

# The environmental impact of changing uses on the North Sea littoral of Scotland

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## The nature of the North Sea coastline of Scotland

Unlike the high, deeply indented and fragmented western coastline of Scotland with its two lines of large islands, the east or North Sea coast is lower and less intricate. It has almost no islands and is dominated by five major inlets i.e. the Forth, Tay, Inner Moray, Cromarty and Dornoch Firths. These estuaries, especially the Forth and Tay, provide the fundamental sub-divisions of the North Sea littoral. Although there are some excellent examples of bold cliffs normally with associated rock platforms, especially in Caithness, south of Aberdeen and at St Abbs north of Eyemouth, the North Sea coast is mainly low with extensive sand beaches and dunes and occasional shingle features, especially at the mouth of the River Spey. In relation to economic activities and consequent environmental impact the great firths which reach deeply into the interior continue to be the main areas for commerce, trade, industry and urban spread, including major ports. Historically, the North Sea coast provided the location for trade with Europe, including the Baltic countries. The fishing industry of Scotland, including the medium and distance-water trawler fleets, was also concentrated in small and great ports along this coast. Elsewhere developments tend to be scattered, especially at river mouths, and single-function, e.g. power station, oil platform fabrication facility.

Geological structure, inherited landforms and the consequent pattern of Ice Age movements contributed to processes of deposition rather than erosion, the legacies of which are coastal plains, rolling lowlands and fertile soils. There are also raised shorelines, some as high as 30m above sea level, but the most common platform dates from the post-glacial period and is normally less than 5m above sea level. These Ice

Age related sea level changes also include substantially lower sea levels and the indirect effects of base level changes on the hydraulic gradients of all the Scottish rivers, and therefore their associated landforms, have been equally profound, especially in the lower valleys of the firths, where evidence of high sea levels such as broad terraces, ancient flood plains, flat peaty carse lands and raised beaches co-exist with over-deepened but presently infilled river beds from periods when sea levels were lower and hydraulic gradients much steeper. These same valleys also provided the main axes for the vast meltwater discharges during inter-glacial and post-glacial warmer phases; events which deposited an abundance of sand and other materials nearshore, which would form the basis of modern beach and sand dune systems (Stapleton and Pethic, 1996 (a) and (b)). These changes therefore underpin the physical nature of the coastal and nearshore zone, and provide the basis, in a sense the resource base, for subsequent use and exploitation.

Although the North Sea has its own distinctive physical, chemical and biological characteristics, it is essentially a semi-enclosed extension of the Atlantic Ocean. Tapering southwards to the English Channel it receives its tidal flow and water mass exchanges from the Atlantic from the north but such is the size of the basin that it has its own system of two tidal gyres with the node which influences Scotland near the Danish coast. For a variety of physical reasons, especially related to winds, currents, the large influx of fresh water from peripheral drainage catchments and seasonal weather changes, it is also an area of mixing and turbulence which are vital to high levels of biomass production and therefore fish production. In fact the North Sea is one of the most biologically productive areas in the world. Occasional destructive tidal surges propagate southwards into the narrowing funnel of the southern North Sea and augment the damage of these storms but, in general, these are not severely destructive in Scotland. In general the sea bed near Scotland is not deep and is covered by heterogeneous sediments, usually of glacial and fluvio-glacial origin and exposed bedrock is rare except near the coast, especially between the Forth and Berwick. Reflecting the commercial interests of surrounding nations, the scientific knowledge base of the North Sea is very high and of long-standing and there is a vast scientific literature on its physical, chemical and biological characteristics. (e.g. Coastal Directives Project, JNCC, 1996 and 1997)<sup>1</sup> Sea water properties such as temperature and salinity are well-documented and reflect climate, latitude and

the fresh water discharges into the basin from some of the great rivers of North-western Europe.

