

5 Cross cutting environmental themes

This section describes the following cross cutting environmental themes and includes recommendations that promote their understanding, consideration and protection:

- Natural Heritage;
- Wild Migratory Salmonids;
- the Historic Environment;
- Invasive Non Native Species;
- Water Quality; and
- Climate Change.

How marine and coastal activities interact with these environmental themes is detailed in section 6 of the Plan, and opportunities specific to a particular location identified where appropriate in the Policy Zone section of the Plan (section 7).

5.1 Natural Heritage Interests

Loch Etive is an area rich in scenery with a diverse range of marine and coastal habitats and wildlife which attract visitors to the area to appreciate its natural qualities. All of the designated sites, habitats and species in or bordering Loch Etive are of at least regional significance with many being of national or European importance. The relative importance of these interests is summarised in Appendix V.

5.1.1 Designated sites

There are a number of sites around the immediate coast designated for species, habitats and landscape, and these are shown in Figure 5.1. A definition of the different types of designations can be found in the Glossary. Landscape designations are discussed in section 5.1.4.

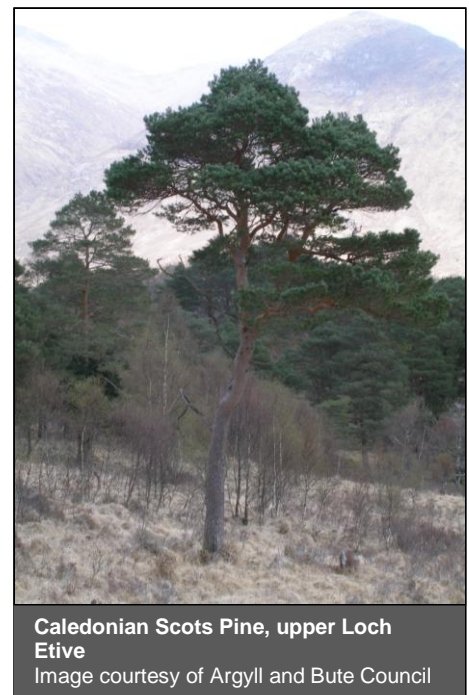
Special Area of Conservation (SAC)

There are eleven large areas that make up the Loch Etive Woods SAC in the vicinity of Loch Etive. This site of European importance is designated for Alder woodland on floodplains; mixed woodland on base-rich soils associated with rocky slopes; Western acidic oak woodland and Otter (*Lutra lutra*).

Sites of Special Scientific Interest (SSSI)

There are seven SSSI's bordering or immediately adjacent to Loch Etive.

- Airds Park and Coille Nathais; Ard Trilleachan; Barran Dubh; Bonawe to Cadderlie; and Kennacraig and Esragan Burn are notified for natural woodland with birch, oak and native Scots pine often with an abundance of oceanic species of ferns, mosses and liverworts. The Bonawe to Cadderlie SSSI is also notified for its geological interest.
- Clais Dhearg is notified for its woodland and open water habitat, and Glen Nant, part of which is a National Nature Reserve, is also notified for its woodland habitat.



Glen Etive and Glen Fyne Special Protection Area (SPA)

Glen Etive and Glen Fyne are of special nature conservation importance within Britain and the EU for regularly supporting a population of Golden Eagle (*Aquila chrysaetos*). The site supports 19 pairs of golden eagle, slightly greater than 4.2% of the GB population.

National Nature Reserve (NNR)

Glen Nant NNR is located south of Taynuilt and is part of the Glen Nant SSSI.

Marine Consultation Area (MCA)

Loch Etive was identified as an MCA in 1990 for its physical and biological features and its conservation interest. These are described in more detail below. The MCA boundary encompasses Dunstaffnage Bay to Rubha Doire Làrach, upper Loch Etive.

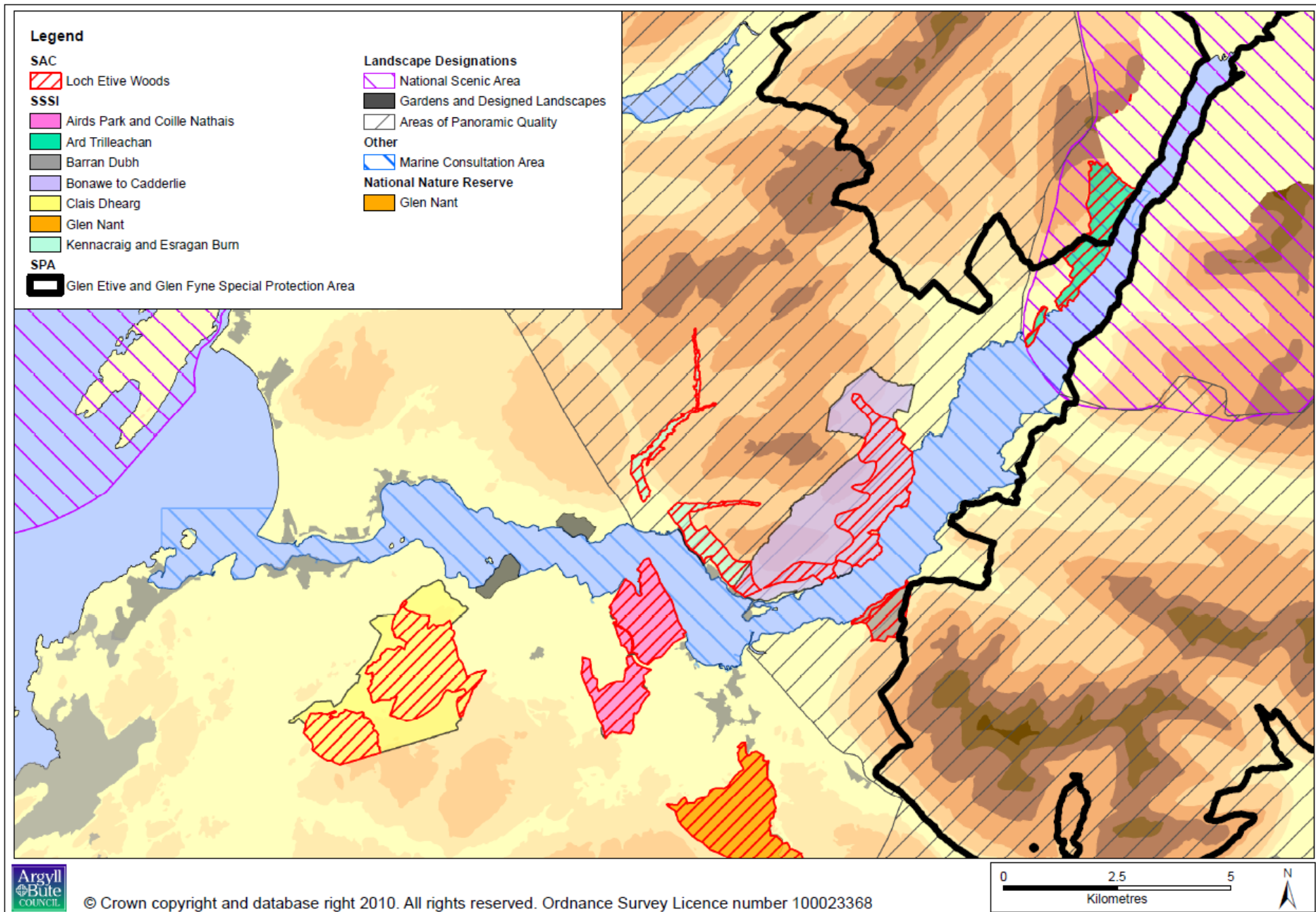


Figure 5.1 Location of designated sites for habitats, species and landscape

5.1.2 Biodiversity Action Plan Species and Habitats

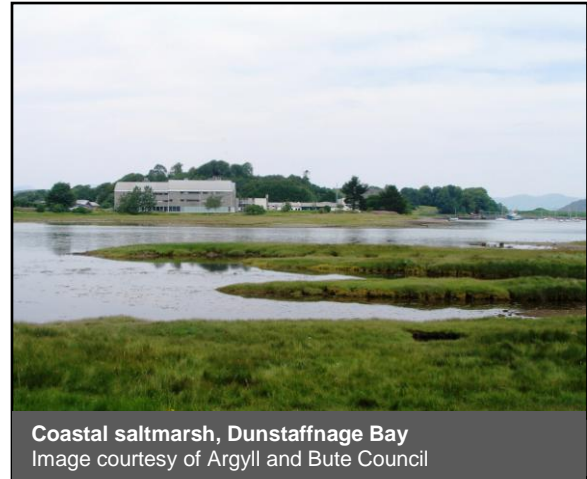
Figure 5.2 shows the location of habitats and species of biodiversity interest. The most up to date published data and local knowledge has been used to produce this map. However, as is generally the case with the marine environment full, detailed sea bed survey coverage of the loch does not exist. As a result, there is a need to update much of the existing information on important areas for biodiversity.

Argyll and Bute Local Biodiversity Action Plan (LBAP)

The current LBAP sets out actions for marine and coastal habitats and species. The following priority habitats and species listed in the Argyll and Bute LBAP are present in and around Loch Etive, and are of both national and regional importance. The LBAP is currently under review and the ICZM Plan will take account of any changes within the revised document.

Priority habitats – Mud Habitats in Deep Water, Mudflats, Coastal Saltmarsh, Tidal rapids, Sheltered muddy gravels

Priority species – Atlantic Salmon (*Salmo salar*), Brown/Sea Trout (*Salmo trutta*), European Otter (*Lutra lutra*)



UK List of Priority Species and Habitats

In addition to the habitats and species listed in the Argyll and Bute LBAP the common seal (*Phoca vitulina*) and the fireworks anemone (*Pachycerianthus multiplicatus*) are present in Loch Etive and are identified as UK BAP priority species.

