbour facilities Manufacturing industries Chemical industries Ship & boat building Others
●	●	Extraction & processing of natural gas & oil Exploration Production Rig & platform construction Pipeline construction Pipeline installation Import/export jetties & single-point moorings Oil refineries Mothballing of rigs & tankers
●		Military activities Overflying by military aircraft Others
●	●	Waste discharge Domestic waste disposal Sewage discharge & outfalls Sewage treatment works Rubbish tips Industrial & agricultural waste discharge Thermal discharges (power stations) Dredge spoil Accidental discharges Aerial crop spraying Waste incinerators Others
●	●	Sediment extraction Capital dredging Maintenance dredging Commercial estuarine aggregates extraction Commercial terrestrial aggregates extraction Non-commercial aggregates extraction Hard-rock quarrying
●	●	Transport & communications Airports & helipads Tunnels, bridges & aqueducts Causeways & fords Road schemes Ferries Cables
	●	Urbanisation Land-claim for housing & car parks
●	●	Education & scientific research Sampling, specimen collection & observation Nature trails & interpretative facilities Seismic studies & geological test drilling Marine & terrestrial archaeology Fossil collecting

Present	Proposed	
●	●	Tourism & recreation Infrastructure developments Marinas Non-marina moorings Dinghy & boat parks Caravan parks & chalets Leisure centres, complexes & piers Aquatic-based recreation Power-boating & water-skiing Jet-skiing Sailing Sailboarding & wind-surfing SCUBA & snorkelling Canoeing Surfing Rowing Tourist boat trips/leisure barges Angling Other non-commercial fishing Bathing & general beach recreation Terrestrial & intertidal-based recreation Walking, including dog walking Bird-watching Sand-yachting 4WD & trial-biking Car sand-racing Horse-riding Rock-climbing Golf courses Clay-pigeon shooting Others Airborne recreation Overflying by light aircraft Radio-controlled model aircraft Others
●		Wildfowling & hunting Wildfowling Other hunting-related activities
●		Bait-collecting Digging & pumping for lugworms & ragworms Hydraulic dredging for worms Others
●		Commercial fisheries Fish-netting & trawling Fyke-netting for eels Fish traps & other fixed devices & nets Crustacea Molluscs – Hand-gathering Dredging Hydraulic dredging
●		Cultivation of living resource Saltmarsh grazing Sand dune grazing Agricultural land-claim Fish-farming Shellfish farming Bottom & tray cultivation Suspended cultivation Crustacea farming Reeds for roofing <i>Salicornia</i> picking Others
●	●	Management & killing of birds & mammals Killing of mammals Killing of birds Adult fish-eating birds Adult shellfish-eating birds Gulls Geese
●		Wildlife habitat management <i>Spartina</i> control Habitat creation & restoration Marine Intertidal Terrestrial Habitat management
●		Others

Features of human use



Numerous leisure activities occur on the estuary. Water sports are widespread and focus around areas where there are moorings or marinas, for example at Queensferry, Granton, and Blackness Bay. Beach recreation is limited to the outer estuary, and in Aberlady Bay leisure pursuits are restricted.

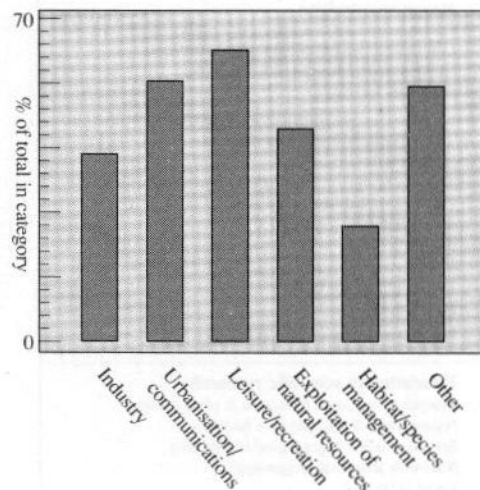
Exploitation of the natural resources includes netting for fish, commercial hand-gathering of winkles and mussels from rocky shores, and bait-digging for worms, which is extensive on the southern shore. Other forms of bait-collecting are not intensive. Wildfowling occurs over much of the estuary. On the northern shore there are no organised clubs but individuals shoot over Torry Bay. On the southern shore there is restricted shooting over Cramond and Aberlady Bay.