By most standards it is a severely exploited marine basin. The normal marine activities, i.e. transport, fishing and recreation are augmented by intensive areas of sub-sea extraction of natural gas and crude oil. North Sea oil and gas extraction dominates the economic exploitation of this region but no production platforms are located nearshore and the most productive fields lie towards the middle of the basin. Considerable scientific research continues to be amassed on the impact of the production platforms on the sea bed and adjacent waters. The onshore and nearshore effects are less substantial and much less than predicted during the excitement of the early exploitation phases of the 1970's. Pipelines have come ashore unobtrusively at Nigg, St Fergus and Cruden Bay. There is a small terminal in the Cromarty Firth and a major gas receiving terminal at St Fergus (Ritchie and Kingham 1997), but Grangemouth in the Firth of Forth, which long pre-exists North Sea Oil, remains the main petro-chemical facility. Thus the environmental, physical, ecological and visual impact of North Sea oil and gas on the coastal zone has been small and will reduce through time. Such was, and is, the level of public interest in the oil industry, however, (an interest which is paradoxical, since the impact of "oil" compared with other land uses such as agriculture, pre-existing industry, urban expansion and, for the inshore waters, fishing is extremely small) that unprecedented quantities of environmental baseline and monitoring data were and continue to be gathered. The North Sea is also used for dumping, especially of capital and maintenance dredge spoil (SEPA, 1999), dilution of various types of discharges and, to a very limited extent, sand and gravel extraction – all of which can be regarded as creating environmental pressures both in the sea and along the coast, especially in the Firth of Forth.

## The use of the coastline

Although the coastline of Britain is often regarded as densely settled, this is not true for most of Scotland. Although up to a quarter of the population of Scotland live near the North Sea coast, over one million

1 In the subsequent text three agencies are quoted extensively, these are JNCC (Joint Nature Conservancy Committee), SNH (Scottish Natural Heritage) and SEPA (Scottish Environmental Protection Agency).

occupy the three historic cities of Aberdeen, Dundee and Edinburgh. There are several medium-sized towns of various types and numerous small harbour villages but, in general, most of the coastal fringe is occupied by farmland, forest and extensive land uses such as golf courses, military installations and various types of conservational land uses. (Fletcher, 1998; Hansom and Black, 1996; Firth, Collins and Smith, 1997.) The absence of extensive constructional engineering works such as sea walls, esplanades and coastal protection devices such as groynes provides a useful index of the nature of coastal exploitation. In a survey based on a careful scrutiny of 1:50,000 maps which were supplemented by aerial photographs and some field work the following statistics were produced. (Table 1. Ritchie and McLean, 1988)

*Table 1*

Area	Coastal Protection, sea walls, embankments etc	Harbours by length	Piers and Jetties	Other
Duncansby Head to St Combs	62.4 km	12.5 km	31.4 km	12.3 km
St Combs to English border	58.8 km	40.8 km	29.0 km	32.7 km

Total length of this coastline is 1770 km. Note : The most important "other" categories are groyne fields to sustain beaches and capture sediment by arresting longshore drift. There are also 9.7 km of reclamation areas in the northern section and 31.9 km in the south, mainly in the Firth of Forth.

A re-examination of the same coastline in 1999 showed remarkably little change. There were a few additional local coastal protection works, often renewals rather than new-build, some older ports had been converted to allow for marina development and others were almost abandoned (Walker, 1997). Some of the more conspicuous industrial uses such as the coastal collieries of Fife have all but disappeared and, to some extent, with the exception of oil-related activity at Invergordon, Aberdeen and Peterhead, the general use of major ports such as Dundee and Leith has declined and the west side of the latter is currently being infilled to provide valuable space for recreational facilities. Indeed a recurring theme in coastal land use in this area, as elsewhere, is the grow-

ing relative importance of leisure and recreational uses of all types. Rosyth, a major naval base in the Firth Estuary, is much less important than in the recent past. Oil tankers ply directly to Grangemouth but elsewhere they load and discharge on dedicated jetties, notably in the Firth of Forth to the east of the Rail Bridge at Braefoot Bay and Hound Point.

