The Story of Loch Leven National Nature Reserve
(2nd edition)

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Situated midway between Edinburgh and Perth, Loch Leven National Nature Reserve (NNR), lies at the heart of the old county of Kinross. Loch Leven is one of Scotland’s top natural assets; it is world renowned for the abundance of birdlife which breeds or winters here.

Surrounded by gently rolling hills and agricultural land Loch Leven is a haven for wildlife; an extensive, shallow freshwater loch fringed with a rich diversity of wetland and woodlands. It is home to the largest concentration of breeding ducks in inland Europe. From late summer right through until spring, tens of thousands of migratory birds from many different countries use it for short and long-term stopovers during their migration. Their presence gives Loch Leven year round interest and global importance.

Loch Leven NNR is managed by Scottish Natural Heritage (SNH) through an agreement with Kinross Estates who own the loch. We work in partnership with the Royal Society for the Protection of Birds who own and manage a section of the reserve along the south and east shore of the loch.

It is one of a suite of National Nature Reserves in Scotland. Scotland’s NNRs are special places for nature, where some of the best examples of Scotland’s wildlife are managed. Every NNR is carefully managed for both nature and people, giving visitors the opportunity to experience our rich natural heritage. The visitor facilities, trails, viewpoints all make Loch Leven a truly accessible reserve for all to explore and enjoy.

The Story of Loch Leven NNR contains background information about the reserve, describing the wildlife interest, its land use history and management since it became a reserve. The future management of the reserve is covered in a separate management plan document.
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Maps of Loch Leven NNR

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1 Introduction to Loch Leven NNR

“Lough Leven is four mile square and sixteen miles about. So far the land is good, but here and there many high rocks and hills: in this lough is fish every day gotten for store, none in Britain like, and consider the bigness of it as also for fowl. There is a river they call the Leven running out of it eight miles to the sea, and in it is salmons… there be great store of all kinds of wildfowl, of wild geese there being continually seen 3,000 or 4,000, and swans many.”
Sir Christopher Lowther, 1629.

Lying midway between Edinburgh and Perth, beneath the shadow of the Lomond Hills, Loch Leven is Scotland’s largest lowland loch and one of the most important sites for waterfowl in Britain. It is a unique environment that attracts, not only the largest concentration of breeding ducks found anywhere in the UK, but many thousands of migratory ducks, geese and swans every autumn and winter.

Britain has a mild climate compared to that of mainland Europe. The winters, moderated by the warming effects of the Gulf Stream, are less harsh than other areas of the same latitude. This makes Britain a favourable place for birds that breed in sub-arctic latitudes to winter, or stop over on migration. Because of this Britain holds important numbers of wildfowl and waders compared to mainland Europe. Loch Leven is less susceptible to freezing than lochs in Highland areas and is one of the first large, freshwater bodies, encountered by birds migrating from the north.

The NNR covers 1824 hectares, including 1300 hectares of loch and islands, a narrow strip of shoreline and associated wetlands and woodlands. The loch is an attractive centrepiece to Kinross-shire. Set in a mainly arable farming landscape against an impressive backdrop of Bishop Hill to the East and the prominent ridge of Benarty Hill to the South.

The catchment for the loch is the broad glacial valley extending westwards to the slopes of the Ochil and Cleish Hills. Two-thirds of the catchment is fertile farmland growing a variety of crops such as cereals, turf, broccoli and strawberries, as well as providing pasture for dairy and beef cattle.

Loch Leven at harvest time
Access to the reserve

The NNR is within easy travelling distance of Scotland’s central belt. The M90 runs close to its western shore and minor roads ring the Loch. The communities of Kinross, Milnathort, Wester and Easter Balgedie, Scotlandwell, Kinnesswood and Gairney Bank form a ring around the site.

