NatureScot
Scotland's Nature Agency
Buidheann Nàdair na h-Alba

RIVER OYKEL
SPECIAL AREA OF CONSERVATION (SAC)

CONSERVATION ADVICE PACKAGE

Image: © Lyn Wells, NatureScot

Site Details

Site name: River Oykel

Site map: https://sitelink.nature.scot/site/8363

Location: Highlands and Islands

Site code: UK0030261

Area (ha): 921.46

Date designated: 17 March 2005

Qualifying features

Qualifying feature	SCM assessed condition on this site	SCM visit date	UK overall Conservation Status
Freshwater pearl mussel (*Margaritifera margaritifera*) [S1029]	Unfavourable - No change	8 April 2015	Unfavourable – bad
Atlantic salmon (*Salmo salar*) [S1106]	Favourable – Recovered	7 July 2011	Unfavourable-Inadequate

Notes:
Assessed condition refers to the condition of the SAC feature assessed at a site level as part of NatureScot's Site Condition Monitoring (SCM) programme.
Conservation status is the overall condition of the feature throughout its range within the UK as reported to the European Commission under Article 17 of the Habitats Directive in 2019.

Overlapping and linked Protected Areas

The River Oykel SAC includes main stem of the River Oykel, which rises within

- Ben More Assynt Site of Special Scientific Interest (SSSI) https://sitelink.nature.scot/site/191

The river flows through Loch Ailsh, which is part of

- Inverpolly, Loch Urigill and nearby Lochs Special Protection Area (SPA) https://sitelink.nature.scot/site/8516 and
- Loch Awe and Loch Ailsh SSSI https://sitelink.nature.scot/site/1710.

It also flows through

- Oykel Gorge SSSI https://sitelink.nature.scot/site/1264
- Kyle of Sutherland Marshes SSSI https://sitelink.nature.scot/site/885

The River Oykel SAC also includes two principle tributaries of the River Oykel:

- the River Cassley which rises within a different part of Ben More Assynt SSSI https://sitelink.nature.scot/site/191
- the River Einig which rises within Beinn Dearg SAC https://sitelink.nature.scot/site/8198 and Beinn Dearg SSSI https://sitelink.nature.scot/site/165

The seaward end of the River Oykel SAC meets the

- Dornoch Firth and Morrich More SAC https://sitelink.nature.scot/site/8242

at Bonar Bridge.

Key factors affecting the qualifying features

Freshwater pearl mussel

Freshwater pearl mussels are long-lived freshwater molluscs that live in the gravel beds of clear, unpolluted rivers. For part of their lifecycle they are dependent upon a healthy population of salmonids (young salmon or trout) which act as host species. The mussel larvae attach to the gills of salmonid fish in mid to late summer and drop off the following spring. When they detach from their hosts they must land in sandy or gravelly substrates to settle and grow to adulthood. In suitable conditions they can live for over 100 years. However freshwater mussel populations are vulnerable to changes to water quality (including pollution), hydrological alterations (including river engineering and abstractions), habitat degradation of river beds and banks, illegal pearl fishing and availability of host species.

The feature has been assessed through NatureScot's site condition monitoring programme as being in unfavourable condition at this SAC due to the low number and density of freshwater pearl mussels present, low levels of juvenile recruitment, water quality, water flow and disturbance of mussel beds through illegal pearl fishing.

Further information about freshwater pearl mussels can be found here.

Atlantic salmon

Atlantic salmon live in both freshwater and marine environments as part of their lifecycle. They hatch and live in freshwater as juveniles and then migrate to sea as adults. After one year or more at sea the adults return to their natal river to spawn. This homing behaviour has resulted in the development of genetically distinct populations of Atlantic salmon between rivers and several populations may exist within the same river.

