

DUNKELD–BLAIRGOWRIE LOCHS SPECIAL AREA OF CONSERVATION (SAC)

CONSERVATION ADVICE PACKAGE



Site Details

Site name:	Dunkeld-Blairgowrie Lochs
Map:	https://sitelink.nature.scot/site/8245
Location:	Eastern Scotland
Site code:	UK0012638
Area (ha):	427.84
Date designated:	17 March 2005

Qualifying features

Qualifying feature	SCM assessed condition	SCM visit date	UK overall Conservation Status
Clear-water lakes or lochs with aquatic vegetation and poor to moderate nutrient levels (Oligotrophic to mesotrophic standing waters with vegetation of the <i>Littorelletea uniflorae</i> and/or of the <i>Isoëto-Nanojuncetea</i>) [H3130]	Unfavourable No change	13-Sep-10	Unfavourable - Bad
Very wet mires often identified by an unstable 'quaking' surface (Transition mires and quaking bogs) [H7140]	Unfavourable Declining	21-Jul-09	Unfavourable - Bad
Otter (<i>Lutra lutra</i>) [S1355]	Favourable Maintained	03-Oct-11	Favourable
Slender naiad (<i>Najas flexilis</i>) [S1833]	Unfavourable Declining	05-Sep-16	Unfavourable – Inadequate

Notes:

Assessed condition refers to the condition of the SAC feature assessed at a site level as part of SNH'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 Protected Areas:

[Lochs of Butterstone, Craiglush and Lowes Site of Special Scientific Interest \(SSSI\)](#)

[Lochs Clunie and Marlee SSSI](#)

[River Tay SAC](#)

Key factors affecting the qualifying features

Clear-water lakes or lochs with aquatic vegetation and poor to moderate nutrient levels

This habitat type comprises both oligotrophic (nutrient-poor) and mesotrophic (moderate nutrient levels) waters, and more rarely may include intergrading types. The dominant substrates of both oligotrophic and mesotrophic waters are silt, sand, gravel, stones and boulders. The clear soft water, which characterises this habitat type, contains low to moderate levels of plant nutrients and supports characteristic assemblages of plant species. The vegetation community is characterised by amphibious short perennial vegetation the marginal components of which can be exposed on the lake shores during summer.

This site, comprising five lochs along the Lunan Burn on the northern edge of the central Scottish lowlands, provides a natural example of gradually-increasing eutrophy. The three upper lochs (Craiglush, Lowes and Butterstone) lie on the southern edge of the Highland Boundary Fault with catchments which are predominantly upland and acidic; the lower lochs (Clunie and Marlee) lie south of the Fault with predominantly agricultural and more enriched catchments. The series provides examples of relatively unpolluted oligotrophic to mesotrophic loch types, which are rare and decreasing habitats in Britain, especially in the lowlands. The aquatic flora is exceptionally diverse, with the number of pondweeds *Potamogeton* spp. at Loch of the Lowes and Loch Clunie being outstanding. Slender naiad *Najas flexilis* occurs in each of the lochs. The site also contains a very large number of plant species, including many of local or national rarity, and is notable for the extensive area of poor-fen.

Key management issues at the Dunkeld-Blairgowrie Lochs include changes to hydrology, invasive non-native species, particularly Himalayan balsam and Skunk cabbage, and nutrient enrichment. Filamentous algae has been recorded at Dunkeld-Blairgowrie Lochs (indicative of high nutrient levels). In high densities this algae can form dense blankets, reducing light and causing problems when it dies and decays. Algal blooms have also occurred.

Water quality in four of the five Lunan lochs had been declining for over a century. At the start of this century Loch of Butterstone was at risk of tipping into a permanent eutrophied state with higher pH, phosphate and nitrate levels and increased turbidity through suspended algal growth. The combination of these factors resulted in decreased water clarity and reduced photosynthesis. This started to lead to some decline in the associated natural heritage interest of the site with an increase in algal blooms and a reduction (and disappearance from the lowest loch, Marlee loch) of the aquatic plant species *slender naiad*. Detailed monitoring by a range of university and research bodies, including SEPA and SNH, has looked at water quality, paleolimnological studies of the sediment, modelling of phosphorus budgets from land use and the condition of the natural heritage interests. This has built up compelling evidence that the decline in water quality and associated natural heritage interests is due to nutrient enrichment by diffuse phosphorus pollution. The Lunan Lochs Natural Scheme was launched in 2004 and successfully arrested the decline in water quality. All five lochs that comprise the SAC are now within the appropriate range for a meso-oligotrophic loch.

The feature has been assessed through NatureScot's site condition monitoring programme as being in unfavourable condition at this SAC due to the high frequency of occurrence of the non-native *Elodea canadensis* in all lochs, bar Lowes, evidence of raised sediment loads at Marlee Loch, ongoing nutrient enrichment of the lochs, and the crash in the *Najas flexilis* population. The presence of Himalayan balsam has also been noted within the catchment of the Lochs Clunie and Marlee SSSI. Skunk cabbage has been recorded adjacent to Loch of Butterstone. Both species are being eradicated via SNH Management Agreements.