Thus, although the perception of the North Sea coastline of Scotland might be dominated by human presence and there are images of busy ports, industrial locations such as the former coalfields in Fife, and oil terminals, pipelines, jetties and refineries – and in a few locations, power stations, the reality is different. The direct use of the coastline by industrial use is relatively small. Substantial areas are occupied by urban landscapes, especially in the Firth of Forth, but for the North Sea coast as a whole, obvious man-made features are absent or widely distributed.

Although difficult to quantify there can be little doubt that the coastal holiday trade, especially the post-war phenomenon of “trades holidays”, which saw busy beaches, promenades, boarding houses and hotels, i.e. the traditional “seaside holiday”, has been in severe decline since the advent of package holidays to southern Europe and beyond. Most long-stay holidays have now been replaced by short visits and towns have had to diversify into rather more specialist attractions which do not rely directly on the sand beach and related facilities. Coastal caravan sites are also common but planning restrictions have tended to prevent new developments at the coastline. Nevertheless, several large “caravan parks” remain, especially in Fife and along parts of the southern Moray Firth.

Thus for at least the last three decades the direct pressure on the North Sea coastline of Scotland has steadily and sometimes dramatically reduced. There have been some notable point developments, e.g. a nuclear power station at Torness, and high profile oil-related constructions such as oil and gas terminals, pipelines, fabrication and repair yards, and temporary pipe-stringing facilities at Sinclair’s Bay and Morrich Mor. These are all relatively new developments and some might be temporary, especially if related to the oil industry. Nevertheless, the length of the coastline which has been affected by these changes is not great. At a local scale, the changes to the small harbours which originated in the early 20th century with the decline in herring fishing has now reached a stage where only a few small lobster and shellfish boats remain alongside various types of recreational vessels in most of these picturesque stone-built havens. These changes did not alter

the physical appearance of the coastline significantly, for the small harbours and fishing villages still exist, but the associated economic impact, including the decline in local support and ancillary industries, has been profound and irreversible.

## The nature of environmental impacts on the coastal zone

### *Terrestrial impacts*

As with any discussion of environmental impact, no account of the changing impacts on the North Sea littoral of Scotland can ignore natural changes, some of which might be cyclic and some of which might be responses to larger-scale trends such as sea level change, climatic effects and other global changes (Raven, 1991). Unfortunately long-term coastal changes – both physical and biological – are almost impossible to analyse since, with few exceptions, the evidence is derived from historical data sets typically of less than a century and few such records exist. A special example of the problem of trying to quantify coastal changes is exemplified by the use of historical maps. In the 1870's the Ordnance Survey produced excellent "6 inch" (1:10,560) maps of the coastline. Some investigators try to compare these maps with more modern 1:10,000 maps to measure coastline erosion. This is not possible, since the crucial lines High Water Mark Spring Tides were not measured in the 1870's but extrapolated and today, even with the use of infra-red aerial photography, the precise definition of this critical physical and legal boundary is extremely difficult to survey and to map (Ritchie 1991). Further, if the impact under consideration is some type of coastal erosion (normally an exaggerated problem in coastal zone management), it is not the movement of a tidal line which is material but shifts in the coastal edge which on most maps is not actually depicted in any way. Rightly, assessments have been made of the possibility of global sea level rise on Scotland but very few areas are at risk and these are only in the low margins of some inner parts of the estuaries. The timescale for change is long, and continuing isostatic rise along the North Sea littoral will probably compensate for such theoretical submergence.

For the landward areas most changes have been visual and aesthetic; new buildings, maturing forests and, on occasion, conspicuous