Atlantic salmon numbers have declined throughout their geographic range, including in Scottish rivers. They may be impacted by a range of pressures in the freshwater and marine phases of their lifecycle. In the River Oykel these pressures include: over exploitation, loss of habitat connectivity, habitat degradation, climate change-related changes to surface water temperature and hydrology, built development (such as hydropower on the River Cassley and a weir on the Tutim Burn which is a barrier to salmon reaching apparently suitable habitat upstream) and direct and diffuse pollution and inappropriate stocking with young salmon in the past. The river is also vulnerable to the introduction of other new species through a number of routes (anglers, canoes, etc) which could have a negative impact.

Marine mortality is one of the key issues facing Atlantic salmon in Scotland and elsewhere. Environmental factors, climate change, marine developments, enhanced sea lice burdens associated with aquaculture, by-catch in pelagic fisheries, over-exploitation, prey availability, pollution and predation are all key factors that could affect this species. However, the exact nature of these interactions is not fully understood.

The feature has previously been assessed through NatureScot's Site Condition Monitoring programme as being in unfavourable condition at this SAC due to the low number of salmon in the river. Marine mortality of adult salmon may be contributing to this, but the scope of this document covers only those measures that can be taken within the SAC. Management measures are in place in the River Oykel to increase the salmon population through a locally agreed catch-and-release policy and by working more closely with forestry managers to resolve water quality issues in the run-off from conifer plantations. Salmon runs prior to the most recent assessment had increased enough for the feature to be in favourable condition.

Further information about Atlantic salmon can be found here.

Conservation Priorities

There is unlikely to be any conflict between management of the Atlantic salmon and freshwater pearl mussel features of the River Oykel SAC as both require similar environmental conditions and pearl mussels are dependent on salmon for part of their life cycle.

A small part of the River Oykel SAC overlaps with Beinn Dearg SAC, which has blanket bog and Caledonian forest as Habitats Directive Priority Features. Broadly similar management is likely to be suitable for both SACs where they overlap, although careful consideration would be needed before planting trees on blanket bog within Beinn Dearg SAC to benefit Atlantic salmon or freshwater pearl mussel.

Any management for the River Oykel SAC or assessment of plans or projects will need to take account of all the interests of the Beinn Dearg SAC, Dornoch Firth and Morrich More SAC and Inverpolly, Loch Urigill and nearby Lochs SPA where the sites are adjacent or overlap. If any management conflicts were to arise between the qualifying features of the River Oykel SAC and Beinn Dearg SAC where the sites overlap, blanket bog should be given priority. This is because blanket bog is a Priority Feature and because management to benefit the River Oykel SAC could be done outwith Beinn Dearg SAC. No conflict is expected between the Caledonian forest feature of Beinn Dearg SAC and the features of the River Oykel SAC because Caledonian forest does not occur within the River Oykel SAC.

Overarching Conservation Objectives for all features of River Oykel SAC

1. To ensure that the qualifying features of the River Oykel SAC are in favourable condition and make an appropriate contribution to achieving favourable conservation status
Favourable Conservation Status (FCS) is considered at a European biogeographic level. When determining whether management measures may be required to ensure that the conservation objectives for this site are achieved, the focus should be on maintaining or restoring the contribution that this site makes to FCS. When carrying out appraisals of plans and projects against these conservation objectives, it is not necessary to understand the status of the feature in other SACs in this biogeographic region. The purpose of the appraisal should be to understand whether the integrity of the site (see objective 2) would be maintained. If this is the case then its contribution to FCS across the Atlantic Biogeographic Region will continue to be met. Further details on how these appraisals should be carried out in relation to maintaining site integrity is provided by objective 2 (including parts a, b, c – and for freshwater pearl mussel - d). If broader information on the feature is available then it should be used to provide context to the site-based appraisal. Note that “appropriate” within this part of the conservation objectives is included to indicate that the contribution to FCS varies from site to site and feature to feature.