Industry is widespread over the Forth, with major dockyards at Leith and Grangemouth and a naval dockyard at Rosyth which includes a ship-building/repair yard. There are also many other small ports, harbours and jetties on the estuary. Industrial sites include two coal power stations, each with its associated import/export jetty, and chemical industries at Granton, Burntisland, Grangemouth, Alloa and Cambus. There is also an oil refinery at Grangemouth with a pipeline to Hound Point and a deep water anchorage for tankers, and there is an oil terminal at Braefoot Bay. Exploration for oil is continuing in the outer and inner Firth.

In 1989 there were proposals for jetty development at Grangemouth with associated capital dredging, a sewage treatment works at Carriden, a road scheme at Kincardine Bridge, development of a hotel and leisure complex at

Wardie Bay, marinas, golf courses and several habitat creation/translocation schemes. By 1993 proposals for two of the three golf courses had been turned down or dropped, as had three of the proposed marinas. One marina had undergone construction and the proposal for a hotel and leisure complex at Wardie had been dropped in favour of housing only. There have been further recent proposals for a barrage and associated recreation, a new Forth Road Bridge, and development of housing and light industry at Port Edgar/Queensferry which would involve some land-claim.

Categories of human use



Further reading

- Anderson, K.J., & Read, P.A. 1974. Pollution studies in the Firth of Forth. *Marine Pollution Bulletin*, 5: 121-125.
- Assie, L.C., McIntosh, A.D., Davies, J.M., & Mackie, P.R. 1987. Hydrocarbons and their microbial degradation in the Firth of Forth. *Proceedings of the Royal Society of Edinburgh*, 93B: 566-567.
- Bagheri, E.A., & McLusky, D.S. 1982. Population dynamics of oligochaetes and small polychaetes in the polluted Forth Estuary ecosystem. *Netherlands Journal of Sea Research*, 16: 55-66.
- Bailey, S.K., & Davies, I.M. 1987. Tributyl tin contamination in the Firth of Forth. *Proceedings of the Royal Society of Edinburgh*, 93B: 561-562.
- Browne, M.A.E. 1987. Physical geography and geology of the estuary and Firth of Forth. *Proceedings of the Royal Society of Edinburgh*, 93B: 235-244.
- Bryant, D.M. 1979. Effects of prey density and site character on estuary usage by overwintering waders. *Estuarine and Coastal Shelf Science*, 9: 369-384.
- Bryant, D.M. 1987. Wading birds and wildfowl of the estuary and Firth of Forth, Scotland. *Proceedings of the Royal Society of Edinburgh*, 93B: 509-520.
- Campbell, L.H. 1978. Patterns of distribution and behaviour of flocks of seaducks wintering at Leith and Musselburgh, Scotland. *Biological Conservation*, 14: 111-124.
- Campbell, L.H. 1984. The impact of changes in sewage treatment in seaducks wintering in the Firth of Forth, Scotland. *Biological Conservation*, 28: 173-180.
- Campbell, L.H., Stranding, K.Y., & Cadbury, C.J. 1978. Firth of Forth oil pollution incident February 1978. *Marine Pollution Bulletin*, 9: 335-339.
- Caulton, E., & Mocogni, M. 1987. Maritime litter studies in the Firth of Forth. *Proceedings of the Royal Society of Edinburgh*, 93B: 561.
- Clark, G.K. 1987. Preliminary investigation of the heavy metal content of *Capitella capitata* (polychaete, annelid) from Largo Bay, Firth of Forth and Garroch Head sludge dump site, Firth of Forth. *Proceedings of the Royal Society of Edinburgh*, 93B: 563.