large buildings such as a power station or a flare stack have been constructed. For the most part, however, planning regulations now insist on very good standards of design and landscape awareness especially at highly visible, low profile locations. For the higher coastal areas, such as cliffs, there have been few if any changes to land use and appearance. Further, good environmental management now permeates developments at all levels – not only as statutory requirements within regulatory mechanisms but also in terms of public expectations. Direct conservational management applies to a large fraction of the North Sea coastline which is under Sites of Special Scientific Interest or similar designation and over 90 sites can be listed for the North Sea coastline (Ritchie, 1992; Dargie, 1992, 1994; SNH, 1999). Conservational management also has an expression in coastal parks for recreational purposes; several good examples, including forest areas under Forestry Commission ownership, exist along the North Sea coast. Over the last thirty years the single most important change which had its origin in the gathering swell of public opinion from the 1960's has been the cultural change towards a need to conserve and to enhance the quality of the environment – and regulations and official guidelines, Acts of Parliament and Government Directives, including increasingly from the EC (Bell, 1995), are only the explicit manifestations of growing public awareness and interest (although a cautionary point may need to be introduced to ensure that environmental concerns do not become too important and therefore inhibit equally important economic development).

Although there are still improvements to be made, the main body responsible for monitoring the quality of river and drainage to coastal and estuarine waters (SEPA) can record steady improvements since its inception in 1975. In its Annual Report (1999) on water quality, considerable improvements have been recorded and more will be achieved in the next decade.

Thus any re-examination of the terrestrial part of the North Sea coastal zone over the last 30 years would conclude that, with few exceptions, the coastline is cleaner (although some voluntary organisations report that beach debris, normally of plastic materials, is increasing), more scenic, better managed and aesthetically conserved. Conservational bodies would also agree that on the whole the ecological value of the habitats and wildlife populations are being maintained and in most areas enhanced.

### *Non-terrestrial impacts*

The coastline consists of three elements – an indeterminate land area which is often defined as “as far inland as marine influences are important”, an intertidal zone and a marine zone below low tidal level which also has indeterminate boundaries. To the coastal geomorphologist the seaward limit is wave base – the zone where typical waves become effective in bringing about physical changes along the coastline (usually a water depth of 10 to 20m); for coastal zone management old boundaries such as the Three-mile and the Twelve-mile limit still have some currency. Economic Zones extend much further seawards and in the North Sea Britain’s interests are defined by treaty at specific geographical ownership boundaries, normally median lines as agreed by coastal states. These zones are criss-crossed by most forms of coastal and marine exploitation. Navigation is an example of a sea-use where ships approach the coast from open international waters and enter a tightly controlled and regulated port jurisdiction and, in so-doing, cross invisible legal and managerial boundaries, which have little correspondence with natural, physical or biological zones. Most impacts on coastal waters, however, begin on the land and extend differential distances both offshore and alongshore. The most common impact consists of aqueous discharges but there are also physical impacts, e.g. sludge and dredged materials which are taken offshore for dumping. Given the prevailing winds, aerial discharges from urban areas and industrial land uses from the North Sea coast are also carried towards the North Sea for variable distances.

Non-terrestrial impacts are substantially more difficult to measure; they are mainly unseen and become components of natural systems by variable pathways. For low, dynamic coastlines, normally some kind of beach, system boundaries are available as defined by sediment cells between headlands. From a scientific perspective, one welcomes the recognition by the Department of the Environment (1996) that these natural units might also become effective management zones (this concept was reviewed for Scotland in 1997 by Hydraulics Research, Wallingford, and Earth Sciences Branch SNH). Since 1997 the use of coastal cells for management purposes has been taken forward and Shoreline Management Plans (SMP) are being prepared as the basis for sustainable management of coastal erosion along specified lengths of coast (SNH, 1999 (a)). Further offshore, cause and effect relationships can only be detected where there is a clear point-source such as a pipeline outfall or an offshore dredge-spoil dump site. Complex tidal and other currents and variable wave actions contribute to diffusion

and, helpfully, massive dilution. Dispersion, diffusion and dilution are rapid in open coastal and offshore areas and measurement techniques to measure pollution levels need to be extremely sensitive. Again, however, there is a need to emphasise the differences between open coast and the semi-enclosed estuaries where the hydrodynamic systems are more constrained and complex due, for example, to the compounding effects of tidal and fluvial interchanges and the precise geometry of the estuarine basin. The estuaries of the Tay and Forth, the Moray Firth and smaller estuaries such as the Eden have been subjected to comprehensive studies including symposia by the Royal Society of Edinburgh (1986, 1987, 1988) and McLusky (1997) and most hydrodynamic and biological relationships are relatively well studied and understood. Both the Tay and Forth also have prediction models for surface oil movements in the event of a spill.