2. To ensure that the integrity of the River Oykel SAC is restored by meeting objectives 2a, 2b, 2c for both features (and 2d for freshwater pearl mussel)
The aim at this SAC is to maintain, or where appropriate restore, the qualifying species in a favourable condition as a contribution to their wider conservation status. Therefore any impacts to the objectives shown in 2a, 2b, 2c or 2d below must not persist so that they prevent the achievement of this overall aim. When carrying out appraisals of plans or projects the focus should be on restoring site integrity, specifically by meeting the objectives

outlined in 2a, 2b, 2c and 2d. If these are met then site integrity will be restored. Note that not all of these will be relevant for every activity being considered. Any impacts on the objectives shown in 2a, 2b, 2c or 2d below must not persist so that they prevent the restoration of site integrity. Temporary impacts on these objectives resulting from plans or projects can only be permitted where they do not prevent the ability of a feature to recover and there is certainty that the feature will be able to quickly recover.

This objective recognises that the qualifying species are exposed to a wide range of drivers of change. Some of these are natural (e.g. population fluctuations/ shifts or habitat changes resulting from natural processes) and are not a direct result of human influences. Such changes in the qualifying species' distribution and use of the site, which are brought about by natural processes, directly or indirectly, are normally considered compatible with the site's conservation objectives. An assessment of whether a change is natural or anthropogenic, or a combination of both, will need to be looked at on a case by case basis.

Conservation Objectives for freshwater pearl mussel (*Margaritifera margaritifera*)

2a. Restore the population of freshwater pearl mussel as a viable component of the site

The conditions for the species' long-term existence within the River Oykel SAC should be restored. This includes encouraging and allowing the number and density of mussels to increase.

This conservation objective is considered to be met, if the conditions for the species' long-term existence are in place. These conditions include:
- Avoiding effects that could lead to an inability of the population to successfully reproduce and recruit sufficient juveniles into the population (e.g. >20% of the population should be juvenile <65mm long. Very young juveniles <30mm long should also be present).
- Avoiding effects that could lead to a permanent reduction in the density and number of freshwater pearl mussels in the population, or that prevent a recovery in density and numbers, through mortality, injury or impacts caused by disturbance. These effects could be caused by development, water pollution, river engineering, land-use change, abstractions, and wildlife crime. For a healthy mussel population the aim is to have at least 5 mussels per m^2 in appropriate habitat.
- Ensuring high quality habitat in river reaches that support freshwater pearl mussels (see conservation objective 2c).
- Allowing the species distribution within the site to be maintained or expanded (see conservation objective 2b).
- Maintaining the distribution and viability of the freshwater pearl mussel's host (*Salmonid* species), and their supporting habitat (see conservation objective 2d).

However, freshwater pearl mussels are in unfavourable condition at this site. The focus of this objective will therefore be to stop the decline in population and subsequently promote its increase. Recovery of mussel populations is notoriously difficult. This is partly due to their unusually long lifecycle and their requirement for high quality freshwater conditions and riverine habitats, including low levels of nutrients and fine sediments. These conditions generally need to be provided all the time.

The early stages of the pearl mussels' lifecycle is also complex and delicate, as it relies on the presence of healthy, abundant, juvenile, native salmonids. It is therefore also important that the local salmonid population is robust and able to access all relevant areas of this SAC.

When assessing the effects of any plan or project consideration should be given to whether impacts outwith the SAC could affect achievement of this conservation objective.

2b. Restore the distribution of freshwater pearl mussel throughout the site

Conditions should allow for the distribution of the species to be expanded or at least restored to their previous known extent.

Distribution of mussels can be affected by disturbance originating both within and outwith the site. Factors such as abstraction, water pollution, illegal pearl fishing, river engineering and intensification of land use can risk directly affecting freshwater pearl mussels.

The species can be directly affected, or the species' habitat quality reduced such that recruitment is unsuccessful, leading to a contraction in the species' distribution. It is important that the distribution of mussels is maintained. Freshwater pearl mussels are mainly present within the main river stem. However, tributaries may contain populations that are yet to be discovered.