Loch Leven is now circumnavigated by an all abilities trail known as Loch Leven Heritage Trail (LLHT). There are 7 main car parks to access the trail. These are: Kinross pier, Kirkgate Park, Burleigh, Loch Levens larder, Findatie, RSPB, Cashmere at Loch Leven cashmere. The trail was completed in April 2014 and the key phases in the development of the trail were:

- 2007 – First section of Heritage Trail complete from Kinross to Burleigh
- 2008 (November) – Official opening of Loch Leven Heritage Trail from Kinross to RSPB
- 2012 - Heritage Trail extended around Factory Bay, including the installation of a new bird hide
- 2014 (April) – Last section of Heritage Trail connecting RSPB to Kinross.

Figures for the number of visitors using the trail vary somewhat but are estimated to be in excess of 200,000, and have increased steadily as the trail has developed.

Management

Loch Leven NNR was first declared in 1964 by agreement with the owners of the loch, Kinross Estate. The Montgomery family has owned Kinross Estate, which includes Loch Leven, since 1770. In 2002 the NNR was re-declared and extended to include RSPB’s Vane Farm Reserve (now known as RSPB Loch Leven). In 2010 ownership of Kinross House along with Kirkgate Point and 4 islands changed.

In tandem with the NNR and under the terms of the agreement the Estate retains the traditional sporting uses of fly-fishing and wildfowling. Loch Leven is world famous for its trout fishing, and angling has been the economic mainstay of the loch for many years.

The day-to-day management of the loch is shared between SNH who manage most of the reserve and RSPB who manage an extensive wetland area and woodland at the south of the NNR. Kinross Estate manages the fishing and shooting, Perth and Kinross Council manage Kirkgate Park and are responsible for the maintenance of the trail surface and verges. Historic Scotland manages Castle Island and run the ferry and the River Leven Trustees are responsible for managing the loch’s water levels.
Designations

In recognition of its international wildlife importance Loch Leven has a number of conservation designations. Because of the internationally important bird populations, the loch is part of the European Natura 2000 network classified as a Special Protection Area (SPA) and is also designated as a Ramsar site for its wetlands and bird interest. Under Scottish legislation it is notified as a Site of Special Scientific Interest (SSSI) for birds, plants, and insects. Table 1 summarises the features for which Loch Leven has been designated.

In addition to the wildlife designations, the local planning authority has designated approximately two thirds of the shore as an Area of Great Landscape Value. Scheduled Monuments within the NNR include Loch Leven Castle and St Serf’s Priory. The Kinross House Designed Landscape includes Kirkgate Park and Kirkgate Point, both within the boundaries of the NNR.

Table 1 – Designated and qualifying features for Loch Leven NNR

<table>
<thead>
<tr>
<th>Feature</th>
<th>Protected Area</th>
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<tbody>
<tr>
<td>Beetle assemblage</td>
<td>Loch Leven SSSI</td>
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<td>Breeding bird assemblage</td>
<td>Loch Leven SSSI</td>
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<td>Cormorant (<em>Phalacrocorax carbo</em>), non-breeding</td>
<td>Loch Leven SPA&lt;br&gt;</td>
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<td>Eutrophic loch</td>
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<td>Gadwall (<em>Anas strepera</em>), breeding</td>
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<td>Gadwall (<em>Anas strepera</em>), non-breeding</td>
<td>Loch Leven SPA&lt;br&gt;</td>
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<td>Goldeneye (<em>Bucephala clangula</em>), non-breeding</td>
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<td>Greylag goose (<em>Anser anser</em>), non-breeding</td>
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<td>Hydromorphological mire range</td>
<td>Loch Leven SSSI</td>
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<tr>
<td>Pink-footed goose (<em>Anser brachyrhynchos</em>), non-breeding</td>
<td>Loch Leven RAMSAR&lt;br&gt;</td>
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<td>Pochard (<em>Aythya ferina</em>), non-breeding</td>
<td>Loch Leven SPA&lt;br&gt;</td>
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<td>Shoveler (<em>Anas clypeata</em>), non-breeding</td>
<td>Loch Leven RAMSAR&lt;br&gt;</td>
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<td>Feature</td>
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<td>Teal (<em>Anas crecca</em>), non-breeding</td>
<td>Loch Leven SPA</td>
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<td>Loch Leven SSSI</td>
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<tr>
<td>Tufted duck (<em>Aythya fuligula</em>), breeding</td>
<td>Loch Leven SSSI</td>
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<tr>
<td>Tufted duck (<em>Aythya fuligula</em>), non-breeding</td>
<td>Loch Leven SPA</td>
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<td>Vascular plant assemblage</td>
<td>Loch Leven SSSI</td>
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<td>Waterfowl assemblage, non-breeding</td>
<td>Loch Leven RAMSAR</td>
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<td>Loch Leven SPA</td>
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<td>Whooper swan (<em>Cygnus cygnus</em>), non-breeding</td>
<td>Loch Leven SPA</td>
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<td>Loch Leven SSSI</td>
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2 The Natural Heritage of Loch Leven NNR