With the exception of point-sources which are related to offshore oil and gas production, most toxic pollution has a land-based origin, usually from natural and artificial drainage, sewage and industrial outfalls. For the North Sea coastline of Scotland the main sources of possible pollution relate to centres of population and, with few exceptions, most problems originate in the main estuaries especially the Forth and Tay (SEPA, 1999). For both these areas massive improvements have occurred as a consequence of the introduction of good practice, strict compliance standards and the availability of reliable measurements of a wide range of chemical and biological indicators (Scottish Office, SOAEFD, 1997). The discharge of untreated sewage and industrial waste has reduced substantially. Annual reports formerly from the River Purification Boards and now SEPA show substantial improvements, sometimes as a consequence of major capital investment in treatment capacity (Read, 1983) and the construction of relatively deep water outfalls (SEPA, 1999). A coastal waters classification scheme is in place (Table 2) and most coastal zones have or are close to achieving making A and B categories (SEPA 1999). Although contentious and unpopular it might be timely to raise questions about the extent to which discharges and dumping are necessarily "bad" for the marine environment. Although some inputs such as heavy metals are clearly toxic, many other inputs can be absorbed easily into marine ecosystems and, at certain levels, might be beneficial as nutrient sources. The level of knowledge and information on the North Sea Coast is probably now of sufficient quantity and quality that it would be a suitable area (and time) to test these and similar questions.

Table 2

Class/ Description	Use-related Description	Aesthetic condition	Biological condition	Bacteriological condition	Chemical condition
A Excellent	Fit for all defined uses	Near pristine, uncontam- inated	and Flora and fauna normal	and Likely to meet quality standards no less stringent than the guideline standards for EC Designated shellfish and bathing waters	
B Good	Fit for all defined uses	Unpolluted but may show signs of contam- ination	and Flora and fauna normal	and Likely to meet quality standards no less stringent than the guideline standards for EC Designated shellfish and bathing waters	
C Unsatis- factory	Defined uses may be compro- mised by the occasional presence of sewage derived material or by moderate organic enrichment	Occasional observations or sub- stantiated complaints of sewage solids, smell nuisance or oil	or Flora and/or fauna modified by effluent discharged	or Likely to fail to meet quality standards no less stringent than the mandatory standards for EC Designated bathing waters	or Likely to meet all quality standards applied as a conse- quence of the EC Dangerous Substan- ces Directive
D Seriously polluted	Defined uses compromised or prevented by the fre- quent pre- sence of sewage derived material, or chemical pollutants	Frequent observation or sub- stantiated complaints of sewage solids, smell nuisance or oil	or Flora and/or fauna impover- ished or absent	or Likely to fail to meet quality standards no less stringent than the manda- tory standards for EC Designated bathing waters	or Likely to fail any one or more of quality standards applied as a conse- quence of the EC Dangerous Substances Directive

SEPA Coastal Waters Classification Scheme

In spite of these improvements, the complexity of the use of estuaries requires constant vigilance. In 1991 the Nature Conservancy Council produced a definitive report on British Estuaries which, on the whole,

showed the North Sea estuaries of Scotland to have the full range of functions but, with the exception of the Forth, these uses were less intensive and potentially less damaging. This report was designed to assess and to safeguard the conservational resources and noted substantial reductions and destruction of typical estuarine habitats and, in 1991, it identified threats, most of which related to likely economic and population pressures on the margins of major estuaries, including increasing leisure and recreational use. On the whole these adverse warnings were directed more at the estuaries of England and Wales and the more northern examples were not deemed to be at similar degrees of risk.