Plans and projects that cause disturbance, displacement and barrier effects to the host species can also affect mussel distribution (see conservation objective 2d).

2c. Restore the habitats supporting the freshwater pearl mussel within the site and availability of food

The distribution and extent of the mussel's habitat within the site, together with the structure, function and supporting processes of the habitat should be restored.

Freshwater pearl mussels are typically found in rivers with 'soft' high water quality conditions, combined with abundant gravel river beds. They feed by filtering fine organic particles from the water. In order to maintain the supporting freshwater pearl mussels' habitat it is important that the species' high quality habitat requirements are met.

High water quality and natural flow conditions should be in place to provide the necessary conditions for freshwater pearl mussel. The restoration of peatlands (e.g. drain-blocking) and creation of native riparian woodlands will also lead to more sustainable river flow regimes. These land management practices will help to reduce the potential for damaging flood impacts and also create more sustainable steady flows during droughts.

Freshwater pearl mussel populations are particularly vulnerable to nutrient enrichment and increases in fine sediment, both of which can affect the juvenile mussels that predominantly live buried in river gravels. River engineering can also directly damage populations, as well as interrupt the supply of sediment that maintains the habitat. Changes in land use have the potential to increase nutrient and fine sediment concentrations within the river. However land use changes, such as the establishment of native riparian woodlands, have the potential to improve habitat by providing shade that can mitigate damaging peaks in summer temperature, stabilise river banks and thereby reduce erosion.

In this respect, we welcome the large scale positive expansion of riparian native woodland proposed for Ben More Forest, managed by Forestry & Land Scotland (FLS). This will assist in providing riparian shade, increasing invertebrate and leaf fall for freshwater life. Riparian woodland will also buffer potential impacts from nearby commercial woodland operations. This large scale woodland proposal is an important step in assisting the restoration of freshwater pearl mussel within this protected area. We would welcome similar restoration proposals from private forestry, where potential exists to expand native riparian woodland adjacent to the main stem and smaller tributaries.

Specific targets for water quality parameters include:
- Nutrient concentrations should be near-natural. High levels of soluble reactive phosphorus can be particularly problematic, therefore levels entering the river system should be kept very low[1], or avoided altogether.[1]
- Mean Biochemical Oxygen Demand (BOD) should be <1 mg/L. BOD measures the oxygen consumed by bacteria from the decomposition of organic matter (such as sewage or run-off from eroding land) in water. Unpolluted water has a naturally low BOD level (i.e., well oxygenated water with a low level of organic matter). Freshwater pearl mussels need river water to have some organic particles, as this is what they feed on. However mussels can be harmed by excessive levels of organic particles, and associated low levels of oxygen within the water. At present, the BOD is higher than the desired threshold level within the lower reaches of the SAC.
- Filamentous algae should have <5% coverage of the river bed during the summer months (indicating that the river does not have excess nutrients).
- Excess fine sediment should be avoided in the river as this can smother freshwater pearl mussels or interfere with filter feeding.
The quality of the riverbed habitat is particularly important for freshwater pearl mussels, and is best assessed by measuring the 'redox potential' (a measure of how much oxygen there is in the water).
- There should be no pronounced difference in the redox potential between open water and interstitial (within sediment) water at 5cm depth (a typical depth for juvenile freshwater pearl mussels which are normally buried within the gravels).
- River flow rates should be natural and should meet the WFD 'high status' as standard throughout the site. In the River Cassley, some reaches are currently classed as 'moderate' status and the possible effects on resident pearl mussels should be investigated further.

The site includes several streams which are below the size threshold for SEPA's freshwater classification system and so ideally separate water quality monitoring is needed to ensure these targets are met for all reaches of the SAC.

2d. Maintain the distribution and viability of freshwater pearl mussel host species and their supporting habitats

Sufficient salmonid fish hosts should be present to support juvenile mussel recruitment.