Priority Marine Features (PMF)

This list of UK BAP habitats and species has been considered by SNH in drawing up a list of Priority Marine Features, which are believed to be of greatest conservation importance in Scottish territorial waters. The draft list contains 53 habitats and species and will be used to support the advice SNH give on marine biodiversity, playing a role in the delivery of new marine planning and licensing systems set out in the Marine (Scotland) Act. The list will also be used to guide future research and a subset of the PMFs will be used to underpin the selection of Nature Conservation Marine Protected Areas.

Priority Marine Features (from draft list) known to be present in Loch Etive include:

Habitats

- Burrowed mud (SpMeg, MegMax and *Pachycerianthus multiplicatus*)*
- Blue mussel beds*
- Inshore deep mud with burrowing heart urchins*
- Intertidal mudflats*
- Low or variable salinity habitats*

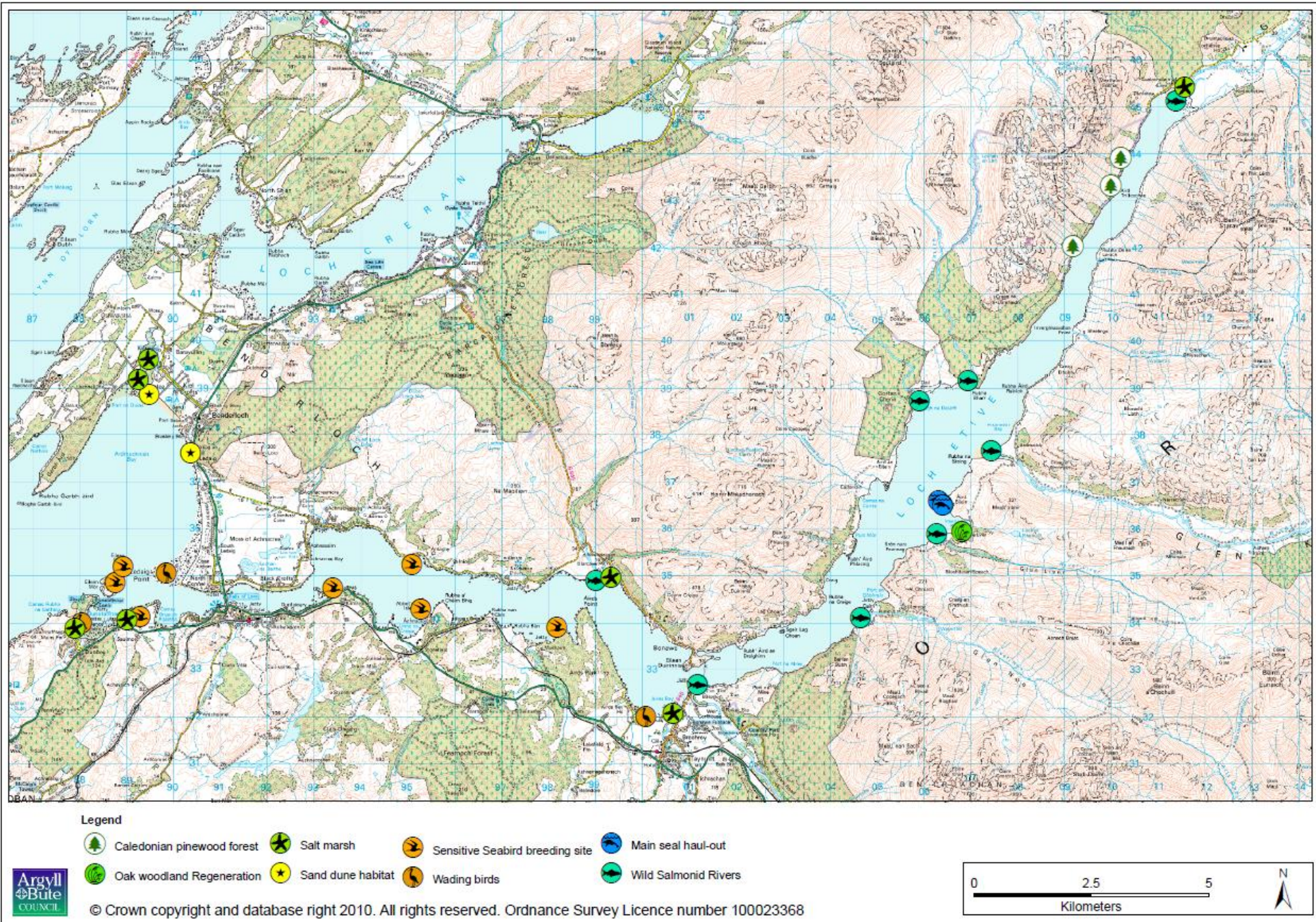


Figure 5.2 Location of habitats and species of biodiversity interest, areas of biodiversity interest and wildfish rivers

Species

- Spiny dogfish (spurdog)
- Northern featherstar*
- Iceland cyprine*
- Otter*
- Sand goby*
- Angler fish (juveniles)
- Atlantic mackerel
- Atlantic herring (juveniles and spawning adults)
- Cod
- Eel (marine part of life cycle)
- Ling
- Saithe (juveniles)
- Whiting (juveniles)

* PMFs considered for selection of Marine Protected Areas

5.1.3 Areas of Biodiversity Interest

Marine habitats and species

Loch Etive is of significant marine ecological interest because of the unusually high brackish influence and the effect this has on marine communities (Holt 1991). Although a limited range of sheltered brackish-influenced communities are present, many of them appear to be unique to this particular loch. These include very tide-swept communities on bedrock in the Falls of Lora, shallow, tide-swept, impoverished sediments in the Bonawe Narrows, and vertical bedrock walls with variable salinity conditions in the upper loch (Holt 1991).

The gradation in salinity, both longitudinally and vertically, is reflected by the reduction in diversity of shore and shallow water species towards the head of the loch, and by the increase in diversity of marine species in deeper water. Shallow water communities have to contend with low and widely fluctuating salinities and temperatures, and as a consequence there seems to be some turnover of species in the shallow communities (Holt 1991).

Tide-swept communities

Brackish tide-swept communities are present on either side of the Falls of Lora, through the Kilmarnaig Narrows and in Bonawe Narrows (Holt 1991).

At the entrance to Loch Etive a combination of shallow sill depth and constricted topography gives rise to the most spectacular tidal rapid system of any Scottish sea loch, with flow rates exceeding 8 knots in places (Wilding *et. al* 2005). A forest of short, stocky kelp (*Laminaria hyperborea*) occurs over a region extending from the Falls of Lora, to Kilmarnaig Narrows and across the shallow part of Achnacree Bay following the path of the fastest tidal flow. While the understorey fauna in the kelp forest in the Falls of Lora is not particularly diverse, probably due to the high water speeds and low salinity, species present (hydroids, bryozoans, barnacles, seasquirts and sponges) were recorded at high densities (Holt 1991).



Falls of Lora, tide-swept communities
Image courtesy of Trevor Davies



Falls of Lora, tide-swept communities
Image courtesy of Trevor Davies

In the narrows above and below the Falls of Lora tidal speeds are slightly less extreme and the flow less turbulent. The more moderate conditions allow development of a more diverse community including turfs of the sponge *Halichondria bowerbanki*, bryozoans and a variety of solitary sea squirt species (Holt, 1991).

Seabed sediment communities

A survey conducted by Holt (1991) recorded small numbers of the deep water fireworks anemone (*Pachycerianthus multiplicatus*) on soft mud in the upper basin of Loch Etive. Deep sediment communities between Bonawe and Ardmaddy also included the seapen (*Pennatula phosphorea*), and the deep water mollusc, *Arctica Islandica* was recorded throughout the soft sediments in the loch.

Sediment communities in the lower loch were characterised by the seapens (*Virgularia mirabilis* and *Pennatula phosphorea*) and brittlestars (*Amphiura* spp). Soft mud in Airds Bay was characterised by the seapen (*Virgularia mirabilis*) and the burrowing anemone (*Cerianthus lloydii*) along with brittlestars (*Amphiura* and *Ophiura* spp.).

Coastal habitats

Coastal saltmarsh is present at a number of locations. This habitat supports a wide range of plant communities and is important for wading birds and wildfowl. It acts as a high-tide refuge for birds feeding on adjacent shoreline, as breeding sites for waders, gulls and terns, and as a source of food for passerine birds, particularly in autumn and winter. A Local Nature Conservation Site at An Sàilean, Ardmucknish Bay encompasses areas of saltmarsh which are at threat from the invasive non-native species; Common Cordgrass (see section 5.4.2). A management plan¹ commissioned by the Scottish Agricultural College, on behalf of Lochnell Estate has been developed to maintain and enhance the biodiversity of saltmarsh at this location.

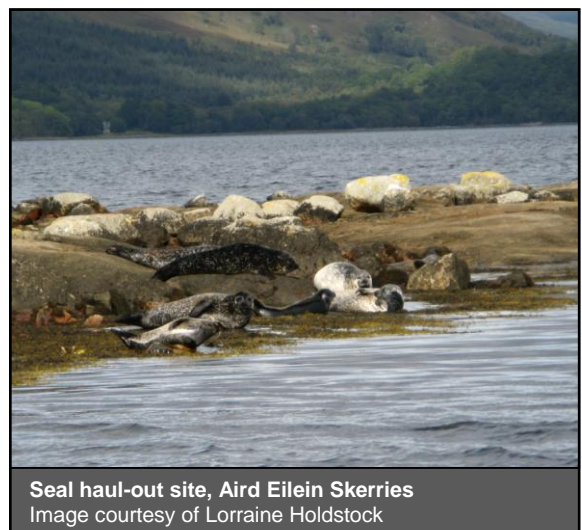
Sand dune habitats are found at Tralee and Ledaig, Ardmucknish Bay. In most cases the dunes are important in protecting the land against potential storm waves from the sea and providing niches for highly specialised plants and animals.