In 1999 some of these threats in Scotland have not materialised. The impact of population growth, new polluting industries and other threats to the coastal and marine ecosystems cannot be documented, whereas, conversely, improved management, scientific knowledge and effective legislation have grown substantially. Naturally some problems remain – some extensive shorelines remain classified as “seriously polluted”, toxic discharges occur, habitats are damaged and, occasionally, destroyed, many species of wildlife continue to require conservational management and protection. Diffuse inputs of nitrates which might be associated with agricultural practices are also causing some concern with the area of most interest being the Ythan Estuary (Marsden *et al.*, 1999). There are also rare occurrences of health problems with local contamination of sea food but the general overview must be one of some satisfaction to those charged with monitoring the quality of these vital coastal estuarine environments in so far as some of the fears expressed in 1991 have not materialised.

The most obvious impact on the coastal marine resource of the North Sea littoral is on various types of fish populations and associated food webs. Political and economic decisions allied to technical changes have profoundly affected fish catches with consequent infrastructural implications to ports and harbours. An important change was the eventual repeal of the prohibition of trawling within three miles of the coast and in the firths. By the 1960's the curbs on the use of drag nets in inshore waters had been considerably relaxed to allow for the development of seine netting and prawn trawling, while there were now very few line fishermen who needed protection. Eventually in the 1980's the trawling ban was to be replaced by a system of protected static gear reserves in prescribed places, mainly to protect lobster and crab fisheries (Coull, 1996). A major relatively recent change along the North Sea coast has been relatively greater concentration on the

nearshore resource, especially high-value shellfish (Coull, 1997), but there has been little or no development of fish farming (mainly salmon), which has occurred almost entirely on the west coast and in the islands of Scotland, with its current controversy that some farms might be a source of pollution and disease. The complex environmental consequences of these major changes and shift in the nature of the North Sea fisheries of Scotland cannot be summarised adequately here but the ecological effects are substantial. The effects of commercial fishing on the biological, physical and chemical interactions in the highly productive North Sea area, including the nearshore and estuarine areas are substantial. One of the main reasons for monitoring marine and coastal pollution is in relation to possible effects on food chains and therefore on fish catches. Changes in fish productivity occur for natural reasons but technical changes in boats and gear, fishing rules and regulations, allowable quotas, by-catches, all of which are strongly affected by policies and decisions which to some extent lie outwith the control of those who operate from the remaining fishing ports of the Scottish coast, seem to be of greater relative importance. At this time there is substantial interest in monitoring the effects of contaminated land drainage and other discharges on marine ecology but the reciprocal effects of changes in the extent and nature of commercial fishing *on* marine and nearshore environments do not seem to have been given equal weight. There is, for example, evidence that trawling has substantial physical effects on seabed sediments and on benthic fauna. Given the history of change and the ubiquitous nature of fishing along the North Sea coast, the study of the environmental and ecological effects of the fishing industry on coastal and marine habitats should be given very high priority.

## Integrated coastal zone management

In the Introduction to the book "The Development of Integrated Sea-Use Management", Smith (1991) identified global factors as exerting pressure for moves away from the traditional management of *individual* uses where natural management infrastructures were well developed to a more comprehensive approach. He argued that new pressures for mineral extractions, disposal of waste, pollution control, marine recreation and conservational management were creating forces which cut across the historical basis of individual, separate forms of

exploitation. National maritime agreements such as UNCLOS III, whilst essentially a comprehensive legal framework for marine affairs, clearly had coastal implications, as did Law of the Sea Conventions. It is important to stress however that such international policy and legal arguments have to be accepted and, subsequently, must be applied in the particular context of the nearshore jurisdiction of an individual nation state. To this end, political geography, maritime boundary definition and the locus of decision making become powerful factors in determining how the concept of Integrated Coastal Zone Management might apply (Cleator and Irvine, 1995). How this concept has developed for Scotland can be gleaned from two documents from the Scottish Office, the National Planning Policy Guideline (NPPG13, 1997) on Coastal Planning, and Scotland's Coasts : a discussion paper, 1996. Setting aside the high level of importance which these documents give to sustainable development, enhancing biodiversity, risks of erosion and flooding and, noting the useful division of the Scottish coast into three types – the Developed (mainly urban), the Undeveloped (small towns and villages, but mainly agricultural and low intensity use) – and this category is 88% of the total mainland coastline of Scotland, – and Isolated (effectively rare or undisturbed), – the document signals a significant policy shift towards co-ordinated, integrated planning. Two paragraphs can be quoted verbatim to emphasise this trend, i.e.