Further information about clear-water lakes or lochs with aquatic vegetation and poor to moderate nutrient levels can be found [here](#).

Very wet mires often identified by an unstable 'quaking' surface

This feature is also known as transition mires and quaking bogs. The term 'transition mire' relates to vegetation that in floristic composition and general ecological characteristics is transitional between acid bog and alkaline fens, in which the surface conditions range from markedly acidic to slightly base-rich.

This habitat type can occur in a variety of situations, related to different geomorphological processes: in flood plain mires, valley bogs, basin mires and the lagg zone of raised bogs, and as regeneration surfaces within mires that have been cut-over for peat or areas of mineral soil influence within blanket bogs (e.g. ladder fens).

The water table is often close to or above the surface of the substrate giving rise to characteristic floating mats of vegetation. This means that key factors affecting this habitat type are alterations to the hydrology. It is particularly sensitive to any over and undergrazing, invasive non-native species or disturbance to the surface i.e. trampling or use of ATVs or other vehicles.

At this site the habitat is found around the fringes, and formed between the lochs.

The feature has been assessed through NatureScot's site condition monitoring programme as being in unfavourable condition at this SAC, mainly due to scrub encroachment. However, through management agreements with the landowner SNH has removed the scrub and the status is now Unfavourable Recovering.

Further information about very wet mires often identified by an unstable 'quaking' surface can be found [here](#).

Otter

The extensive lochs together with their marshes, streams and ditches provide ideal feeding, resting and shelter areas for otter *Lutra* and support a good population. There is wide prey availability, with populations of Atlantic salmon, brown trout, frogs, toads and other prey.

Otter require continued proximity to unpolluted open water. There should be a plentiful food supply and habitats for providing shelter for both resting and breeding. They are wide ranging and normally occur at low densities. At this site, otter associated with the SAC are likely to have holts or resting places outside the site boundary as well as within the site itself. Recreational disturbance can have an effect but they have large ranges and can largely avoid people.

Previous population declines in otters were primarily due to pollution and persecution. Otters can be trapped and drown in disused equipment such as eel traps. They are regularly killed on roads by traffic, especially on roads such as the A923 and A984.

However, these issues do not appear to be impacting on the otter population at the Dunkeld-Blairgowrie Lochs.

Further information about otters can be found [here](#).

Slender naiad

Slender naiad is an aquatic plant that spends its entire life cycle completely submerged. It can grow to approximately 30cm and is usually found at depths of 1.5m or more, rooted in a

particular silty, organic, flocculent sediment. In the UK the population is restricted to lochs in Scotland. Dunkeld – Blairgowrie Lochs is one of its few locations in eastern Scotland.

The key factors affecting this species include eutrophication arising from agricultural diffuse pollution and septic tank discharges, and competition from invasive non-native species (INNS) such as Canadian pondweed. Water abstraction and forestry land use causing diffuse pollution can also affect this species.

Slender naiad has been assessed through NatureScot's site condition monitoring programme as being in unfavourable condition at this SAC. The naiad population at the Dunkeld-Blairgowrie Lochs has been in decline for a number of years. High nutrient loads from the surrounding catchment is thought to be the primary issue affecting this feature. However, despite the introduction of a management scheme to address diffuse pollution impacts and development management measures to ensure that development within the catchment does not increase nutrient enrichment of the lochs, the decline does not seem to have been reversed. Non-native species have been recorded in the lochs, including *Crassula helmsii* and *Elodea canadensis*, however this is not thought to be the primary cause of the decline in the naiad population.

Further information about slender naiad can be found [here](#).

Conservation Priorities

There are no priority qualifying features within the site and no apparent management conflicts between the qualifying features. If any conservation management conflicts between the qualifying features were to arise consideration should first be given to, clear-water lakes or lochs with aquatic vegetation and poor to moderate nutrient levels and slender naiad, the primary reasons for site selection. However, the impact of any proposed management measure on all the qualifying features should first be considered as part of a Habitats Regulations Appraisal.

This site overlaps with the River Tay SAC designation and the features of this site need to be taken into account when making decisions on Dunkeld – Blairgowrie Lochs SAC. The additional, overlapping SAC features are Atlantic salmon, river lamprey, brook lamprey and sea lamprey.

The additional, overlapping SSSI features are breeding bird assemblage and greylag goose.

None of these other features are prioritised over any of the Dunkeld – Blairgowrie Lochs SAC features, nor vice versa. Management for these features is largely compatible.

All qualifiers rely on good water quality, and appropriate water levels and hydrological functioning.

Conservation Objectives for habitats

1. To ensure that the qualifying features of Dunkeld–Blairgowrie Lochs 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 and c). 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 Dunkeld–Blairgowrie Lochs is restored by meeting objectives 2a, 2b and 2c for each qualifying feature.