- Clarke, W.E. 1895. Some fishes new to or rare in the Firth of Forth. *Annals of Scottish Natural History*, 4: 23-28.
- Collett, W.F. 1972. The quality of the Forth Estuary. *Proceedings of the Royal Society of Edinburgh*, 71B: 137-141.
- Covill, R.W. 1972. The quality of the Forth Estuary. *Proceedings of the Royal Society of Edinburgh*, 71B: 143-70.
- Covill, R.W., Davies, A.W., & Chander, J.R. 1970. Parameters of marine pollution in the Forth Estuary. *Journal of the Water Pollution Control Federation*, 69: 12-29.
- Craig, R.E. 1972. Water movements in the Firth of Forth. *Proceedings of the Royal Society of Edinburgh*, 71B: 131-135.
- Elliott, M., & Kingston, P.F. 1987. The sublittoral benthic fauna of the estuary of the Firth of Forth, Scotland. *Proceedings of the Royal Society of Edinburgh*, 93B: 449-466.
- Elliott, M., O'Reilly, M.G., & Taylor, C.J.L. 1990. The Forth Estuary: a nursery and overwintering area for North Sea fishes. *Hydrobiologia*, 195: 89-103.
- Elliott, M., & Taylor, C.J.L. 1989. The production ecology of the subtidal benthos of the Forth Estuary, Scotland. *Scientia Marina*, 53: 531-541.
- Elliott, M., & Taylor, C.J.L. 1989. The structure and functioning of an estuarine/marine fish community in the Forth Estuary, Scotland. *Proceedings of the 21st European Marine Biological Symposium, Polish Academy of Sciences*, 227-240.
- Forth River Purification Board. 1987. The estuary and Firth of Forth. Background paper for presentation and tour. In: *International conference on the North Sea 1987: international meeting of senior officials (IMSO), 15-16 September*. Edinburgh, Forth River Purification Board.
- Gordon, N.J. 1987. Selection and management of sites of nature conservation importance in the Forth Estuary and Firth, Scotland. *Proceedings of the Royal Society of Edinburgh*, 93B: 545-557.
- Griffiths, A.H. 1987. Water quality of the estuary and Firth of Forth, Scotland. *Proceedings of the Royal Society of Edinburgh*, 93B: 303-314.
- Howarth, D., & Bryant, D.M. 1988. Spatial and temporal changes in bird populations on the Estuary and Firth of Forth: 1969-1986. *Nature Conservancy Council, CSD Report*, No. 841.
- Howard, F.G., McKay, D.W., & Newton, A.W. 1987. Fisheries of the Forth, Scotland. *Proceedings of the Royal Society of Edinburgh*, 93B: 479-494.
- Johnston, C.S. 1972. Macroalgae and their environment. *Proceedings of the Royal Society of Edinburgh*, 71B: 195-207.
- Johnston, R., & Davies, I.M. 1975. The fortunes of the Firth of Forth. *Scottish Fisheries Bulletin*, 42: 18-22.
- Knight, S.J.T., & Johnston, C.S. 1981. Effects of pollution on the seaweed distribution in the Firth of Forth. *Proceedings of the International Seaweed Symposium*, 8: 383-387. Menai Bridge, Marine Science Laboratories.
- Leatherland, T.M. 1987. The estuary and Firth of Forth, Scotland: uses and aims. *Proceedings of the Royal Society of Edinburgh*, 93B: 285-298.
- McLusky, D. 1987. Intertidal habitats and benthic macrofauna of the Forth Estuary. *Proceedings of the Royal Society of Edinburgh*, 93B: 389-399.
- McLusky, D. 1987. The natural environment of the estuary and Firth of Forth. *Proceedings of the Royal Society of Edinburgh*, 93B.
- McLusky, D., Bryant, D.M., Berry, A.J., & Proctor, J. [1991]. *Forth estuary publications*. Stirling, University of Stirling, Department of Biological and Molecular Sciences.