Loch Leven is one of Scotland’s top natural assets; it is the largest naturally eutrophic (nutrient rich) loch in the UK. Due to its position, size, nutrient rich shallow waters, and comparatively undisturbed nature, Loch Leven has an ecosystem ideal for a wealth of plants, insects, and fish. These in turn support a wide variety of birds at different seasons, making the site important throughout the year.

Geomorphology

Loch Leven is one of a series of lochs of glacial origin between the Firth of Forth and the Highland Boundary Fault, lying in drift (glacial and river deposits). Glaciers stretching east from the Ochil Hills formed Loch Leven by eroding and hollowing out the underlying bedrock and leaving a shallow depression. At the end of the last ice age as the glaciers retreated, the whole area was washed with deposits of sand and gravel. The River Leven cut through these sediments damming the loch to the east and flooding the area.

The loch is mostly shallow with an average depth of only 4 metres (m). To the north and east there is an extensive shallow shelf but in the middle are two ‘deeps’, the North and South Deeps, 23.2m and 25.5m deep respectively. These are kettle holes formed during the retreat of glaciers.

The shallow parts of the loch have a predominantly sandy bottom with a few stony stretches of shoreline. Clay and silty mud, however, are present in the deeps. There are several islands on the loch, the largest being St Serfs in the southeast. The second largest is Castle Island, lying a short distance east of Kinross, with a cluster of smaller islands around it.

The catchment for the loch is the broad glacial valley extending westwards for 145km$^2$ to the slopes of the Ochil and Cleish Hills. Four major burns drain the catchment: the North and South Queich, the Gairney Water and the Pow Burn. Along with several smaller streams these burns supply the loch. The outflow is the River Leven in the southeast corner, which flows into the Firth of Forth at Leven some 24km downstream, and is artificially managed through sluices.
Species

Loch Leven is internationally important for its bird life with up to 35,000 waterfowl regularly present in the winter months. Its location in the lowlands, its shallow nutrient rich waters supporting abundant food sources, its safe island nesting sites and its large water surface (more than 13 km²) are all factors that contribute to its attractiveness to birds. As a result the loch is used by a wide variety of water birds for feeding, breeding, moulting and roosting. The species and numbers of birds using the loch have changed over time as national populations and surrounding land use has changed.

There are many spectacular wildlife experiences at Loch Leven. Winter morning and evening flights of geese going to and from their roosts, the aerobatic displays of sand martins and swifts feeding over the water in the late summer, the fishing exploits of kingfishers and ospreys and rare migrants dropping in such as spoonbill and little egret.

Wintering Birds

Loch Leven is a very important stopover for waterfowl migrating between their breeding and wintering grounds, offering relatively disturbance-free stretches of shallow water, a shoreline with abundant food, and flocks of other birds providing safety in numbers. Waterfowl use the loch to rest and refuel whilst migrating over
longer distances, with peak bird numbers occurring during late autumn and early spring. Birds migrate to Loch Leven from Iceland, Greenland, Ireland, northern and central Europe, and Siberia. Each year waterfowl numbers in excess of 35,000 use Loch Leven including goldeneye, tufted duck, pochard, teal, gadwall, cormorant, and shoveler. Loch Leven has an abundance of feeding niches; this attracts many ducks of different species to stay over winter in nationally important numbers. A number of species have benefited from the additional shelter provided by 3.5km of gabion baskets installed along the southeast shore, which was suffering from erosion. The shelter provided by these gabions has allowed phragmites to establish and many bird species now shelter in these areas.