The aim at this SAC is to restore, the qualifying habitats to a favourable condition as a contribution to their wider conservation status. Therefore any impacts to the objectives shown in 2a, 2b or 2c 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 and 2c. 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 or 2c 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 features will be able to quickly recover.

This objective recognises that the qualifying habitats are exposed to a wide range of drivers of change. Some of these are natural and are not a direct result of human influences. Such changes in the habitats’ extent, distribution or condition within the site which are brought about by natural processes, directly or indirectly, are normally considered compatible with the site’s conservation objectives. An exception to this is when the favourable condition of a habitat is dependent on halting or managing natural succession. 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 clear-water lakes or lochs with aquatic vegetation and poor to moderate nutrient levels (oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea*)

2a. Maintain the extent and distribution of the clear-water lakes or lochs with aquatic vegetation and poor to moderate nutrient levels habitat within the site

The extent of clear-water lakes or lochs with aquatic vegetation and poor to moderate nutrient levels habitat feature has been estimated at 284.81ha. The area figure has been taken from the Standard Data Form.

Fundamentally there should be no measurable net reduction the extent of the habitat unless it occurs by natural succession. Most importantly, the distribution throughout the site and the number of sites should be restored. In cases of loss of open water due to natural succession, the default position will be to allow natural processes to occur, even if this may result in the loss of area of this habitat in the long term.

This should include the total surface area, depth of water and type and distribution of loch substrate sediments. As well as natural succession, changes to surface area can indicate man-made pressures on the structure and function of lochs. Man-made changes to surface area and the associated change to depth can adversely affect the character of the loch, particularly the edge vegetation. Changes to the surface area may indicate a number of pressures such as abstraction, regulation, construction, excessive sediment deposition and natural succession which may occur in the catchment.

2b. Restore, the structure, function and supporting processes of the clear-water lakes or lochs with aquatic vegetation and poor to moderate nutrient levels habitat

The structure and function of lochs are strongly influenced by activities within their catchment. Changes in land management or development can affect the integrity of the feature which will manifest itself in changes to the lochs.

Physical Attributes

-Hydrological regime

The hydrology of the lochs should be maintained as this affects both water level fluctuations and annual and within year flushing patterns. Flushing is important as it is strongly related to dilution and removal of nutrients and plankton. Changes to the flushing pattern can be caused by factors similar to those affecting area; abstraction, regulation, construction, excessive sediment deposition and natural succession which may occur in the catchment.

-Loch substrate character

The type and distribution of sediment particles within the lochs should be restored as this will affect the biology of the lochs and the availability of habitats. Changes to the substrate character may also be indicative of changes to the area and hydrological regime. Reduction in area or flushing may affect the substrate character as finer sediments become trapped and there is increased input of leaf-litter from scrub encroachment.

-Natural sediment load

Accumulation of nutrient-rich sediment may have a strong effect on the water quality and biology of the lochs. Release of nutrients bound to silt can increase enrichment. Increases in sediment loading from both changes in land management practice in the catchment or on the shoreline and short term events such as construction should be avoided. Evidence is growing that an increase in storm events associated with climate change may increase

the amount of sediment deposited in lochs. This should be minimised by avoiding having large areas of bare ground close to the lochs.

-Connectivity between the loch and the surrounding area

While a loch is often perceived as a discrete entity the connections between it and the surrounding area are vital to its functioning as part of a natural system. These natural connections can be reduced or changed by, for example, hard engineering works on the shoreline or loch bed and anything that impedes the exchange of water either on the surface or with the underlying water table.

Water Quality

-Dissolved Oxygen

Dissolved oxygen in loch water is vital for respiration of all aquatic animals, including fish, as well as for aquatic plants. An artificially high biomass caused by increased loadings of organic matter or algal blooms should be avoided as this can create a heavy demand which causes low levels of dissolved oxygen. Dissolved oxygen is likely to be lowest in July and August. The target for Dunkeld – Blairgowrie Lochs is dissolved oxygen >7.0mg/l when classified as at Good Ecological Status (GES) under the Water framework Directive (WFD) or >9.0 Mg/l when classified as High Ecological Status (HES) during July and August.

-pH

This influences many of the chemical processes in lochs such as the binding of phosphorus. Oligotrophic lochs should have pH of 5.5 to 7 and Mesotrophic 6.5 to 8. Artificial changes through eutrophication or acidification should be avoided as these can have a significant effect on pH.

- Nutrients

In general, issues with nutrient levels are inferred from effects upon the vegetation. Phosphorus is one of the main nutrients required for plant growth and there is strong correlation between Total Phosphorus (TP) concentration and phytoplankton biomass. The mean total phosphorus in oligo-mesotrophic lochs should fall within the range of 10-35 µg l⁻¹. Based on the 2016 data, all of the lochs in the SAC are compliant, with Loch of Craiglush the lowest at 10.93 µg l⁻¹ and Loch of the Lowes the highest at 23.44 µg l⁻¹.