“The interrelationships between human activities and these natural processes do not respect administrative boundaries – an example of this being the natural processes of erosion and deposition at work on the coast. These inter-relationships have already been recognised through the establishment of a number of Firths Fora and other local coastal fora where different interests have come together voluntarily to consider cross sectoral issues; this type of approach is one which the Government wishes to encourage. *Planning authorities should therefore consider whether there are additional areas where the need to work with other authorities and agencies to pursue a co-ordinated approach to issues arising on the coast.* Such issues are likely to range more widely than land use planning.” And, –

“The coast is not only a complex natural environment; it is also a complex policy area where a range of agencies with differing, but often overlapping, objectives, responsibilities and powers operate. The scope of land use planning is limited by statute and develop-

ment plans cannot, therefore, deal with all the issues which arise on the coast; a range of organisations have to work together if an agreed overview of how the coast is to be used, managed and protected is to be reached. In Scotland the various Firths Initiatives which SNH has helped establish around the Clyde, Forth, Solway and Moray Firths have taken a lead in this field; a draft Management Strategy and Action Plan for the Cromarty Firth has recently been produced. The Government support this approach to coastal planning and see an important role for similar local coastal fora away from the major Firths. The establishment of a Scottish Coastal Forum was announced in November 1996 to provide a context for the work of such local fora, as well as a national focus for Coastal issues. It is envisaged that the Forum will play a part in the preparation of future national guidance relating to the coast and the dissemination of good practice on coastal zone management.”

In theory these trends have to be welcomed but major problems remain in moving from a stage of talking and communicating issues which are concerned with the multiple use of the same physical space, especially when different legal and planning jurisdictions apply to the stage of implementation. Terminology such as “fora”, “overview”, “context”, “national guidance” and “good practice” are to be welcomed but the real test is the next stage which must be to convert concepts and abstractions into operational reality. On the whole the North Sea littoral zone of Scotland is relatively unpolluted, well-managed and increasingly affected by good conservational (in the widest sense of the word) practice. SEPA and SNH are bringing a greater sense of overarching responsibility, which is backed by statutory powers.

There is also a wealth of scientific, economic, technical and policy documents including an excellent and thorough review of Scottish coastal issues which provides a comprehensive listing of data sources, agencies and their responsibilities and notes on legislation, designations and controls, which cascades from international level connections to local controls and voluntary agreements (Burbridge and Burbridge, 1994). An increasing convergence of interests with common managerial goals can be detected and there appears to be political will to marshal these hitherto individual and sectoral approaches to the exploitation of the coastal, estuarine and nearshore resources of the North Sea littoral into a more coherent structure. Conflicts of interest will continue to arise but there is some comfort in the knowledge that opportunities for dialogue appear to

be increasing. Equally important is the increasing scientific realisation that on the basis of careful monitoring of effects some environmental impacts can be shown to be less serious in reality than was perceived or implied at earlier stages. Historical problems remain, as illustrated by the recent survey of coastal pollution of its northern area by SEPA, where the satisfactory conditions of the entire coastline from Wick in the north to Montrose in the south contains references to very small pockets of poorer quality discharges, almost all of which emanate from older urban areas or small coastal towns, whereas the major urban areas now have higher quality offshore sewerage and wastewater schemes in place (SEPA 1999). No doubt in time these small scale problems can be overcome at commensurately relatively small cost. Thus as a preface to the general conclusion and summary as given below, there has to be a sense of optimism that the momentum of progress will continue on the basis of recognised need, political prioritisation and sufficient expertise, experience and knowledge in individuals and agencies to sustain the rapid progress that has been made over the last three decades.