- McLusky, D.S., Bryant, D.M., & Elliott, M. 1992. The impact of land-claim on macrobenthos, fish and shorebirds on the Forth Estuary, eastern Scotland. *Aquatic Conservation*, 2: 211-222.
- Parnell, R. 1938. On the natural and economic history of the fishes of the river district of the Firth of Forth. *Memoirs of the Wernerian Natural History Society*, 7: 161-520.
- Poxton, M.G. 1987. Fishery studies in the estuary and Firth of Forth, Scotland. *Proceedings of the Royal Society of Edinburgh*, 93B: 495-508.
- Proctor, J., Fraser, M.W., & Thompson, J. 1982. Saltmarshes of the upper Forth Estuary. *Transactions of the Botanical Society of Edinburgh*, 44: 95-102.
- Ratray, J. 1986. The distribution of the marine algae of the Firth of Forth. *Transactions and Proceedings of the Botanical Society of Edinburgh*, 16: 421-466.
- Read, P. 1987. The intertidal benthos and sediments of particulate shores in the Firth of Forth, Scotland. *Proceedings of the Royal Society of Edinburgh*, 93B: 401-414.
- Read, P.A., Anderson, K.J., Matthews, J.E., Watson, P.G., Halliday, M.S., & Shiells, G.M. 1982. Water quality in the Firth of Forth. *Marine Pollution Bulletin*, 13: 421-425.
- Read, P.A., Anderson, K.J., Matthews, J.E., Watson, P.G., Halliday, M.C., & Shiells, G.M. 1983. Effects of pollution on the benthos of the Firth of Forth. *Marine Pollution Bulletin*, 14: 12-16.
- Smith, S.M. 1970. *Ensis* from the Firth of Forth. *Journal of Conchology*, 27: 127-129.
- Smith, S.M. 1974. Mollusca dredged off Musselburgh, Firth of Forth, Scotland in 1972, with particular reference to the population of *Spinosa solida*. *Journal of Conchology*, 28: 217-224.
- Symonds, F.L., Langslow, D., & Pienkowski, M. 1984. Movements of wintering shorebirds within the Firth of Forth; species differences in usage of an intertidal complex. *Biological Conservation*, 28: 187-215.
- Taylor, C.J.L. 1990. The zooplankton of the Forth, Scotland. *Proceedings of the Royal Society of Edinburgh*, 93: 377-388.
- Thomas, H.J., & Saville, A. 1972. The fisheries of the Forth-Tay estuaries. *Proceedings of the Royal Society of Edinburgh*, 71B: 171-188.
- Traill, G.W. 1880. The algae of the Forth. *Proceedings of the Royal Physical Society of Edinburgh*, 5: 171-189.
- Webb, A.J., & Metcalfe, A.P. 1987. Physical aspects, water movements and modelling studies of the Forth Estuary, Scotland. *Proceedings of the Royal Society of Edinburgh*, 93B: 259-272.
- Wilkinson, M., Scanlan, C.M., & Tittley, I. 1987. The attached algal flora of the estuary and Firth of Forth, Scotland. *Proceedings of the Royal Society of Edinburgh*, 93B: 343-354.