Nitrogen is the other main nutrient important in loch ecosystems. It is generally less likely to be limiting than phosphorus because of the ability of some organisms to fix Nitrogen from the atmosphere. The target for Dunkeld – Blairgowrie Lochs is that annual mean Total Nitrogen should not exceed 1.5mg/l.

Measurements of Chlorophyll are used as a proxy for algal growth. Phytoplankton is an important part of the processes of a loch ecosystem affecting light penetration and oxygen demand. Excessive chlorophyll a should be avoided as this is usually associated with nutrient enrichment. Dense floating rafts of filamentous algae (or thick algal coatings on aquatic plants) and algal blooms should also be avoided as these are a negative indicator associated with high nutrient levels.

2c. Restore, the distribution and viability of typical species of the clear-water lakes or lochs with aquatic vegetation and poor to moderate nutrient levels habitat

Typical species of mesotrophic lochs found at the Dunkeld-Blairgowrie Lochs are:

<i>Elatine hexandra</i>	six-stamened waterwort
<i>Isoetes echinospora</i>	spring quillwort

<i>Lobelia dortmanna</i>	water lobelia
<i>Najas flexilis</i>	slender naiad
<i>Subularia aquatic</i>	awwort

Typical species of oligotrophic lochs at the Dunkeld-Blairgowrie Lochs:

<i>Subularia aquatic</i>	awwort
<i>Isoetes echinospora</i>	spring quillwort

The most recent Site Condition Monitoring results are from Cycle 2. In Loch of Butterstone only one pondweed species and two isoetid species were recorded, however, stoneworts were doing better with four species present.

There had been little change in Loch of Lowes over recent decades with 23 submerged and floating aquatic species recorded, which included six pondweed species, three stonewort species and five isoetid species. A visit later in the year found a seventh pondweed species. However, *Potamogeton filiformis*, which was last seen in 1986 seems to have been lost from the loch.

Loch of Clunie retained a very high diversity of species with 27 submerged and floating species, including seven pondweeds, four stoneworts and five isoetid species.

Marlee Loch still retains a diverse aquatic flora, but there are some issues of concern, in particular an apparent trend in favour of narrow-leaved *Potamogeton* species over broad-leaved species, both in terms of diversity and abundance.

The viability of the characteristic species is determined by water quality and other conditions that support the plant community such as water clarity. Raised sediment loads and ongoing nutrient enrichment (illustrated by poor water clarity, an abundance of filamentous algae and algal blooms) have been recorded in Dunkeld–Blairgowrie Lochs SAC, resulting in this feature being in unfavourable condition. Loss or a reduction in the population of ‘typical species’ is an indicator of deteriorating or changing water quality. The focus of this objective will therefore be to stop the decline in typical species, including the population of slender naiad and subsequently, promote their increase. Higher water quality will need to be provided all the time.

Non-native species can have direct effects upon the natural plant communities through competition. They may also have more subtle effects as the niche they fill is different and this may directly or indirectly affect the rest of the ecosystem. A list of high impact species has been agreed as part of the Water Framework Directive. *Elodea canadensis* has been recorded in all the lochs in Dunkeld–Blairgowrie Lochs SAC, except Loch Lowes. Other species that may also affect the integrity of the site include *Elodea nutallii*, *E.canadensis* and *Crassula helmsii*.

The habitat is also used by Atlantic salmon, river lamprey, brook lamprey and sea lamprey.

The site is important for its wintering wildfowl, most notably its roosting population of Icelandic greylag geese, and also the diversity of breeding birds, which includes ospreys at one of the longest established eyries in Scotland and other water and wetland birds.

Conservation Objectives for very wet mires often identified by an unstable 'quaking' surface (transition mires and quaking bogs)

2a. Restore the extent and distribution of the very wet mires often identified by an unstable 'quaking' surface habitat within the site

The extent of transition mires and quaking bogs at Dunkeld–Blairgowrie Lochs SAC, has been estimated as 5.39ha. This should be restored.

Accurate measurement of the extent of the transition mires and quaking bogs habitat is hard to achieve due to gradual transitions in vegetation to adjacent habitats. The area figure has been taken from the Standard Data Form and is therefore used as a guide only. There should be no measurable net reduction in the extent of the habitat and its distribution throughout the site should be restored.

This habitat is transitional with other adjacent wetland habitats so current baseline estimates may not be precise and any changes in extent estimates as a result of new survey may not represent real change but greater precision.

At the Dunkeld-Blairgowrie Lochs this habitat is found in a lowland situation adjacent to all five lochs amongst other fen, mire and raised bog habitats.

2b. Restore the structure, function and supporting processes of the very wet mires often identified by an unstable 'quaking' surface habitat

This habitat is usually present as a mosaic with other wetland habitats. The term "transition mire" relates to vegetation that, in floristic composition and general ecological characteristic, is transitional between acid bog and alkaline fens, in which the surface conditions range from markedly acidic to slightly base-rich.