Salmonid fish (native salmon and trout) are an integral part of the freshwater pearl mussels' lifecycle as a host species during their larval stage. Therefore, salmon and/or trout should be available in sufficient numbers to ensure continued recruitment of juvenile mussels back into the population. An abundance of > 0.1 native juvenile host salmonid per m^2 in appropriate habitat should ensure sufficient host species are available. More generally, the density of host juvenile salmonids should not differ significantly from those expected for the river type/reach under conditions of good physical and chemical quality.

It is important that juvenile host salmonids, including any range of genetic types, are present in all areas of the catchment to which they, and adult fish, have natural access and where freshwater pearl mussels have historically been present.
Freshwater pearl mussel population viability is dependent upon the viability of the host salmonid population. Therefore, any threats to host species stocks should be avoided. Factors that can affect the viability of host fish include those that affect freshwater pearl mussel, but potential barriers to fish migration, inappropriate fish stocking and biosecurity issues further increase the risk factors. Factors that also affect the marine survival, and therefore viability, of Atlantic salmon and sea trout populations should also be considered

[1] *The soluble reactive phosphorus annual mean should be <0.005mg/l. If this is exceeded then a site specific target of reference condition should be set. Alternatively, the Water Framework Direct (WFD) 'high status' or the target for Common Standards Monitoring river habitat should apply.*

within context to the mussel population.

Host fish should be able to continue to use and access all areas of importance within the site. Plans and projects that cause long-term disturbance, displacement and barrier effects can affect fish distribution and in turn the distribution of freshwater pearl mussels. The fish pass at the hydro scheme abstraction on the River Cassley should remain functional, as there are freshwater pearl mussels upstream of this point.

To ensure a viable population of host species is present, supporting salmonid habitat should be maintained throughout the site. Atlantic salmon and trout, both require the presence of clean gravels for spawning. For Atlantic salmon and large trout, these typically occur at the tail-end of pools, although spawning may take place if suitable gravels and flows are present. On emergence, usually between March and early May, the young fry disperse and set up territories which they defend aggressively. Atlantic salmon fry prefer fast flows (>30 cm/s) in addition to a rough bed of pebble, cobble and gravel; favouring these areas which provide a surface turbulence (riffle habitat). Trout fry prefer areas of relatively low water velocity near the streambed. Cover from stones, plants and in-river debris is essential for maintaining high fry densities.

Atlantic salmon that have survived their first winter (parr) prefer deeper water than fry (typically 15-40 cm) and a coarser substrate of pebbles, cobbles and boulders.
Trout parr generally favour currents of relatively low speed, where cover is available. Juvenile trout are often to be found under bankside cover, within undercuts, among tree roots or under marginal vegetation. Cover remains important for adult trout and Atlantic salmon particularly in smaller streams. The shade from bushes next to the river or overhanging trees is likely to help to prevent fish from becoming stressed due to high water temperature combined with low water levels. Where the river is larger this may be less important as deeper water provides refuge.

Conservation Objectives for Atlantic salmon (*Salmo salar*)

2a. Maintain the population of Atlantic salmon, including range of genetic types, as a viable component of the site

The conditions for the species' long-term existence at the River Oykel should be maintained.

This conservation objective is considered to be met if the conditions for the species' long-term existence are in place. These conditions include:

- Effects should be avoided that could lead to a permanent reduction in the Atlantic salmon population, or that prevent the population from recovering, through mortality, injury, or impacts caused by disturbance or displacement. For example, this could include the effects caused by the construction of in-stream barriers to migration, changes in water flow rates or water quality. Observed densities therefore need to be assessed in relation to the expectation for the River Oykel overall and for each river reach, based on productivity and natural habitat character of the system. However, these should not differ significantly from those expected for the river type/reach under conditions of high physical and chemical quality.
- The numbers of returning Atlantic salmon should be sufficient to maintain the long-term viability of each life history type. All returning adults and emigrating smolts must have unhindered access between freshwater and marine habitats (see conservation objective 2b). All supporting freshwater habitats must be of sufficient quality and quantity, to support both adult and juvenile fish (see conservation objective 2c). Different rivers have different seasonal patterns of adult migration associated with the environmental

characteristics of the catchment and the river system. Multi-sea winter fish are an important component of a natural Atlantic salmon run and the spring run component has declined considerably in recent years. The characteristic seasonal pattern of migration within the river, in particular, the multi-sea-winter stock component, should be maintained.