Seabirds

Ornithological interests include eider ducks, winter migratory species, and both common tern and gull colonies. There are a number of sensitive bird breeding islands in Loch Etive, in particular Eilean Mor and Eilean Beag in Ardmucknish Bay, and the Kilmarnaig Islands and Abbot Islands in the lower loch. The breeding season commences in spring and continues into early summer (Craig 2000). The sand pits behind the beach, west of Port Selma, Benderloch are of local importance for a number of breeding birds including Moorhen and Water Rail, which are both scarce in Argyll and Bute.

Mammals

Otters are common along the coast of Loch Etive and are a designated feature of Loch Etive Woods SAC. Small numbers of common seal (*Phoca vitulina*) use the loch to haul-out regularly, with the main haul-out at the skerries just north of Inverliver Bay in the upper loch. Seals are also regularly sighted feeding in and around the narrows at Connel, Kilmarnaig and Bonawe.



Seal haul-out site, Aird Eilein Skerries
Image courtesy of Lorraine Holdstock

¹ An t'Sailean Saltmarsh: Management Plan 2008 - 2013

Predation by mink at seabird colonies in this area was first observed in 1983 and became widespread from 1989 onwards, seriously affecting the breeding success and breeding distribution of island-nesting colonial seabirds. The seabird species most affected by mink are those with smaller eggs and chicks, particularly terns (*Sterna* spp.), small gulls such as Common Gull and Black-headed Gull (*L. ridibundus*), and Black Guillemot (*Cephus grille*) (Craik 1995, 1997 and unpublished results 1989-1997).

5.1.4 Landscape

Loch Etive has a great diversity of landscape character with the lower loch extending from its mouth, which embraces Dunstaffnage and Ardmucknish Bay, and inland through the narrow straights of Connel to a sheltered, but expansive series of bays. Upper Loch Etive, which is narrow and fjord like in character, feels relatively remote and undeveloped, with little habitation and minimal access.



Landscape designations

The importance and sensitivity of the landscape of upper Loch Etive is recognised in the northern section of the upper loch being part of the Ben Nevis and Glen Coe National Scenic Area. The southern part of the upper loch has been designated as an Area of Panoramic Quality by Argyll and Bute Council in the Argyll and Bute Development Plan (Structure & Local Plan). These areas are important for not only their physical landforms and for the flora and fauna which they support, but also for the environmental assets that they represent. The locations of these designations are presented in Figure 5.1.

In 2006, SNH undertook a Landscape/Seascape carrying capacity study for aquaculture which assessed part of North Argyll including Ardmucknish Bay and Loch Etive. In addition to this, a further Landscape/Seascape assessment has been undertaken by SNH in 2010. Both reports² have been used to assess the sensitivity of stretches of coastline to aquaculture development and describe the landscape character in section 7 of the plan.

5.1.5 Additional information on Natural Heritage interests

A wide range of further information is available from the following sources:

Scottish Natural Heritage (Sitelink) - Information on designated sites, <http://www.snh.org.uk/snhi/>

Argyll and Bute Council: Local Biodiversity Action Plan, <http://www.argyll-bute.gov.uk/biodiversity>

MarLIN: The Marine Life Information Network – Information on the sensitivity of marine habitats and species, <http://www.marlin.ac.uk/bacs.php>

UKBAP website - UK List of Priority Species and Habitats & action plans,

² Landscape reports for Loch Etive can be viewed at www.argyll-bute.gov.uk/lochetive

<http://www.ukbap.org.uk/NewPriorityList.aspx>

RSPB - <http://www.rspb.org.uk/> - Information on birds and wildlife

Argyll Bird Club & County Bird Recorder - http://www.argyllbirdclub.org/bird_rec/bird_recorder.asp

Wetland Birds Survey (WeBS) - <http://blx1.bto.org/websonline/>

5.1.6 Safeguarding Natural Heritage

Scottish Natural Heritage (SNH) is a statutory advisor on natural heritage, and provides advice, development guidance and undertakes research relating to the management of the land and sea, including fishing, aquaculture, non-native species, marine renewables and coastal development.

Under the Nature Conservation (Scotland) Act 2004, all public bodies have a duty to further the conservation of biodiversity and the Scottish Biodiversity Strategy. In addition to the policies set out in this plan, Appendix I outlines specific environmental policies from the Council's Development Plan that are relevant to marine and coastal developments and aim to safeguard key environmental assets and guide new development to locations that minimise environmental impacts.

5.1.7 Local perspective on Natural Heritage

Views on Natural Heritage, gathered during public meetings for the Loch Etive ICZM project included:

- lack of information on local wildlife;
- need for local interpretation panels promoting natural heritage interests;
- the unique ecosystem of Loch Etive should be preserved, including biology, hydrology and geology;
- visitors and locals should be encouraged to engage in wildlife recording schemes;
- need to preserve the wild and remote character of upper Loch Etive; and
- local websites could be used to improve local knowledge and raise awareness of wildlife sites.

5.1.8 Recommendations for Natural Heritage

- Further informal and formal marine survey work is encouraged, to build up a better understanding of the distribution and abundance of marine and coastal species and habitats, and further scientific research to assess their sensitivity to activities and development.
- All natural heritage datasets, including those gathered for Environmental Impact Assessments (EIA), should be made available for future revisions of the Loch Etive ICZM Plan.
- The eradication of mink is encouraged in order to reduce predation and increase breeding success of important seabird breeding colonies.
- Loch users are encouraged to report sightings of birds and marine mammals to the relevant agencies/conservation groups. Details of recording schemes and contact details can be found in Appendix IV.

Recommendations and Good Practice that promote understanding, consideration and protection of natural heritage, but are specific to particular marine and coastal activities, are included under the relevant activity section.

5.2 Wild Migratory Salmonids

Atlantic Salmon are widely distributed in Argyll, usually spending two years in rivers as fry and parr before migrating to sea as smolts. Most salmon (grilse) spend one winter at sea before returning, although some remain at sea for two or more years before returning to spawn; these are known as multi-sea winter salmon. Sea trout have a similar freshwater life history to salmon but differ in that they are understood to remain in local inshore marine waters for the growth phase of their life-cycle and therefore may be more susceptible to local development and use of marine resources compared to salmon (Argyll Fisheries Trust 2009).

There are 10 rivers with a catchment over 5km² that flow into Loch Etive, the largest catchments being the Awe/Orchy catchment (827km²), River Etive (161km²), River Kinglass (74km²) and Nant (46km²) that support salmon populations. Smaller rivers such as the Noe, Liver, Allt Easach, Abhainn Dalach and Esragan are primarily habitats for recruitment of sea trout. Most of the larger rivers are important fisheries. Loch Etive itself traditionally supported net fisheries and some rod fishing for sea trout (Argyll Fisheries Trust 2009).

5.2.1 Factors affecting migratory fish populations

The fishery for wild salmonids in Loch Etive is greatly reduced since records of fishery catches in the Awe fisheries district began from the mid-20th Century, with many of the historical benefits to the local community and economy diminished (Argyll Fisheries Trust 2009).

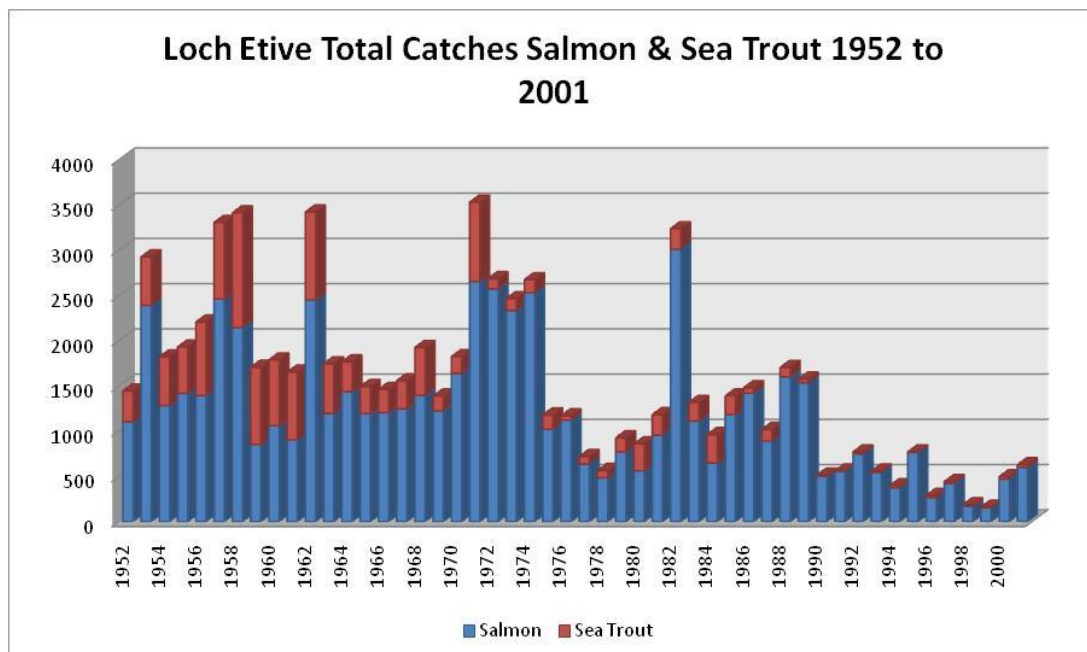


Figure 5.3 Total catches of salmon and sea trout in Loch Etive between 1952 and 2001 (Argyll Fisheries Trust 2009)

While there are many marine and freshwater based factors affecting migratory fish populations, it is the reduction of the number of smolts returning as adults from the sea that is understood to be the most significant factor influencing fishery catches. It is understood that the condition of local marine habitats are crucial to important phases of their life-cycle, particularly as post-smolts when the young fish leave the freshwater environment. At this stage when they enter the marine environment they are vulnerable to predation and potential infection by sea lice. Local and national studies indicate that the proximity of marine cage-based aquaculture can potentially increase infection levels of sea lice on post-smolts and reduce growth and survival.