The maintenance of appropriate hydrology for this habitat is important to retain the structure and function of this habitat. This habitat has developed here due to the ground being close to the water table. Natural fluctuations in water level (in the river and the site) need to continue to support the long-term existence of the habitat. The site should be damp or wet all year, with a higher water level when there is more water in the river in winter, and temporary flooding following heavy rain. Management to prevent or reduce detrimental effects of drainage, including in the wider surrounding area, is key to retain an appropriate water table and to avoid the habitat drying out or suffering from cycles of extreme high and low water levels. No issues have been identified at this site relating to drainage or disturbance.

Colonisation of this habitat by tree or scrub growth or invasive non-native species could lead to irreversible habitat loss in the longer term, through shading, drying out of the habitat and possible conversion to other open-ground habitats or woodland.

Where trees are colonising the habitat, priority is given to the wetland, and trees may be removed. On Dunkeld–Blairgowrie Lochs SAC birch, alder and willow are present and should be removed from the mire.

One vigorous native species on this site is Common reed *Phragmites*. The change in frequency and extent of common reed may be in response to a higher water table and/or increased nutrient levels, both of which favour this species. Common reed dominates the M9 mire habitat beside Loch of Lowes, although this is not currently considered a problem.

Grazing, browsing and trampling by sheep, deer and recreation can damage the structure of this habitat and the wider mosaic of wetland habitats in which it is found. These are not currently an issue at this site.

2c. Restore the distribution and viability of typical species of the very wet mires often identified by an unstable 'quaking' surface habitat

On Dunkeld–Blairgowrie Lochs SAC the transitional mires and quaking bogs habitat has the following NVC types;

M5 *Carex rostrata* – *Sphagnum squarrosum* mire
M9 *Carex rostrata* – *Calliergon cuspidatum/giganteum*
S27 *Carex rostrata* – *Potentilla palustre* tall-herb fen.

In the long term, the typical species will benefit from the control of birch, alder and willow colonisation. Skunk cabbage and rhododendron have also been recorded on site.

The main indicator species found in each NVC community are given below:

The M5 *Carex rostrata* – *Sphagnum squarrosum* mire. In these areas *Molinia caerulea* and *Myrica gale* were locally prominent in patches with *Eriophorum vaginatum* frequent. Sporadically interspersed between clumps of these species were *Vaccinium myrtillus*, *Deschampsia flexuosa*, *Calluna vulgaris*, *Erica tetralix*, *Carex panicea* and *Carex nigra*. The bryophyte layer was a prominent part of the community carpeting much of the ground. The bryophytes were dominated by *Polytrichum commune* with *Sphagnum recurvum*, *S. palustre*, and *Hylocomium splendens* frequent, and *Dicranum scoparium* rare.

The M9 *Carex rostrata* – *Calliergon cuspidatum/giganteum*. The habitat at this site fits best with a species poor example of the M9a sub-community. At this site *C. lasiocarpa* is frequently the most prominent sedge, with *C. rostrata* infrequent. *C. panicea* and *C. echinata* are also found. Of the grasses *M. caerulea* is frequent, *A. stolonifera* and *A. canina* may also occur. *P. australis* is also prominent. The sphagna recorded here include *S. palustre*, *S. recurvum* and *S. capillifolium*. Herbs include *Myrica gale* and *Potamogeton polygonifolius*.

The S27 *Potentilla-Caricetum rostratae*. There are several good examples of this community through the site. Prominent sedges recorded in these areas are *Carex rostrata* and *C. vesicaria*, *C. lasiocarpa*, *C. nigra*, *C. disticha*, *C. panicea* and *C. echinata*. Also found are *Filipendula ulmaria*, *Iris pseudacorus*, *Eriophorum angustifolium*, *Angelica sylvestris*, *Equisetum fluviatile*, *Bryum pseudotriquetrum*, *Juncus effusus* and *acutiflorus*, *Potentilla palustris*, *Galium palustre*, *Agrostis stolonifera*, *Juncus acutiflorus*, *Sparganium erectum*, *Chamerion angustifolium*, *Ranunculus repens*, *Myosotis scorpioides* and *Epilobium palustre*. Scattered willow can be found throughout the community.

The habitat also supports osprey during the breeding season.

Conservation Objectives for species

1. To ensure that the qualifying features of Dunkeld–Blairgowrie Lochs 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 and c). 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 Dunkeld–Blairgowrie Lochs is restored by meeting objectives 2a, 2b and 2c for each qualifying feature.

The aim at this SAC is to maintain, or where appropriate restore, the qualifying species to a favourable condition as a contribution to their wider conservation status. Therefore any impacts to the objectives shown in 2a, 2b or 2c 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 and 2c. 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 or 2c 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 features 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 otter (*Lutra lutra*)

2a. Maintain the population of otter as a viable component of the site

The conditions for the long-term existence of the otter at the Dunkeld–Blairgowrie Lochs SAC should be maintained.