When assessing the effects of any plan or project consideration should be given to whether impacts outwith the SAC could affect achievement of this conservation objective. The appraisal should also consider the life history traits of the species, including maintaining all genetic types of Atlantic salmon, and the scale and duration of the impact being assessed. Impacts resulting in the loss of genetically distinct populations of Atlantic salmon would not be considered temporary in nature as these adaptive traits may have evolved over generations and could not be recovered if lost.

2b. Maintain the distribution of Atlantic salmon throughout the site

The distribution of Atlantic salmon within this SAC should not be restricted by pollution or human activities.

Access to spawning sites, juvenile rearing sites and areas where adult Atlantic salmon may rest prior to spawning (some may be present within the river for a year prior to spawning), should all be *maintained*. Juvenile Atlantic salmon should be present in all areas of the catchment to which they, and adult fish, have natural access. This does not include areas above naturally impassable barriers, but areas where access has been limited by man-made obstructions. The fish pass at the hydro scheme abstraction point on the River Cassley should remain functional to allow salmonid access to the upper reaches of this river.

The distribution of Atlantic salmon within the site may be affected by disturbance originating both within and outwith the site (including estuarine and coastal areas). Plans and projects that cause displacement and barrier effects to the species, for example by impeding access to spawning areas or downstream passage of smolts to the sea, can also affect species distribution. Examples may include: the provision of compensation flows which are inadequate to allow adult Atlantic salmon to reach known spawning areas; the presence of physical in-stream structures such as flow deflectors, coffer dams etc. which may increase flow velocity to that which is beyond the swimming capacity of migrating fish or sustained noise generation (such as that caused by piling) in places that cannot be avoided by migrating Atlantic salmon.

2c. Maintain the habitats supporting Atlantic salmon within the site and availability of food

The distribution and extent of the species' habitat within the site, together with the structure, function and supporting processes of the habitat should be maintained.

High water quality and natural flow conditions should be in place to provide the necessary conditions for Atlantic salmon survival and recruitment.

Atlantic salmon spawn in late autumn and early winter, depositing their eggs in redds which they excavate in gravel and pebble beds. Eggs are often deposited in areas of accelerating flow, such as the tail end of pools and glides, upstream from riffles. However, in upland streams eggs may be deposited in any areas of gravel that can be physically moved by the fish. A good supply of oxygen is essential for eggs to develop and this is facilitated by a flow of water through the gravel. Therefore, clogging these fine sediments with silt and fine sand can reduce the water and oxygen flow resulting in egg mortality. Egg survival is also affected by redd 'washout' during winter spates, resulting in the physical scouring out of eggs from the gravel. Substrate stability, the dynamics of water flow and the weather all influence the

extent of siltation and scale of washouts.

After hatching, the young fry remain in the gravel until March to early May, when they disperse and set up territories. Atlantic salmon fry prefer fast flows (>30 cm/s) and favour areas with surface turbulence (riffle habitat). They require a rough bed of pebble, cobble and gravel and water <20 cm deep. Good cover is essential for maintaining high fry densities, such as cover from stones, plants or debris.

Atlantic salmon that have survived their first winter (parr) prefer deeper water than fry (typically 20-40 cm) and a coarser substrate of pebbles, cobbles and boulders. Cover remains important for adult Atlantic salmon particularly in smaller streams and rivers. In larger rivers and lochs this type of cover is less important.