## Conclusion and summary

This overview of the changing types and amount of impacts on the North Sea coastal environments of Scotland over the last three decades can be summarised as follows:

1. There is widespread recognition that for both scientific and managerial reasons this coastline should be divided into major estuaries and open coastlines.
2. Only the Forth and to a lesser extent the Tay are subjected to a wide range of activities with consequent problems of multiple usage.
3. Almost 90% of the coastline is not used for intensive urban or industrial use other than at a number of "individual single function" sites.
4. The knowledge and information base relating to a wide spectrum of interests has grown extremely rapidly
5. The problems of conflicting legal, planning, natural and functional boundaries have been recognised and potential conflicts are being addressed.
6. This increase in information is mainly in response to the growing needs of specific agencies and interests, notably –

- (i) Government and its agencies especially those with regulatory functions, specifically SEPA, SNH and planning agencies at national and regional levels.
  - (ii) Government departments and occupational groups with direct responsibility for the coastline, including the fishing industry.
  - (iii) Directives and other guidelines from EC.
  - (iv) The perceived impact of the North Sea oil and gas industry.
  - (v) A substantial increase in public awareness and concern about “environmental” matters.
7. Largely stimulated by SNH, the concept of Integrated Coastal Zone Management is gaining acceptance. This has been led by initiatives in the Forth, Tay and Moray Firth where mechanisms exist for a wide range of groups and agencies to discuss the interaction of relevant concerns. There are also long-standing British groups, e.g. National Coasts and Estuarine Advisory Group, which provides further impetus for similar and inclusive developments in Scotland. Although the statistical and regulatory baseline information is substantial, and although expert opinion may demur from this assertion, there is a sense of imbalance in that the impact of activities *on* fishing is not matched by the effects *of* fishing on marine and coastal ecology and environments.
  8. On almost all criteria the coastal environment is cleaner, less damaged and less polluted. Very large tracts (in excess of 90 sites) are under conservational management. Arguably, there has been no reduction in visual quality. Apart from local problems of diffuse aqueous discharges most spot sources of pollution have been identified and are being corrected.
  9. Significant environmental milestones have been (and are close to being) reached, e.g. cessation of offshore sludge dumping, and effective monitoring of specific discharge consents.
  10. There is a welcome move to recognise and to use coastal systems as defined by natural boundaries for both formal and functional purposes. Eleven coastal sediment cells have been identified for parts of Scotland and are being actively used in two areas as the basis for coastal erosion studies. This “working with nature” approach is also notable at the local scale where soft solutions to coastal defences, to flood protection, and to general coastal management, are being preferred.

11. On a world-scale, population (and tourist/recreation) demands on the coastal zone are accelerating with consequent pressures and possible destruction of coastal habitats. This trend cannot be demonstrated as true for the North Sea coastline of Scotland. Population, industry, commerce and other traditional uses of the coastal zone are either static or reducing whereas, in contrast, environmental good practice both voluntary and regulatory is increasing steadily.

## Note on sources of information

As described above, the quantity of information which is available for the North Sea and its coastline is vast. Little use has been made of the extensive data sets for the more distant offshore zones of the North Sea which relate both to oil and gas extraction and to the fishing industry. It is notable that most of the data has had to be accessed through reports from developers, agencies and several government officers, including international bodies and organisations. For the coastline there has been a relative decline in articles in refereed academic journals and a greater reliance on symposia, chapters in reports notably from SNH, SEPA and the JNCC with much of the material having been commissioned by these and other bodies. Management and Planning literature has three dimensions, European, British and Scottish with the Department of the Environment being the prime source of policy development. The reference list given below is extensive and reflects these sources. The substantial help of two main agency staff, including librarians, in SNH (Edinburgh) and SEPA (Edinburgh and Inverness) is gratefully acknowledged, especially in the provision of unpublished data sets and other information. Nevertheless the opinions and conclusions as given above are solely the responsibility of the author.

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