An estimate of the number of otter occupying the site is not available and therefore there is no numerical baseline that can be given for the site.

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

- Avoiding effects that could lead to a permanent reduction in the otter population through mortality, injury, or impacts caused by disturbance or displacement. This includes for example the effects caused by development, river engineering, water pollution, roads without adequate crossing provision for otters or suitable culverts, or entanglement in fishing gear.

Otters can drown in unprotected or disused fishing gear such as eel traps or fyke nets, so these should be removed, or if active, an otter guard fitted.

- Maintaining the species' ability to use all areas of importance within the site (to be considered under conservation objective 2b).

- Maintaining access to, and availability of, undisturbed resting places.

- Maintaining access to, and availability of, supporting habitats and prey (to be considered under conservation objective 2c).

Otter is a wide-ranging and highly mobile species. The population at Dunkeld – Blairgowrie Lochs SAC is reliant on suitable habitat in the surrounding countryside, including the adjoining River Tay SAC, it is unlikely to be viable (capable of being self-sustaining) in isolation. The home range of an otter will vary depending on their sex, habitat quality and food availability, but is likely to be much larger than this site. Males living in rivers and streams can have a mean linear range size of around 40km and females living in the same habitat can have a linear home range of 20km. Males have been known to range as far as 80km.

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.

Otter is a European protected species (EPS) and it is an offence to deliberately or recklessly capture, injure, kill, harass or disturb them in certain circumstances, or to damage or destroy their breeding or resting places anywhere in Scotland unless a licence has been issued to do so. A licence can only be issued for particular purposes which the law allows. Further, there must be no satisfactory alternative and no detrimental impact on the contribution to the maintenance of otter at a favourable conservation status for a licence to be issued. This assessment considers impacts on the otter population at a local and regional level. The licensing requirement is in addition to considering whether a plan or project will result in any impacts (including incidental impacts) to the otter population within the SAC.

2b. Maintain the distribution of otter throughout the site

The spatial extent of otter within the Dunkeld–Blairgowrie Lochs SAC should be maintained.

The ability for otter to use and access all areas of importance within the SAC should be maintained.

Distribution of otters within the site can be affected by disturbance originating both within and outwith the site. Plans and projects that cause displacement and barrier effects to the species can also affect species distribution. Examples include use of night-time floodlighting of watercourses, road and bridge construction works and general disturbance from human activity (and dogs) by watercourses especially at dusk/night-time.

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

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

Sufficiently high water quality and natural flow conditions should be maintained to provide the necessary conditions for otter and their prey.

Otters require suitable habitat for foraging, breeding and resting. In freshwater environments abundant boulders, crevices and/or peat, or other cavity-forming features such as tree root systems are needed to provide secure holt sites above high water. Dense scrub is also valuable for providing lie-ups and couches. Suitable areas supporting a healthy fish population within a nearby watercourse or still water body are required within each otter's home range, to enable foraging for key prey species such as salmonids and eels. Access to ponds, ditches, reedbeds and wetlands where amphibians may breed is also important.

Changes to water flow and water quality can adversely affect otter habitat and prey on which they depend. Otters' food supply is normally associated with good water quality and therefore the water quality 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 Objectives for slender naiad *Najas flexilis*

2a. Restore the population of the slender naiad as a viable component of the site

Slender naiad has been noted to grow in a particular silty, organic sediment. It is a first colonist and has been noted to thrive in disturbed areas. Removal of sediment, smothering or physical changes such as temporary or permanent alterations to the loch level may therefore have an adverse impact.

An estimate of the population of slender naiad on Dunkeld – Blairgowrie SAC is not available, survey data is limited to occurrence/distribution, there is therefore no numerical baseline that can be given for the site.

The key factors likely to affect the population of the species are eutrophication, acidification, changes to the substrate of the loch and competition from non-native species. A reduction in pH is known to reduce the ability of the plant to produce seed and can affect the plant itself.

Activities which lead to an increase in nutrient inputs are a major concern. This covers both short term releases and more chronic inputs. Once released into the loch excess nutrients can contribute to internal loading which may take a long time to recover. Control of nutrients is also important as it is one of the few things that we can do to increase resilience to non-native species.

The introduction of invasive non-native species (INNS), notably *Elodea sp.* can result in competition reducing or removing the slender naiad population. *Elodea canadensis* has been recorded from all the lochs in Dunkeld–Blairgowrie Lochs SAC, except Loch Lowes. Because it is difficult or often impossible to remove this species it is important to avoid lochs becoming colonised through avoiding transfer of material between lochs and strongly promoting measures such as check, clean, dry for boats and equipment.