Favoured habitat used by adult fish include pools of at least 1.5 m depth, with cover from features such as undercut banks, instream vegetation, submerged objects and even surface turbulence. Spawning habitat is defined as stable coarse substrate without an armoured layer, in the pebble to cobble size range (16-256 mm) but with the majority being <150 mm. Water depth during the spawning and incubation periods should be 15-75 cm.
Coarse woody debris should be retained where appropriate, as it plays a significant role in the formation of new gravel beds.

Juvenile Atlantic salmon (fry and parr) maintain feeding stations within rivers and defend these aggressively. The invertebrates which they feed upon are intercepted by juvenile fish as they drift downstream, and may be of both aquatic and terrestrial origin.

At sea, adult Atlantic salmon feed on range of prey items, including marine amphipods, shrimps and squid and fish, such as sand eels, capelin and herring. Adults do not feed once they return to freshwater.

As a result of their life history, Atlantic salmon stocks can be impacted in both freshwater and marine habitats. In freshwater, both water quality and water quantity are key issues. Salmonids require access to rivers with unpolluted and well-oxygenated water with a habitat mosaic which comprises suitable spawning gravels, cobbles and boulders. In terms of water quality, these fish also require enough water to ensure access to and from spawning areas, as well as enough water to maintain an adequate level of juvenile habitat.

Over-exploitation, inappropriate stocking activities, riparian land management operations (such as those related to forestry and agriculture), in-stream engineering and alterations to natural water flow regimes (including those relating to hydropower development), invasive non-native species, physical barriers to migration (such as historic caulds and lades), pollution (direct and diffuse) and direct damage to spawning habitat (e.g. through mineral or gravel extraction) can all impact the quality of freshwater environments and their value to Atlantic salmon. Climate change, and the rises in water temperatures during summer, may also be a factor in determining the suitability of some waterbodies for Atlantic salmon. Therefore cover is important for Atlantic salmon, particularly in smaller streams. The shade from bushes next to the river or overhanging trees is likely to help to prevent fish from becoming stressed due to high water temperatures which often occur in combination with low water levels. Where the river is larger, this may be less important as deep water can provide cool refuge.

See freshwater pearl mussel conservation objective 2c, for Forestry & Land Scotland's (FLS) proposed riparian planting at Ben More Forest. This restoration proposal, mainly for freshwater pearl mussel, will also benefit salmon by improving riparian habitat and increasing food availability.

Water quality, hydrology, and habitat standards for Good Ecological Status (GES) under the Water Framework Directive should be met. These targets are intended to support a healthy, naturally functioning riverine ecosystem which protects the whole biological community and individual species to a degree characteristic of the river.

Conservation Measures

Parts of the River Oykel SAC are within SSSIs and management changes described on the SSSI list of Operations Requiring Consent must have prior consent from SNH (NatureScot).

Current and recommended management for freshwater pearl mussel and Atlantic salmon

Issue	Measure	Responsible party
Suspected persecution resulting in low numbers and density of mussels	Freshwater pearl mussels are fully protected under Schedule 5 of the Wildlife and Countryside Act 1981 as amended. Offences include intentionally or recklessly killing, injuring or taking from the wild a freshwater pearl mussel.	All
	Continue to monitor for signs of illegal freshwater pearl mussel fishing, report any findings to the Police and implement agreed actions to deter criminal activity.	Public, Police, Kyle of Sutherland Fisheries Board, river managers, NatureScot
Ongoing species protection for salmon	Legislation is in place to manage and protect Atlantic salmon in freshwater and at sea. This includes a statutory close season and catch & release period.	All
	Develop an Atlantic salmon conservation plan for all rivers, or Atlantic salmon management units (if several small rivers are considered to be so close in terms of geography and stock size as to merit a single plan).	Marine Scotland Science, Fishery managers, Kyle of Sutherland Fisheries Board, Fisheries Trusts NatureScot
	Voluntary catch and release policy for anglers.	District Salmon Fisheries Boards, Fisheries managers, Fisheries Trusts
Forest operations resulting in silt/nutrients entering the river – may affect mussel and salmon spawning areas	Planning and implementation of forest harvesting operations should better identify high risk areas. Management should include improved pollution control, blocking of drains and careful harvesting in riparian areas.	Scottish Forestry, Forestry & Land Scotland, forestry agents, owners and land managers.
	Promote adherence to the Forest and Water Guidelines, and published best practice, during forest restructuring and highlight the need to strictly control fine sediment and other diffuse pollution. Forestry planting and harvesting within the catchment should be carefully planned. Heavy rainfall and droughts should be buffered by the forest rather than it exacerbating high/low	Scottish Forestry, Forestry & Land Scotland, forestry agents, owners and land managers.