Containment of farm fish is crucial in preventing genetic dilution from the interbreeding between adult wild fish and escaped farm fish or from salmon smolts returning as salmon from their migratory phase. In the case of rainbow trout, the impact of escapes is limited to competition for habitat/food and once entering rivers, escapees become a management issue that may impact on the value of the fishery.

Initiatives have been undertaken to address the primary sea lice and containment issues related to aquaculture through the development of Area management Agreements (AMAs). This dialogue between aquaculture companies and wild fish interests has led to changes in the way fish are farmed improving the health of wild and farmed salmonids (Argyll Fisheries Trust 2009).

Other potential reasons for the decline in the fishery such as a decrease in marine survival in the wider Atlantic Ocean for salmon are being investigated by studies currently being undertaken by international agencies. Findings from these studies will be used to inform national and local management of stocks in the future. A decrease in freshwater survival locally may be attributed to a range of land and water uses affecting habitats including commercial forestry, drainage, overgrazing, hydropower, and over exploitation in or near freshwater environments (Argyll Fisheries Trust 2009). These factors are being addressed as part of the Water Framework Directive through the Argyll and Lochaber Area Management Plan.

5.2.2 Salmon and Trout Angling

Fisheries for migratory salmonids in Loch Etive and its rivers are managed locally by the Awe District River Improvement Association (ADRIA) under the legal framework provided by the Argyll District Salmon Fisheries Board (ADSF). Loch Etive and its rivers support potential for both recreational rod and line fisheries and commercial netting for salmon and sea trout. However, net fisheries are no longer operational in Loch Etive due to the relatively low number of migratory fish returning to the area and the increase in provision of fish for the retail markets by the development of aquaculture. Recreational rod and line angling fisheries are active in all larger rivers, with the salmon fisheries of the Awe and Orchy being the most productive in the region of Argyll. In response to falling numbers of migratory fish returning to local rivers, catch and release angling has been increasingly utilised on many rivers in an effort to safeguard and improve stocks (Argyll Fisheries Trust 2009).

Management of the fishery potential in Loch Etive is less well developed, but awareness of the loch as a habitat for sea trout is growing and future management is likely to be required. Some protection for stocks in Loch Etive is provided under the Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003, which states that it is an offence to fish for salmon and sea trout in any waters, including any part of the sea within 1.5 kilometres of mean low water springs, without the written permission of the person who owns the fishing rights to that water. Full details and legal requirements can be located on the Fish Britain website <http://www.fishpal.com/Scotland/Legal.asp?dom=Britain>.

Fisheries management advice is provided by The Argyll Fisheries Trust, which has conducted surveys of juvenile salmon and trout populations on most rivers in Loch Etive. The results of the surveys are used to inform management of the fisheries and fish habitats. The Awe Catchment Fishery Management Plan 2010-2015 is currently being developed with the aim of coordinating the management of all fisheries in the catchment and facilitating conservation and improvement activities (Argyll Fisheries Trust 2009).

5.2.3 Recommendations for Wild Migratory Salmonids

- Research is required to improve the understanding of the migratory route of wild migratory salmonids through Loch Etive.
- Efforts to improve the populations of wild salmon and sea trout returning to Loch Etive rivers should be fully supported by all relevant agencies and regulators.
- Continued AMA dialogue and participation by wild and farmed salmonid interests is encouraged.
- Any fisheries management and raising awareness of factors affecting fish and their habitats should be developed under guidance of;
 - Argyll & Islands Fishery Management Plan
 - Argyll & Islands Fishery Bio-security Management Plan
 - Awe Catchment Fishery Management Plan

Recommendations and Good Practice that promote understanding, consideration and protection of Wild Migratory Salmonids, but are specific to particular marine and coastal activities, are included under the relevant activity section.

5.3 Archaeological and Historical Sites

Marine and coastal archaeological and historical interests are identified and mapped in the relevant policy zones (section 7) and have been considered in the development of guidance on future use and development for each zone. Further information on individual interests can be accessed from the Historic Scotland website: <http://www.historic-scotland.gov.uk/> and/or the Past Map website www.pastmap.org.

The setting of historic landmarks and features were included in the sensitivity analysis of the landscape/seascape capacity assessment for aquaculture, and have been considered in section 7, when determining development potential.

5.3.1 Coastal Interests

Listed buildings, scheduled ancient monuments and their surroundings, historic gardens and designed landscapes, conservation areas, and special built environment areas are all subject to special protection measures to ensure that inappropriate or unsympathetic development does not damage the property or its setting.

A number of important archaeological and historical interests are present along the coastline³ of Loch Etive, including 30 Scheduled Ancient Monuments, 25 Listed Buildings, eight unscheduled monuments and two Gardens and Designed Landscapes. Some of the most important coastal interests are described in Table 5.1 and their location presented in Figure 5.4.

Table 5.1 Description of a selection of listed buildings and scheduled ancient monuments of high importance, in proximity to the coastline of Loch Etive. Information from Historic Scotland (<http://hsewsf.sedsh.gov.uk>)

Site no.	Name	Description
1	Bonawe, Iron Furnace	The scheduled ancient monument known as Bonawe, Iron Furnace, comprises the extensive and well preserved remains of the Bonawe Iron Works, encompassing 11 Listed Buildings. The scheduled area is in four distinct parts, of which includes: the pier, the furnace area and lade. Bonawe Furnace was established in 1753 to smelt iron ore imported from Cumbria, using charcoals made from the extensive woods in the Taynuilt area. This industry had a profound effect on the community until it was closed in the late 19th century, employing about 600 people. The buildings have been renovated and the furnace site is now operated as an historical attraction by the National Trust for Scotland.
2	Dunstaffnage Castle	Category A listed building and scheduled ancient monument that dates from 1250. Ruinous, three storey's with curtain walls that has been built on a rocky outcrop. Comprises a Keep, a 17 th century Gate-house behind the entrance, Tower and an 18 th century Tower house.
3	Dunstaffnage Chapel	Category A listed building and scheduled ancient monument that dates from 1250. Gothic, oblong and roofless. Moulded lancets and round-headed windows. Campbell of Dunstaffnage burial enclosure was added in 1740.
4	Ardchattan Priory	The B listed Ardchattan Priory Church is situated with a Garden and Designed Landscape. Based on a monastic garden that probably dates back to the 13 th century, the designed landscape has been improved in the 17 th , 19 th and 20 th centuries.
5	Achnacloich House and Gardens	The B Listed Achnacloich House is situated in a Garden and Designed Landscape. The notable gardens host an attractive collection of rhododendrons and other trees and shrubs. The wider 19 th century designed landscape comprises parkland, woodland and architectural features.

³ Within 500 m of the high tide mark, except from around Taynuilt at 1 km from high tide mark.