Tynninghame Bay

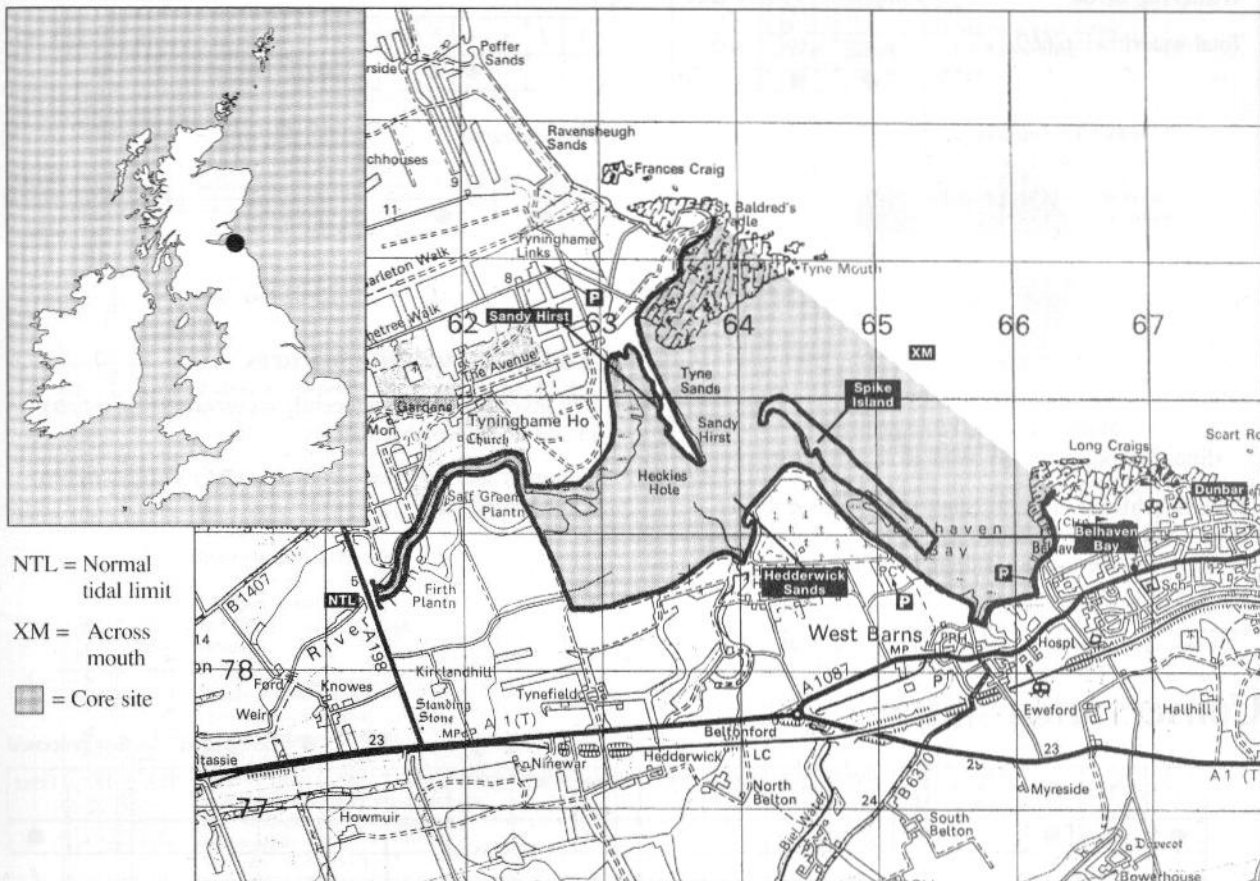
Centre grid: NT6480

District: East Lothian

Region: Lothian

SNH region: South-east Scotland

Review site location



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Total area (ha)	Intertidal area (ha)	Shore length (km)	Channel length (km)	Tidal range (m)	Geomorph. type	Human population
507	400	25.8	5.9	4.5	Bar built	6,000

Description

This estuary of the River Tyne flows into the sea between two rocky headlands west of Dunbar. The estuary is protected from wave action by the Sandy Hirst spit which has grown from the north-western shore, and Spike Island in the east, essentially a barrier beach, which shelters Belhaven Bay. Water quality within the estuary has been classified as grade 1.

At low water a large area of intertidal flats is exposed. These are predominantly muddy in the inner reaches but become sandy towards the mouth. Fringing these flats are two large areas of saltmarsh, one along the western shore

which has developed in the shelter of the Sandy Hirst spit, and the other on the eastern shore protected from erosion by the sand bar of Spike Island. The saltmarsh in the west has large areas of pioneer and low-mid saltmarsh vegetation communities with a small patch of mid-upper vegetation, and that in the east shows the zonation from pioneer communities to high marsh. There is also a small area of saltmarsh at Hedderwick Sands where a freshwater tributary enters the estuary.