Raised sediment loads and ongoing nutrient enrichment (illustrated by poor water clarity, an abundance of filamentous algae and algal blooms) have been recorded in Dunkeld–Blairgowrie Lochs SAC resulting in this feature being in unfavourable condition. The focus of this objective will therefore be to stop the decline in the population of slender naiad and subsequently promote its increase. A management scheme had been created to address diffuse pollution impacts and development management measures have been implemented to ensure that development within the catchment does not further increase the nutrient enrichment of the lochs. Higher water quality will need to be provided all the time.

Slender naiad is an annual plant and is therefore dependent on seed production, and the successful germination of these seeds, for the population to survive. Paleolimnology and work on germination suggests that seed may be able to persist in a viable state for some years.

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.

Slender naiad is a European protected species (EPS) and it is an offence to deliberately or recklessly pick, collect, cut, uproot or destroy plants or seeds anywhere in Scotland unless a licence has been issued to do so. Licences can only be issued for specific legal purposes. There must be no satisfactory alternative and no detrimental impact on contribution to the maintenance of favourable conservation status for the species, at a local and regional level. The licensing requirement is in addition to considering whether a plan or project will result in any impacts (including incidental impacts) to the slender naiad population within the SAC.

2b. Restore the distribution of the slender naiad throughout the site

Slender naiad has been recorded at all of the lochs on this site. The dispersal of pond and loch species between habitats is intrinsically difficult because standing water bodies are effectively aquatic islands in a terrestrial sea. Localised movement of seeds through interconnected water bodies is likely.

In 2007 slender naiad was found in Marlee Loch and was abundant in Loch of Lowes. The 2010 survey was postponed and the survey methods used were not appropriate for an adequate assessment of the population to be undertaken. Despite these problems, the conclusion was one of a continuing decline in the species population. The SCM assessment is still therefore, unfavourable declining.

Slender naiad under favourable conditions produces large numbers of seeds which it disperses widely across an entire lake basin using a rafting mechanism (i.e. carrying seeds on plant fragments that float on currents just below the water surface.) Distribution within each loch is therefore mainly dependant on suitable habitat and conditions for germination as outlined in Objective 2c.

Presence of invasive non-native species may preclude use by slender naiad through competition for suitable areas both in terms of space and availability of CO₂ for respiration. Nutrient enrichment, in addition to encouraging invasive non-native species, may also reduce the penetration of light by encouraging growth of algae in the water column and so reduce depth of water suitable for growth.

Elodea canadensis has been recorded from all the lochs in Dunkeld–Blairgowrie Lochs SAC, except Loch of the Lowes. This SAC is also experiencing ongoing nutrient

enrichment. Restoration of the distribution of slender naiad on this SAC will need to focus on both of these issues.

2c. Restore the habitats supporting the slender naiad within the site

In Scotland the species occupies lochs influenced both by the base-rich input of sedimentary rocks and sands, and the water run-off from the catchments of acidic peatlands or hard igneous rock. The plant utilises phosphorus overwhelmingly from the sediment. However phosphorus in the water is still important as it affects competition. Slender Naiad grows in particularly silty, organic, flocculent sediment with loch shape, depth and size dictating where these occur and at what depth. It is a disturbance tolerator and interaction between exposure and water clarity that will primarily determine the location of slender naiad within a loch.

It is an obligate carbon dioxide utiliser and may be at a competitive disadvantage with bicarbonate using species such as *Elodea* in hard water conditions. It is therefore found in circumneutral pH6-9 Alkalinity 6-307.7 mg/l conditions. Seed production has been shown to decrease under reduced pH. Canadian pondweed *Elodea canadensis* cover in Dunkeld – Blairgowrie Lochs SAC should be reduced to restore habitat availability for the slender naiad.

Germination is greatest in light, deoxygenated conditions at warm temperatures (a temperature of 16°C is sufficient). If dark conditions prevail germination is greater at cooler temperatures (11°C).

Habitat quality should meet either the targets for Common Standards Monitoring or at least Good status under the Water Framework Directive (2000/60/EC). Because it is dependent on factors affecting water conditions Slender Naiad is sensitive to changes both within the lochs and the catchment. Dunkeld–Blairgowrie Lochs SAC is experiencing ongoing nutrient enrichment. Natural levels of nutrients should be promoted to restore the growth and viability of slender naiad.

Eutrophication is a key threat to slender naiad. Any point or diffuse sources increasing the flow of nutrients, particularly phosphorus but also nitrogen, into the lochs are therefore a major concern. New development and in particular proposals not on mains sewerage, relying on septic tanks, can increase the nutrient inputs to the catchment. Changes in land use to more fertiliser dependant models may also increase the amount of nutrients released into the lochs. Forestry can impact water quality in different ways at different stages with both fertiliser and sediment being released during both planting and felling. Sediment can both be a significant source of nutrients, particularly phosphorus, and can cause physical changes to the substrate in the lochs. In poorly buffered catchments forestry can also contribute to acidification.

Because Slender Naiad relies upon the distribution of sediment and the depth of light penetration activities which result in changes to the physical characteristics of the lochs particularly water depth can have an effect.