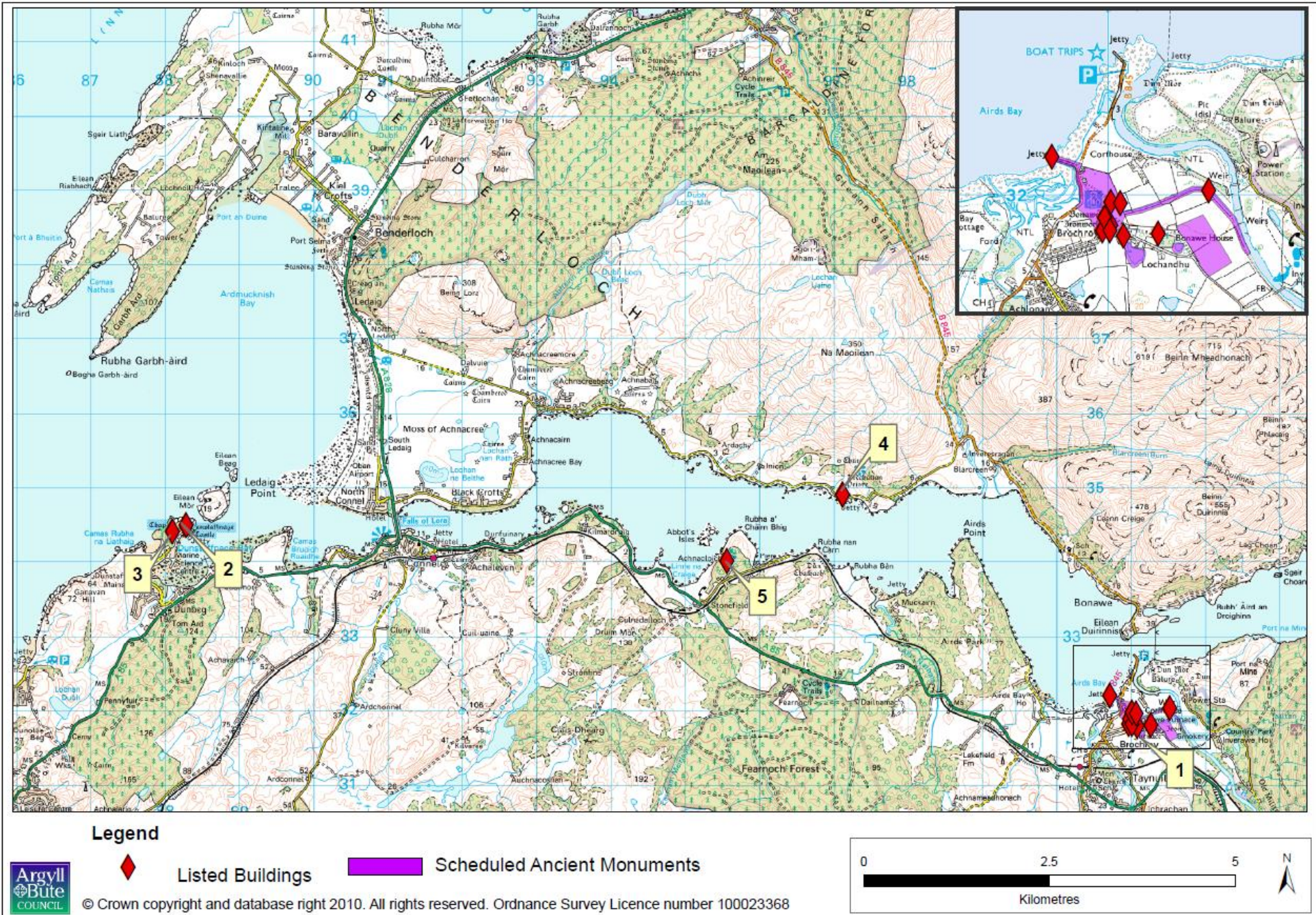


Figure 5.4 Location of listed buildings and scheduled ancient monuments of high importance, in close proximity to the coastline of Loch Etive

5.3.2 Marine Interests

Four ship wrecks, listed in the National Monument Record of Scotland are present in Loch Etive, but have no formal protection. The Historic Scotland website (<http://www.historic-scotland.gov.uk/index/heritage/wrecksites/guidance-for-marine-users.htm>) provides information on what to do if you find a wreck that may be of historic importance and obligations to report material recovered from wrecks.

Historic Scotland are working towards the publication of a strategy for the protection, management and promotion of marine heritage by 2011, which will ensure the new marine planning system under the Marine (Scotland) Act will account for and safeguard the marine historic environment. Where there is the potential for impacts on unscheduled or unrecorded marine archaeology from development proposals, Historic Scotland generally recommend that any assessment of impacts consider onshore impacts to marine historic features within and beyond the proposed development site and offshore impacts to historic features on the seabed or at the coast edge within and beyond any proposed development areas.

5.3.3 Safeguarding Archaeological and Historic Interests

Heritage assets are a finite and often irreplaceable resource and can be vulnerable to a wider range of human activities. Historic Scotland, an executive agency of the Scottish Government, is charged with safeguarding the nation's historic environment and promoting its understanding and enjoyment. Their main statutory remit is in regards to protecting designated heritage features, such as scheduled monuments and listed buildings, and their settings.

Local authorities have a responsibility to protect and support the retention of features or sites of archaeological and historical importance in the development plan process and will expect developers to take account of these interests when submitting planning applications. Relevant policy that aims to safeguard key archaeological and historic interests is detailed in Appendix I.

5.3.4 Local perspective on Historic Environment

Views on the Historic Environment, gathered during public meetings for the Loch Etive ICZM project included:

- Difficult to get information about history and historical sites. Needs to be made more accessible locally and to visitors;
- Would like to see a local history centre;
- Access to many historic sites is difficult and people are not sure which sites they can access;
- Want to see local historic sites safeguarded from development, but where appropriate accessible for peoples' enjoyment;
- Local interpretation should include information on historic interests; and
- Local websites could be used to improve local knowledge and raise awareness of historic sites.

5.3.5 Recommendations for the Historic Environment

- Improve local knowledge and raise awareness of Historic sites through provision of information on websites and interpretation, where appropriate.
- Improve, where appropriate access to important Historic sites and promote those sites that are currently accessible.
- Opportunities for enhanced management and/or interpretation of scheduled monuments should be explored in order to improve awareness of Argyll's designated heritage.
- The possibility of a local history/cultural centre or central heritage hub for the wider area should be explored, that would provide greater links with tourism, recreation and education.

Recommendations and Good Practice that promote understanding, consideration and protection of the Historic Environment, but are specific to particular marine and coastal activities, are included under the relevant activity section.

5.4 Invasive non-native marine species

5.4.1 Background

Invasive non-native species (INNS) are non-native organisms that successfully establish themselves, presenting a potential threat to the environment and the native species living there as they may out-compete the native species, change environmental conditions, or completely take over the new environment. Invasive non-native species are considered to be the second greatest threat to global biodiversity, after habitat destruction. It is estimated that there are around 79 marine and brackish non-native species present in Britain and around 24 of these are present in Scotland (Baxter *et al.* 2008).

5.4.2 Species already established

Five terrestrial INNS are established in the coastal area of Loch Etive. Further information on these species including how they can be spread and the potential impacts they can have can be found in Appendix VI.

Common cord-grass

Spartina anglica is a perennial salt marsh grass which has been planted in many areas for dune stabilisation and can spread by natural dispersal of seed. Its presence at An Sailean, Ardmucknish Bay appears to have resulted in significant change to the flora of the saltmarsh at this location but no sign of area loss. This is recognised by the WFD classification for the Firth of Lorn water body (which includes this area) and has been downgraded from high to good ecological status due to the presence of common cord-grass. On balance, *Spartina* is considered to have an adverse effect on invertebrate and bird populations, though it can increase roosting habitat for waders (Black 2008).

Japanese knotweed

Japanese knotweed *Fallopia japonica* has spread along the north shore of Loch Etive, from Achnaba to Bonawe Narrows, in many places restricting views of the loch from the main road, competing with native species and preventing access to the shore from the road. This species can spread along rivers and the coast by movement of plant fragments in water, and through the movement of plant debris in soil and on vehicles. It forms dense thickets to exclude native plants, prohibits regeneration, reduces biodiversity and alters the habitat for wildlife (Proctor & Rafferty 2004). In order to control this species, there is an ongoing trial control demonstration throughout Argyll and Bute.

Himalayan Balsam

Native to the western Himalayas, Himalayan Balsam *Impatiens glandulifera* is an invasive garden escapee, first introduced to Britain as an ornamental garden plant in the 1830's. It can spread rapidly through rivers and streams causing soil erosion, whilst once established it can out-compete through greater nectar production and shade out low level native plants, thus reducing diversity.

Rhododendron ponticum

Rhododendron ponticum is a non-native species and was introduced to the West Coast of Scotland by the Victorians, who often planted it as shelter around large estates. Over the years the species has spread out of these estates and now threatens large tracts of land throughout the Argyll. The species is particularly damaging to woodland biodiversity as it shades out native plants and mosses, and has a toxic root system which can lead to long term soil degradation. *Rhododendron ponticum* can be found spreading at Craig, Barrs and Glen Etive.

American Mink

The American Mink *Mustela vison* spreads through migration and kills ground nesting birds, small mammals, juvenile salmon and trout. Local seabird populations at some important islands in Loch Etive have been affected by mink predation and mink have also caused damage at some of the trout farms in the Loch. As a result mink control is carried out at some locations but not at a level that might lead to eradication or control of this species.

5.4.3 Threats from introduction of new species

The main threat from the introduction of new INNS to Loch Etive is from marine species, some of which have already been recorded in Argyll.

Activities such as shipping, recreational boating or aquaculture can inadvertently introduce marine invasive species to our waters, and some species can also be transported naturally by ocean currents, wind or may travel attached to floating objects such as seaweed or plastic containers.

Information on these species is summarised below and additional information on these species, including pathways for introduction and potential environmental and economic impacts can be found in Appendix VI.

Sea squirts

Carpet sea squirt

The colonial sea squirt (*Didemnum vexillum*) has recently been found at Largs marina, Firth of Clyde (Beveridge *et al.* 2009). An eradication programme for *D. vexillum* is underway, with some signs of early success. The potential ecological and economic impacts from this species are significant and this species presents the greatest risk to Loch Etive in terms of economic impacts on the aquaculture industry and environmental impacts on marine species.

Didemnum vexillum colonies alter marine habitats by smothering them in thick, sheet-like growths. Because of this it interferes with fishery and aquaculture operations as well as impacting on biodiversity. Colonies are found on hard substrates that include dock structures, moorings and ropes, steel chain, gravel seabed (pebbles, cobbles, boulders), ship and boat hulls. It also grows over organisms such as other sea squirts, sponges, seaweeds and wild shellfish. The colonies have been found at water depths ranging from the intertidal to 65m. Since it is an imported species it has no natural predators, so once established there is little to stop it spreading.

Leathery sea squirt

The Leathery sea squirt (*Styela clava*) is originally from the north western Pacific. It was introduced to the UK on ship hulls and large populations can dominate and displace other species through competition for food and space.