	extremes in flow as both can damage freshwater pearl mussels.	
Sediment load in river from un-forested land – may affect freshwater pearl mussel and salmon spawning areas	Ensure minimal poaching, tracking, or trampling by red deer, livestock and vehicles to prevent an unnatural sediment load from being washed into the river.	Land managers, NatureScot, SGRPID (GEAC)
	Drain blocking within the open hill catchment will help to buffer both high & low extremes in flow and reduce sediment run-off into the river.	Estates and Land managers
Water quality	Implement and maintain monitoring of key water quality parameters.	NatureScot/SEPA
	Any development proposals within the catchment should include appropriate measures to minimise sediment run-off and prevent pollutants from entering the river.	Highland Council
Beneficial habitat management	Evaluation of diffuse pollution and morphological pressures through the river basin planning process and the implementation of restoration measures to maintain or improve habitat for both species.	SEPA
	Promotion of measures to increase resilience from climate change, particularly the creation of native riparian woodland and improved connection with floodplains. Measures to promote coordinated, catchment-scale activity are particularly important. Native tree planting in appropriate locations would help improve the riparian habitat for both species.	All
	Restore riparian and catchment peatlands to reduce fine sediment concentrations, improve floodplain connectivity and restore more natural hydrological regime to benefit salmon and freshwater pearl mussel.	All
Population size	Encourage the natural processes of river flow and morphology through a policy of non-intervention and thereby improve freshwater pearl mussel and salmonid recruitment and survival. Intervention is only definitely beneficial if the river level is particularly low, when it may be appropriate to move pearl mussels to deeper pools if they would otherwise die due to their habitat drying out.	All
Research – salmon	Development and introduction of long-term monitoring protocols for juvenile Atlantic salmon in SACs.	Marine Scotland Science, Kyle of Sutherland Fisheries Board, Fisheries Trusts, Fisheries managers
	Develop and implement monitoring protocol to allow robust, catch independent, assessment of adult population size.	Marine Scotland Science, Kyle of Sutherland Fisheries Board, Fisheries Trusts,

		Fisheries managers
	Monitor the presence and distribution of aquatic & terrestrial non-native species which may adversely impact Atlantic salmon.	SEPA, NatureScot & Kyle of Sutherland Fisheries Board, Fisheries managers
Marine survival - salmon	Monitoring of post-smolt Atlantic salmon to determine their behaviour at sea and better understand the impact of enhanced sea lice burdens.	Marine Scotland (Marine Scotland Science and Farmed Fish Health Inspectorate)
Invasive species	All anglers and other water users (such as canoeists or researchers) should follow the Check, Clean, Dry biosecurity procedures to help prevent the spread of problem non-native species. Action to control invasive non-native species, even on minor tributaries, or near to watercourses, should be implemented as soon as possible, subject to available resources/funding.	All
Water flow	Water transfer for hydro-electric schemes (such as abstraction from the Cassley) should not lower the water flow in the river in a way that would reduce the populations of freshwater pearl mussel and Atlantic salmon.	SEPA, NatureScot, Scottish Water

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