Conservation Measures

The Dunkeld-Blairgowrie Lochs SAC is comprised of two Sites of Special Scientific Interest - Lochs of Butterstone, Craighush and Lowes SSSI and Lochs Clunie and Marlee SSSI. Management changes described on the SSSI list of Operations Requiring Consent must have prior consent from SNH (NatureScot).

Current and recommended management for

- **clear-water lakes or lochs with aquatic vegetation and poor to moderate nutrient levels**
- **very wet mires often identified by an unstable ‘quaking’ surface**
- **otter**
- **slender naiad**

Issue	Measure	Responsible party
Water management	Maintain current hydrological regime or improve where man-made constraints exist. The main regulatory mechanism is the Controlled Activities Regulations, CAR.	SEPA, NatureScot, Land manager
	Very wet mires often identified by an unstable ‘quaking’ surface - Aim to maintain water table near and or above the surface across the habitat.	Land managers, NatureScot
Water quality	Implement and maintain monitoring of key water quality parameters.	NatureScot/SEPA
	Any development proposals in the catchment should include appropriate measures to minimise sediment run-off and prevent pollutants from entering the lochs.	Local Planning Authority
	Tackle water quality issues, especially eutrophication.	SEPA, NatureScot, Land managers
	Raising awareness of the importance of maintaining septic tanks, and upgrading existing systems to tackle point source pollution.	SEPA, NatureScot, Local Planning Authority
	Diffuse agricultural pollution to be addressed through NatureScot Management Scheme, Management Agreements and Agri-environment Schemes.	NatureScot SEPA SGRPID Land managers
Sediment load in lochs from un-forested land	Ensure minimal poaching, tracking, or trampling by red deer, livestock, visitors and vehicles to prevent an unnatural sediment load from being washed into the lochs.	Land managers, NatureScot, SGRPID (GEAC)

	Drain blocking in open peatland in the catchment to help to buffer high/low extremes in flow rate and reduce sediment run-off into the lochs.	Land managers
Forest harvesting operations resulting in silt/nutrients entering the lochs	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 owners and 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 release into the lochs. Forestry planting and harvesting in the catchment needs to be planned so that heavy rainfall and droughts are buffered by the forest rather than exacerbating high/low extremes in flow.	Scottish Forestry, Forestry & Land Scotland, Forestry owners and managers
Habitat Management	Maintain plans as required, for example Loch of Lowes SWT Reserve	NatureScot, Landowners, Land managers, SWT
Ongoing species protection – otter, slender naiad	Otter and slender naiad are European protected species' and therefore the species protection provisions of the Habitats Regulations apply.	All
Road mortality-otter	Any upgrading or bridges or culverts, or widening of roads such as the A923 and A984 or other work on roads, should be assessed and adequate allowance made for otters to safely use underpasses or culverts, so they are not forced to cross the road.	Transport Scotland, Local Planning Authority, NatureScot
Water-based recreation	Recreational miss-use of the lochs, particular Clunie and Craiglush, is an ongoing problem and may cause damage to fringe vegetation. Investigate opportunities to promote responsible access	Land manager Third parties Local Authority NatureScot
Disturbance - otter	Avoid promotion of new paths which risk leading to new disturbance in quiet areas used by otter for holts or resting places.	NatureScot, Land managers
By-catch – otter	Disused eel or fyke nets should be removed when found, and any active nets should use otter guards.	Land managers

<p>Invasive species</p>	<p>Very wet mires often identified by an unstable 'quaking' surface - Ensure colonisation of this habitat by vigorous native species, such as tree or scrub growth or invasive non-native species is minimal to prevent loss of indicator species and conversion to other open ground habitats or woodland.</p> <p>Remove birch, alder and willow trees and their regeneration from the surface of the mire. Trees to be burnt on site on corrugated sheets and ash removed.</p> <p>Removal of trees and scrub has been carried out where this has encroached onto the mire habitats. These areas should continue to be monitored and maintenance work carried out as required</p> <p>The extent of common reed should be mapped in the M9 habitat between Craiglush and Lowes as this will respond quickly to changes in nutrient content and water levels.</p>	<p>Land managers, NatureScot</p>
	<p>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 such as the Canadian pondweed.</p>	<p>All</p>
	<p>Action to control invasive non-native species by physical removal should be implemented as soon as possible, subject to available resources/funding – Canadian pondweed</p>	<p>All</p>
	<p>Although there is no reasonable measure which can totally remove Canadian pondweed from the SAC monitor to track long term effects.</p>	<p>NatureScot, SEPA, Land manager</p>
	<p>Himalayan balsam, Japanese knotweed and skunk cabbage have been recorded in the catchment, various projects are tackling the issue.</p>	<p>NatureScot Land managers</p>
<p>Research – slender naiad</p>	<p>Development of methods to tackle control of invasive and non-native species</p>	<p>SEPA</p>

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