Algal species

Wire weed

Unattached fronds of the large brown seaweed (*Sargassum muticum*), also known as wireweed, were recorded in the Firth of Lorn and at Ganavan, near Oban in 2007 (Davison 2009). *S. Muticum* appears to be dispersing northwards along the west coast of Scotland. Northerly dispersal via natural drift is likely to be facilitated by the prevailing wind and current direction, although anthropogenic vectors, such as the movement of shellfish stock and recreational boating are likely to play important roles in its dispersal (Davison 2009). Wireweed causes problems by competing with native seaweeds and seagrasses through over-growing, shading and abrasion. It is considered a nuisance in harbours and shallow waters where large floating masses may become a hazard to commercial and recreational boating through entangling in propellers or blocking engine cooling systems. The floating mats can also affect water-sports such as swimming, wind surfing and sailing. Wireweed can also foul fishing nets and lines and can seriously impact on oyster beds and other aquaculture structures.



Other algal species

The red algae (*Heterosiphonia japonica*) and green algae (*Codium fragile*) have been recorded at Oban Marina (Beveridge *et al.* 2009). These species can alter seabed communities and habitats and the latter can smother shellfish beds and artificial structures. Wakame (*Undaria pinnatifida*) is an introduced species of brown seaweed (kelp) which has a rapid growth rate and the potential to overgrow and out-compete native species (Oakley 2007).

Other invertebrates

Slipper limpet

The slipper limpet (*Crepidula fornicata*) is typically found attached to shells and stones on soft substrata around the low water mark and the shallow sublittoral. It is often attached to the shells of mussels *Mytilus edulis* and oysters *Ostrea edulis* (Rayment 2008). It was introduced to the UK by hull fouling and contamination of oyster spat. It can smother seabed species, alter habitat structure and compete for food and space with other filter-feeding species, including mussels.

Japanese skeleton shrimp

The Japanese skeleton shrimp (*Caprella mutica*) is a relatively large, robust caprellid amphipod native to north-east Asia. This species is now widespread in Scottish coastal waters, occurring in high numbers on artificial structures such as mooring ropes and nets at aquaculture sites, and on pontoons and boat hulls in marinas (Cook 2005). *C. mutica* is also found on a range of natural substrata such as hydroids and algae. It is often found in association with *S. Muticum* (Oakley 2006). Impacts from this species are unknown.



Chinese mitten crab

Chinese mitten crabs (*Eriocheir sinensis*) are relatively large crustaceans, native to China. It was introduced by ship ballast water and hull fouling in 1935. This invasive species can cause degradation of river banks by burrowing and pose a significant threat to native communities in catchment systems. As a consequence, it has been placed on the IUCN 100 of the World's worst invasive alien species list (Neal 2005).

Parasites

Gyrodactylus salaris (GS)

The biggest current threat to Atlantic salmon populations and the fisheries they support is the parasite *Gyrodactylus salaris*. The potentially catastrophic consequences of its introduction mean that it is a priority for fisheries and aquaculture industries to identify and mitigate potential vectors (Kettle-White 2006). GS is a freshwater parasite and cannot thrive in sea water, meaning that it is most likely to be spread by wet equipment such as felt soled waders or wetsuits, fresh water inadvertently left in well boats or canoes and imported, untreated fish eggs.

It should be assumed that GS is present in all European Countries and endemic in Scandinavia.

Anyone coming from European countries that has used rivers or lakes should take the following precautions:

- Dry equipment at a minimum of 20 degrees C for at least two days;
- Heat for at least 1 hour at temperatures of above 60 degrees C;
- Deep freeze for at least one day;
- Immerse in a solution suitable for killing GS, (Virkon/Wescodine/Aquatic at 1% dilution) sodium chloride (3%) sodium hydroxide (0.2%) for a minimum of 10 minutes.

Guidance on prevention is available from the Scottish Government web site. www.infoscotland.com/gsubug.

5.4.4 Existing management and controls

Legislation

Risks are currently minimised through existing legislation, primarily the Wildlife and Countryside Act 1981⁴ and the Nature Conservation (Scotland) Act. In addition, the Scottish Parliament are currently consulting on the Wildlife and Natural Environmental (Scotland) Bill (August 2010) which seeks to prevent further releases of invasive non-native species and to ensure that, where they have already been released into the wild, they are controlled, contained and eradicated where possible. Prevention will be given highest priority due to the various difficulties, including cost, of control and eradication once a species has become established.

Plans, projects and strategies

The [Invasive Non-native Species Framework Strategy](#), launched on 28th May 2008, is intended to provide a strategic framework within which the actions of government departments, their related bodies and key stakeholders can be better coordinated and aims to minimise the risk posed, and reduce the negative impacts caused, by invasive non-native species in Great Britain.

The Scottish Association for Marine Science run a Marine Aliens Project⁵ that aims to map their current distribution, predict their spread and impact on native biodiversity, identify potential control methods and to raise awareness of their presence in UK coastal waters.

Argyll Fisheries Trust has developed a Bio-security Management Plan for Argyll and the Islands, that aims to establish a sustainable framework that will lead to the prevention, detection, control and eradication of invasive non-native species. This will be undertaken through the application of appropriate management activities, data collection, liaison, education and legislation. The Bio-security Management Plan can be viewed at: www.argyllfisheriestrust.co.uk/pdfs/argyllbiosecurityplan.pdf.

SNH launched a Species Action Framework⁶ in 2007 which in part focuses on invasive non-native species including Wireweed and the American mink. Guidance on identifying and reporting sightings of invasive non-native marine species, including Wireweed can be found in Appendix IV.

The Green Blue is the joint environment programme for the Royal Yachting Association and British Marine Federation and has produced considerable guidance and best practice for managing marine non native species for the recreational boating sector.

The *River Basin Planning Invasive Non-Native Species Supplementary Plan* is currently being prepared through a national advisory group involving SEPA, SNH, Marine Scotland, LINK (represented by RSPB), and the Scottish Government. The plan will tackle the issue of INNS and will be available in early 2011.

The Argyll and Bute Invasive Species Forum aims to establish a sustainable framework that will lead to the prevention, detection, control and eradication of invasive non-native species within the Argyll region. This will be undertaken through the application of appropriate management activities, data collection, liaison, education and legislation.

The Scottish Canoe Association also provides guidance and information on how to minimise the risk of spread of invasive non native species (see Appendix X).

Additional Information

Further information on INNS and where to report sightings is detailed in Appendix VI and IV respectively.

⁴ Under section 14 of The Wildlife and Countryside Act 1981, it is prohibited to introduce any non-native or hybrid species to Great Britain.

⁵ www.marlin.ac.uk/marine Aliens

⁶ <http://www.snh.org.uk/speciesactionframework/saf-background.asp>

5.4.6 Recommendations for invasive non-native species

- Local monitoring projects to collect data on distribution and abundance of INNS should be considered, including the potential to integrate other activities with the identification and reporting of INNS i.e. beach cleaning/mooring maintenance.
- Guidance should be developed to assist developers build bio-security measures into marine and coastal development proposals, including design structure, appropriate facilities and management protocols.
- Measures to reduce the mink population should be funded and supported by the relevant agencies, where appropriate.
- Local initiatives to tackle established coastal INNS should be considered, however the preferred option is for communities to raise funding and then employ trained Council staff, or local contractors with relevant experience, to carry out eradication measures.
- Projects that assist implementation of priorities/actions of Argyll Bio-security Plan should be supported.

Recommendations and Good Practice that promote understanding, consideration and management of invasive non-native species, but are specific to particular marine and coastal activities, are included under the relevant activity section.

5.5 Water Quality

The water environment of Loch Etive is very important for aquaculture, recreation, fisheries, biodiversity and transport. Many of these uses are economically dependent on a high quality water environment which makes its protection important. Aquaculture, in particular shellfish farming, relies on excellent water quality to support the growth of the species concerned and enable the final product to meet strict hygiene standards.

5.5.1 Local concerns about water quality

During the development of this plan a number of local concerns were raised about water quality in Loch Etive. These included:

- Concerns about high *E.coli* counts at certain times of year affect Shellfish Growing Water;
- Scottish Water infrastructure not being sufficient for all houses in Connel to connect to public sewer;
- Potential effects of hydroelectric station and Awe barrage on wild fish and salinity of Loch Etive; and
- Control of sand blast materials entering loch during maintenance of Connel Bridge.

5.5.2 Factors affecting water quality in Loch Etive

Diffuse pollution – Both agriculture and forestry can affect the water environment through diffuse pollution. Agriculture can be a source of nitrogen input and bacterial contamination to coastal waters and forestry operations can result in silt run off and acidification of water courses.

Point source pollution – Discharges

There are a number of point source discharges around Loch Etive from commercial, wastewater treatment and private residential outfalls. In addition, there are many residential outfalls with no treatment that discharge directly into the loch. All new discharges will be treated and disposed of to land where practicable. Where this is not possible the level of treatment will be determined by location of outfall. Future developments may connect to the public sewer in accordance with Sewers for Scotland standards, at the developers cost with a contribution from Scottish Water. Fish farming also releases nutrients and waste materials into the loch (see Section 6.1).

Since 2006 Scottish Water has made a number of improvements to the management of sewage effluent discharges from settlements around Loch Etive including:

- Effluent from Connel and Dunbeg is now pumped to the sewage facility at Saulmore;
- Improvements made to Taynuilt Sewage Treatment Works (STW);
- First time sewerage at Bonawe; and
- UV disinfection process added to Taynuilt and Bonawe STWs.

Climate Change

Rising water temperatures and greater nutrient run-off as a result of higher intensity rainfall events could exacerbate algal blooms, eutrophication and *E. coli* levels.