The mouth of the estuary is surrounded by large areas of rocky shore.

Wildlife features

Coastal habitats

	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other
	●	●	●	●	●	●				
Area (ha)	107	112	288							

● = major habitat ● = minor habitat

Birds

Wintering birds 1986/87 – 1990/91 data

Total waterfowl: 6,660

BoEE	NWC	WSC
●	●	

Wintering species assemblage
(Spp. forming >5% assemblage shown separately)

Breeding birds: moderate numbers of ringed plover and colonies of arctic tern and little tern are known to breed within the estuary, although numbers fluctuate from year to year.

Aquatic estuarine communities

Soft substrate

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
			●	●			●		●	●			●		

Hard substrate

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
	●			●												

Additional wildlife features

The invertebrate fauna recently recorded on the estuary includes two Notable species.

Common and grey seals are frequently recorded within Tynninghame Bay.

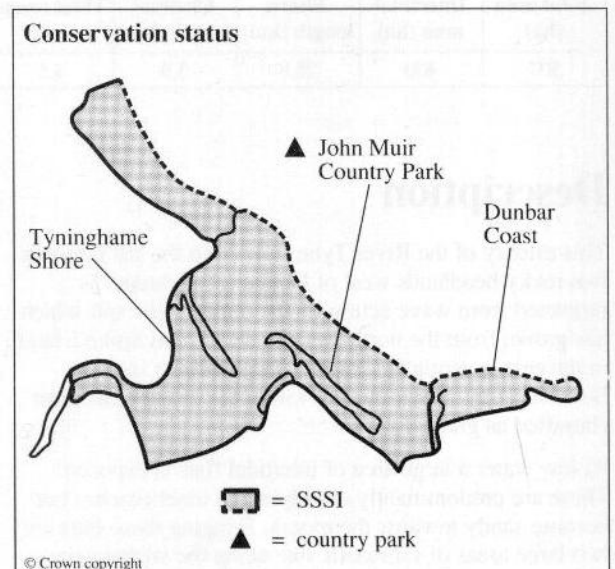
Conservation status

	NCR	GCR	SSSI (B)	SSSI (G)	SSSI (M)	NNR	LNR	Ramsar	SPA	AONB	CWT	RSPB	ESA	NP	WWT	NT	NSA	HC	Other	
	●	●	●		●															●
No.	1	1	1		1															1

● = designated ● = proposed

Most of the estuary lies within the Tynninghame Shore biological Site of Special Scientific Interest (608 ha) which is part of a Nature Conservation Review site. The easternmost point of the estuary lies just within the Dunbar Coast SSSI (81 ha), which was designated for its biological and geological interest and contains the Dunbar Geological Conservation Review site.

Parts of Tynninghame Bay also lie within John Muir Country Park.