As described in section 2.3 of the plan, the upper basin of Loch Etive is more stratified than the lower basin and has poor deep-water circulation due to the shallow basin-dividing sill at Bonawe and significant fresh water input from multiple rivers. A brackish surface layer in the upper loch effectively isolates the bottom-water, resulting in seasonal low oxygen conditions.

Together with changes in precipitation patterns, higher temperatures will potentially increase stratification and reduce vertical oxygen transport to deeper waters and to the seafloor. Thus, predicted climate changes may very well increase the duration and severity of hypoxia (low oxygen conditions) in Loch Etive, a fjord that already is classed as one of the most sensitive Loch's in Scotland in terms of oxygen depletion (Gilibrand *et al.* 2007).

Litter and waste

About 80% of marine litter originates from land and up to 90% of the waste consists of plastics which may persist for considerable periods of time. Litter has an impact on wildlife the visual amenity of an area and can have an economic cost in terms of removing it. Coastal areas of Loch Etive affected by litter and debris were identified by local stakeholders during public meetings. Some of these areas are already targeted by local groups undertaking annual beach cleans and other areas affected by debris in locations that were less accessible were cleaned by the aquaculture industry.

Under the [Marine Strategy Framework Directive](#), Marine Scotland has specific requirements to meet regarding marine litter including ensuring that "properties and quantities of marine litter do not cause harm to the coastal and marine environment". Recognising that marine and coastal litter has multiple causes is a challenging problem involving land and marine issues, Marine Scotland is leading the development of a Scottish marine litter strategy.

5.5.3 Water Quality for Shellfish Growing

Bivalve molluscs such as mussels, scallops and oysters feed by filtering phytoplankton from the water and therefore pristine waters are essential for growing shellfish. Due to their filter feeding nature, shellfish will take up algal toxins, pathogens such as *E.coli* and other pollutants, which can accumulate in high levels in the tissue, making it unsuitable for human consumption. When considering the siting of new shellfish farms, it is important that developments are not close to any significant effluent discharges.

A research project investigating risk factors associated with cultured shellfish undertook a sanitary survey of Loch Etive in 2006/07. The Scottish Aquaculture Research Forum (SARF013) report found that the main source of bacterial contamination in Loch Etive was from agricultural run-off (Gillibrand *et. al* 2007). Local remediation was initiated by SEPA to address problem areas and improvements were made. However, current monitoring results of the Shellfish Growing Water do not appear to reflect improvements that can be directly attributed to this work. As part of the ongoing national diffuse pollution campaign, SEPA and partner organisations are promoting agricultural Best Management Practices and adherence to the diffuse pollution General Binding Rules (GBRs) under the Controlled Activities Regulations (CAR).

The following designations aim to protect water quality for shellfish growing and the quality of shellfish products for human consumption and their location is presented in Figure 5.5.

Shellfish Production Areas

Shellfish Production Areas are designated under the EC Shellfish Hygiene Directive 91/492/EEC, and require monitoring to ensure that shellfish are fit for human consumption. These areas are classified by the Food Standards Agency Scotland on the basis of *E. coli* concentrations, from A to C according to the degree of contamination in samples of mollusc flesh. The regulations also states the degree of depuration treatment required before the produce can be marketed if the production area is classified as B or C.

Loch Etive has clean waters and has been listed as a category A from January to April 2010 and category B shellfish Harvesting Area from May to December. Detailed information can be found at the Food Standards Agency website⁷.

Shellfish Growing Waters

Shellfish Growing Waters are designated under the EC Shellfish Waters Directive (2006/113 EC), which sets physical, chemical and microbiological water quality standards. This designation should contribute to improving and maintaining the quality of the shellfish that are harvested from these waters, protect the health of the people who consume them and thereby also assist the shellfish growing industry. Designation may also provide additional environmental benefits to local flora and fauna and other marine life, from cleaner water at these sites.

⁷ <http://www.food.gov.uk/scotland/safetyhygienescot/shellmonitorscot/shellclassesscot/>

Current SEPA Policy seeks to direct all new discharges of sewage effluent into soakaway arrangements wherever possible in an attempt to avoid direct discharges to designated areas, such as Shellfish Growing Waters. Where such discharges are unavoidable, licence conditions will be set to ensure the discharge is subject to an appropriate level of treatment that will allow the receiving waters to meet the relevant quality objectives and the relevant provisions of these Directives.

From 2013, Shellfish Growing Waters will no longer be designated and monitored under the Shellfish Waters Directive (2006) and will instead come under the WFD legislation. Exactly how this will work and the standards that will be applied have not yet been decided. However, irrespective of the details of the new regime, it is unlikely to be any less stringent than the current regime.

5.5.4 Management of the water environment

SEPA has a duty to control discharges to surface water and tidal water out to the three-mile limit, and groundwater. This is done through legally binding authorisations issued to dischargers. Where they are assessed to be significant, discharges and their effects on the environment may be monitored by taking chemical or biological samples for laboratory analysis.

River Basin Planning

SEPA has lead on the preparation of the River Basin Management Plan for the Scotland river basin district. River basin planning is a strategic decision-making process that integrates the management of land and water within river basin districts to deliver the requirements of the European Water Framework Directive. It aims to avoid deterioration and improve, where necessary, the ecological quality of rivers, lochs, estuaries, coastal and ground waters to good ecological status.

River basin planning in Argyll is being delivered by the Argyll and Lochaber Area Advisory Group who has developed the Argyll and Lochaber Area Management Plan, which covers Loch Etive. This plan provides an overview of the ecological status of all the water bodies in the area, the main pressures and the measures in place to improve water bodies to good ecological status and prevent deterioration as well as timescales for this. It also includes information on the pressures that are not subject to existing regulatory control such as aquatic and riparian non-native invasive plants and animals. An action plan and catchment summaries are being developed to provide more detailed and specific water body information to support this process. Further information and an interactive map showing the ecological status of all water bodies is available at www.sepa.org.uk/water/river_basin_planning.aspx.

Scottish Water Asset Improvement

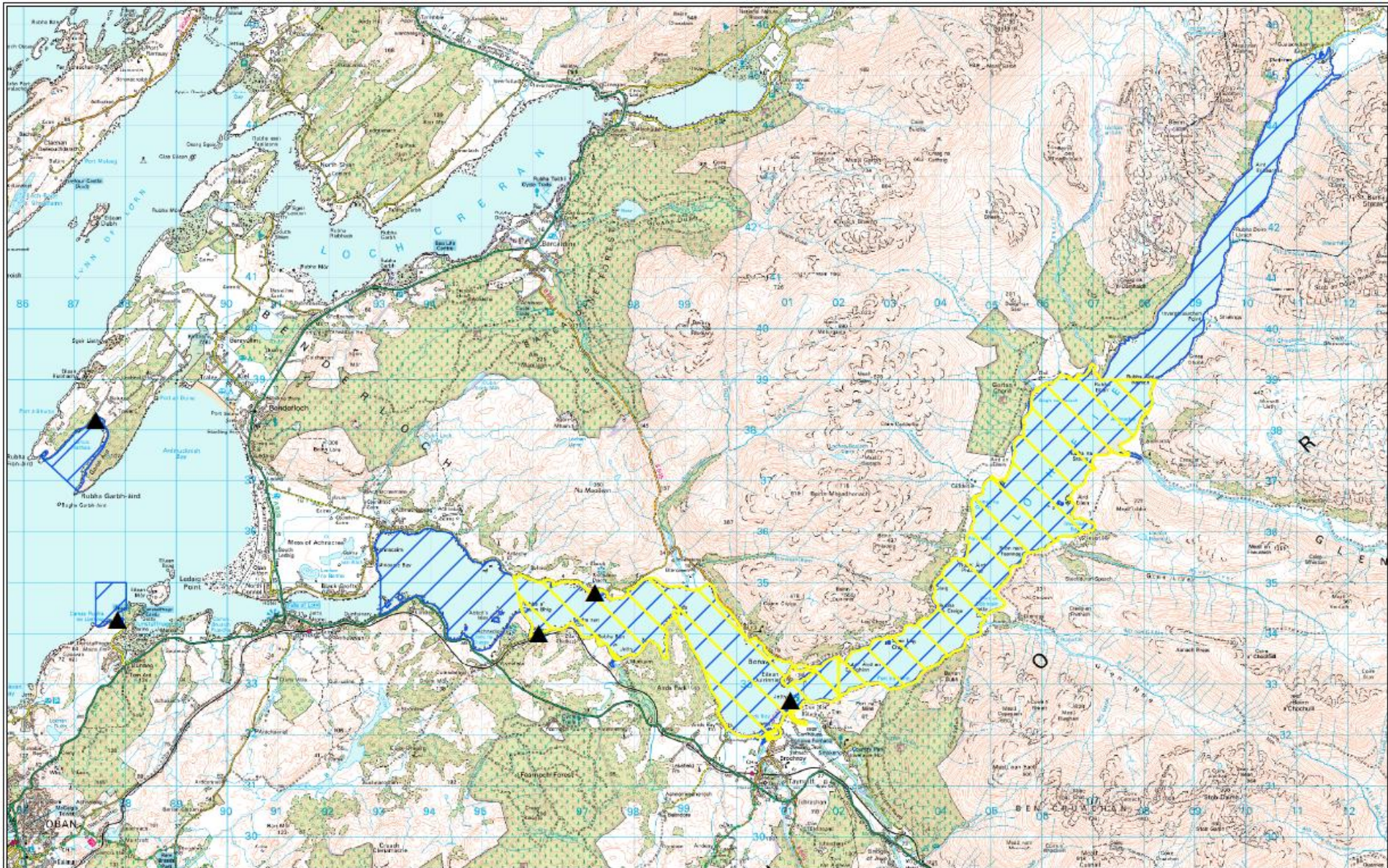
Scottish Water's investment programme is planned in advance and includes upgrades to sewage works and public drinking water supply infrastructure. The planning of the investment programme is an on-going process undertaken in consultation with the wider public, which is known as Quality and Standards (Q & S). Many of the actions undertaken under Q and S will help to achieve improvements in water bodies which are currently failing the Water Framework Directive.

5.5.5 Current water quality status of Loch Etive

As part of the River Basin Planning process, Scottish waters are required to be classified in accordance with their ecological status. Loch Etive itself is a transitional water body which is classified as being at good ecological status. Ardmucknish Bay and the west of the project area is within the Firth of Lorn (North) water body which is classified as moderate ecological status, but is predicted to improve to good status by 2015 or sooner subject to classification reviews.

The Loch Etive Shellfish Growing Water is currently failing guideline standards, but is anticipated to pass by 2021, following diffuse pollution priority catchment work.

There are a number of rivers flowing into Loch Etive which could influence its water quality. The River Etive and the other tributaries are at good ecological status with the exception of Allt Nathais which is high ecological status, Allt Easach and Abhainn Dalach which are at moderate ecological status and the River Esragan which is at bad ecological status.



Legend



- Shellfish Production Area
- Shellfish Growing Water (SGW)
- SEPA monitoring sites (SGW)

© Crown copyright and database right 2010. All rights reserved. Ordnance Survey Licence number 100023368

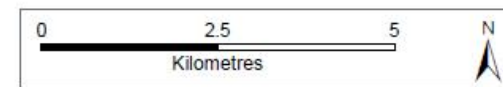


Figure 5.5 Location of Shellfish Growing Waters, Production Areas and monitoring points

5.5.6 Local agreement

The following local agreement was discussed and agreed by the Loch Etive ICZM stakeholder group.

Shoreline debris and litter

Issue

Shoreline debris and litter was determined to be a potential problem at a number of locations in Loch Etive. Accumulation of general litter and occasional debris from aquaculture sites had been exacerbated by winter storms in the past. Removal of litter/debris from problem areas has been undertaken by aquaculture companies and through existing local community beach cleans.

Local management Agreement

Stakeholders should contact The GRAB Trust for advice and support if they would like to pursue clean-ups using the Marine Conservation Society method. Aquaculture companies agreed to collect any aquaculture debris if informed of their location by loch users. Contact details can be found in Appendix VII.

5.5.7 Recommendations for Water Quality

- Home owners whose private sewage discharges into coastal waters or water courses that run into coastal waters, and do not have an authorisation to discharge (e.g. a Consent under the Control of Pollution Act, "COPA") should register their discharge with SEPA under the Controlled Activities Regulations.
- If evidence comes to light that the current sea loch grouping of monitoring sites for classification of coastal water bodies including Loch Etive is not appropriate, the representativeness of monitoring points should be reviewed by SEPA.
- SEPA should be consulted prior to any future maintenance works on Connel Bridge, in order to encourage containment and good practice that will minimise the risk of losing sand blast material.
- The proposed diffuse pollution work on the candidate priority Loch Etive catchment, scheduled for 2015-2021 should be taken forward earlier if the opportunity arises.
- Scottish Water should reconsider undertaking a previously planned feasibility/scoping study to look at the problem of insufficient infrastructure to allow all houses in Connel to connect to the public sewer.

5.6 Climate Change

Due to the considerable maritime influences in Scotland, it is inevitable that changes in the seas caused by climate change will have environmental and socio-economic impacts on Scotland. Therefore, there is a need to improve confidence in both understanding what is happening, and in predicting the likely consequences of climate change within Scottish waters. Further research is required in order to monitor ongoing changes in local marine and coastal environments, and to better understand how future changes in climate may impact highly sensitive marine and coastal ecosystems and the services that they provide.

5.6.1 What are the risks to Loch Etive and its surrounding coast?

It is clear that the potential effects of climate change are not well understood and the combination of different expected trends make it very difficult to estimate future risk and therefore appropriate management. However, there is strong evidence that in the short term, climate change can directly affect weather patterns increasing the frequency of storm and flooding events, and in the longer term, sea level rise and temperature increases.

The main potential effects from climate change on the human use of Loch Etive and its surrounding coast is summarised in Table 5.4. Currently some of the trends identified below are not being seen in Loch Etive, such as a predicted increase in water temperature and increased winter rainfall.

Table 5.4 Potential future effects of climate change relevant to Loch Etive⁸

<i>POTENTIAL EFFECTS</i>	
Coastal flooding	Future coastal flood risk in Scotland depends on a mix of global mean sea level rise, regional uplift or depression of the land surface, tidal changes and changes in wave heights and the frequency and severity of storm surges.
Built structures	Increased wave heights, sea-level rise and increased rates of erosion could increase damage to coastal structures.
Aquaculture	<p>Rising water temperatures could increase growth rates for some species (e.g. Atlantic salmon, mussels), but may also cause thermal stress for cold-water species (e.g. cod and Atlantic halibut) and intertidal shellfish (e.g. oysters).</p> <p>Farmed species may become more susceptible to a wider variety of diseases as temperatures increase.</p> <p>Increasing harmful algal and jellyfish blooms may lead to additional fish kills and closure of some shellfish production areas.</p> <p>Increased temperatures and more abundant plankton could also improve reproduction and settlement of 'spat' at shellfish farms.</p> <p>Average precipitation may increase in winter months and become dryer in summer months over the next 50 years on the west coast of Scotland. This may lead to increased bacterial loading during the winter through increased volumes of sewage overflow discharges and land run-off.</p>
Fisheries	<p>Ocean acidification may pose a significant threat to the UK shellfish industry, but more research is required.</p> <p>Changes in distribution shifts of fish stocks as a result of an increase in temperature may affect productivity and vulnerability of certain stocks to fishing fleets.</p> <p>Changes in climate may provide more favorable conditions for some fish stocks, particularly those that respond well to warmer waters, leading to enhanced fishing opportunities.</p> <p>Increased tendency for stratification could lead to offshore blooms including <i>Karenia mikimotoi</i> which has been associated with fish kills and benthic mortalities in coastal waters.</p>

⁸ Data has been taken from the Marine Climate Change Impacts Partnership Annual Report Card 2010-2011 (<http://www.mccip.org.uk/annual-report-card/2010-2011.aspx>) and Scotland's Seas: Towards Understanding their State (Baxter et al. 2008).

Tourism	<p>Climate over the summer months is projected to become warmer and drier; with the potential to boost tourism and recreation opportunities for coastal communities.</p> <p>Increased visitor numbers could overwhelm small coastal communities with implications for energy, water and waste management and environmental degradation.</p>
Biodiversity	<p>Together with changes in wind and precipitation patterns, higher temperatures will potentially increase stratification of sea lochs which could reduce oxygen transport to deeper waters and to the seafloor.</p> <p>Seabirds sit at the top of the marine food chain and will be impacted by changes in the availability of their prey. Models predict that the geographic range of the common gull and Arctic tern will shrink so that only Shetland and the most northerly tips of mainland Scotland will hold breeding colonies by 2100.</p> <p>Any increased storminess would reduce the amount of safe breeding habitat for shoreline-nesting species (e.g. terns) and create unfavourable foraging conditions at sea, which may lead to starvation of adults and chicks of some species.</p> <p>Increased coastal flood risk could affect seal haul-out and breeding sites in low-lying areas.</p> <p>Continued sea-level rise, and other climate change related factors are expected to have an impact on the extent, distribution and quality of various coastal habitats.</p>

5.6.2 Coastal Flooding

All Scottish mainland tide gauges have recorded sea-level rise over the last 100 years, however some regions will be more affected than others. Sea levels are also affected by meteorological conditions such as air pressure and winds which cause 'surges' that can affect the predicted tide levels significantly. Future sea-level rise and a predicted increase in storm surges may increase the frequency and severity of coastal flooding around Loch Etive.

SEPA has developed the Indicative River and Coastal Flood Map (Scotland) which identifies areas of coast that are at risk of flooding from the sea. Areas estimated to have a 1 in 200 or greater chance of being flooded in any given year are considered to be medium to high risk and have been considered when developing policy guidance for each policy zone in section 7. Argyll and Bute Council requires a 'flood risk assessment' to be submitted with planning applications for vulnerable developments in these medium to high risk areas.

The main impacts from coastal flooding in the past has been flooding over the main roads (A85 and B845) and flooding of the sewage works at Taynuilt. In 2005 an embankment was washed away south of Achnaba on the B845.

Flood Risk Management

SEPA is responsible for providing advice to local authorities on flood risk for planning purposes, and advice on flood prevention. The Flood Risk Management (Scotland) Act places a duty on the Scottish Government, SEPA, Scottish Water and local authorities to better co-ordinate the assessment and management of flood risk. Whereas, current policy focuses on river and coastal flooding, the Act covers all sources of flooding, including overloaded sewers.

Local Transport Strategy 2007-2010: Includes actions relevant to managing the effects of climate change on the transport network. Monitor effects of climate change, (e.g. flooding, storm damage, coastal erosion), on the transport network and implement works as necessary.

5.6.3 Recommendations for Climate Change

- Support should be provided by relevant authorities to enable the aquaculture, fishing and leisure industries to take advantage of opportunities brought about by the effects of climate change and where possible safeguard against the negative effects.

Recommendations and Good Practice that promote understanding, consideration and management of Climate Change, but are specific to particular marine and coastal activities, are included under the relevant activity section.