Human activities

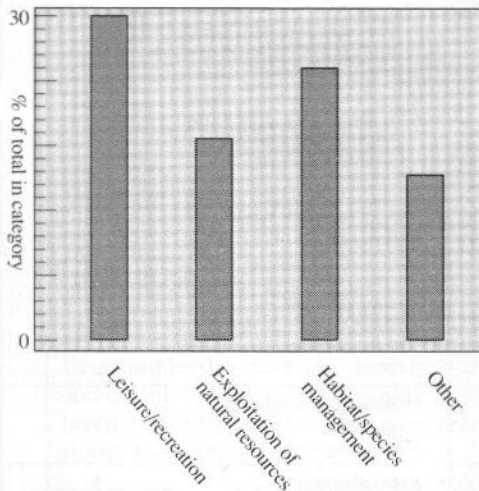
Present	Proposed	
●		Coast protection & sea defences Linear defences Training walls Groynes Brushwood fences <i>Spartina</i> planting Marram grass planting
		Barrage schemes Weirs & barrages for river management Storm surge barrages Water storage barrages & bunds Leisure barrages Tidal power barrages
		Power generation Thermal power stations Import/export jetties (power generation) Wind-power generation
		Industrial, port & related development Dock, port & harbour facilities Manufacturing industries Chemical industries Ship & boat building Others
		Extraction & processing of natural gas & oil Exploration Production Rig & platform construction Pipeline construction Pipeline installation Import/export jetties & single-point moorings Oil refineries Mothballing of rigs & tankers
●		Military activities Overflying by military aircraft Others
●		Waste discharge Domestic waste disposal Sewage discharge & outfalls Sewage treatment works Rubbish tips Industrial & agricultural waste discharge Thermal discharges (power stations) Dredge spoil Accidental discharges Aerial crop spraying Waste incinerators Others
		Sediment extraction Capital dredging Maintenance dredging Commercial estuarine aggregates extraction Commercial terrestrial aggregates extraction Non-commercial aggregates extraction Hard-rock quarrying
		Transport & communications Airports & helipads Tunnels, bridges & aqueducts Causeways & fords Road schemes Ferries Cables
		Urbanisation Land-claim for housing & car parks
●	●	Education & scientific research Sampling, specimen collection & observation Nature trails & interpretative facilities Seismic studies & geological test drilling Marine & terrestrial archaeology Fossil collecting

Present	Proposed	
	●	Tourism & recreation Infrastructure developments Marinas Non-marina moorings Dinghy & boat parks Caravan parks & chalets Leisure centres, complexes & piers Aquatic-based recreation Power-boating & water-skiing Jet-skiing Sailing Sailboarding & wind-surfing SCUBA & snorkelling Canoeing Surfing Rowing Tourist boat trips/leisure barges Angling Other non-commercial fishing Bathing & general beach recreation Terrestrial & intertidal-based recreation Walking, including dog walking Bird-watching Sand-yachting 4WD & trial-biking Car sand-racing Horse-riding Rock-climbing Golf courses Clay-pigeon shooting Others Airborne recreation Overflying by light aircraft Radio-controlled model aircraft Others
●		Wildfowling & hunting Wildfowling Other hunting-related activities
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		Commercial fisheries Fish-netting & trawling Fyke-netting for eels Fish traps & other fixed devices & nets Crustacea Molluscs – Hand-gathering Dredging Hydraulic dredging
		Cultivation of living resource Saltmarsh grazing Sand dune grazing Agricultural land-claim Fish-farming Shellfish farming Bottom & tray cultivation Suspended cultivation Crustacea farming Reeds for roofing <i>Salicornia</i> picking Others
●		Management & killing of birds & mammals Killing of mammals Killing of birds Adult fish-eating birds Adult shellfish-eating birds Gulls Geese
		Wildlife habitat management <i>Spartina</i> control Habitat creation & restoration Marine Intertidal Terrestrial Habitat management
		Others

Features of human use

Leisure activities are numerous on the estuary, with angling, walking, bird-watching, sand-yachting, occasional 4WD and horse-riding, and beach recreation on Belhaven Bay. There are very few other activities occurring on the estuary, for there is no industry and very little exploitation of the natural resources. Wildfowling occurs over most the estuary under a permit system, with a refuge area of 50 ha.

Categories of human use



Further reading

- Burd, F. 1984. *The saltmarsh survey of Great Britain. Scotland regional report*. Unpublished, Nature Conservancy Council.
- Smith, S.M. 1976. *The invertebrate fauna of the foreshore between Dunbar harbour and the Peffer Burn, Tynninghame: Mollusca*. (Contractor: S.M. Smith, Edinburgh.) Unpublished report to Nature Conservancy Council, Edinburgh.
- Traill, G.W. 1890. The marine algae of the Dunbar Coast. *Transactions and Proceedings of the Botanical Society of Edinburgh*, 18: 299.