Monthly wildfowl counts have been undertaken during the autumn/winter/spring since the inception of the NNR. Since the summer of 2003 the counts have been conducted every two weeks and since 2008 they have been done in collaboration with the RSPB.

Populations of wintering wildfowl are broadly considered healthy, with numbers above those recorded in the 70s & 80s. Peak counts for most of the reserves wildfowl are usually recorded in September or October this includes shoveler, gadwall, teal and tufted duck. Whooper swan and cormorant numbers many not peak until as late as November while numbers of mute swans, along with British greylag, peak slightly earlier in the season with large moult aggregations occurring during August.

Total numbers of wintering waterfowl have increased over the last twenty years (Wetland Bird Survey (WeBS) data). Winter counts from 1985/86 – 1989/90 give an average of 6,300 waterfowl on the loch whilst more recent counts have averaged almost 10,000.

The graph below is a representation of how peak wildfowl numbers on the site have changed since 1993/94. It should be noted that these figures are not actual counts but the peaks of each species counted and totalled in a year. There is a weak positive correlation indicating a slight upwards trend in wildfowl maxima over the period.
Geese

The vast majority of the world’s population of pink-footed geese breed in Iceland and Greenland and almost all of these geese winter in Britain, with sites such as Loch Leven providing important autumn and wintering staging posts. At times the loch and surrounds can support over 20,000 pink-footed geese, nearly 10% of the world’s population.

Although many geese may move south from the loch during the winter months, several thousand remain to graze on the grassland within the reserve or on the neighbouring barley stubbles and harvested potato fields. The geese tend to roost at traditional spots around the shoreline of the loch.

Pink-footed goose numbers fluctuate considerably and peak numbers can often pass without a coordinated count being possible. The winter of 2010/2011 was particularly harsh and one of two consecutive winters in which the loch froze. Many sites recorded low counts in this year and the national population estimate was reduced accordingly. In 2013/14 the estimated Icelandic pink-footed goose population was a record 372,074 (Mitchell, C. 2014) in the same year the peak
Loch Leven count was 23,270 representing 6.25% of this population present on the reserve at one time.

Wintering Greylag geese have declined reflecting a national re-distribution of this species. It is now hard to identify what number if any are Icelandic breeding birds and which represent the British population. Peaks in July and August represent British moult flocks and not Icelandic breeders.
Swans

Europe’s wintering whooper swans breed in the sub-arctic region with the majority of the Icelandic population choosing Britain as their over-wintering destination.

Loch Leven has in recent years had a significant increase in whooper swan numbers. The long term trend at Loch Leven had fluctuated from year to year but always at lower levels. In recent years (since 2008) peak numbers of whooper swans have risen dramatically. The peak in November 2013 was 804, the fourth successive record count for the site. Counts have exceeded the threshold for international importance. These peaks are usually short lived as birds then disperse elsewhere. Numbers wintering in the UK have been increasing with the recent high counts at Loch Leven serving to emphasise the sites importance as a migratory stopover.

Diving duck

The graph below shows the 5-year peak mean averages for 3 designated diving duck species. Wintering populations of goldeneye have been declining at both a National and GB level so the relatively steady trend at Loch Leven is a positive reminder of the site’s importance. Contrary to national & GB trends pochard numbers have also been increasing and this has been cited as a positive response by diving duck to improvements in water quality in recent years (Spears et al. 2013).
Dabbling duck

The graph below shows the 5-year peak mean averages for 3 designated dabbling duck species.

The steep increase in teal numbers follows a national trend however there is evidence to indicate that in recent years the Scottish National trend has been one of decline and as numbers continue increasing at Loch Leven it is becoming an ever more important site for the species at a Scottish Level.
The populations of the other two species also follow that of the Scotland National trend. The declining trend in shoveler over the medium term maps that of the Scottish trend in contrast to an increasing GB wintering population. Shoveler is one of the 9 SPA designated species at Loch Leven which have Wetland Bird Survey (WeBs) alerts triggered (Cook, et al. 2013). The WeBs Alert system triggers when a species shows a significant decline in population. It aims to raise awareness and encourage research into the causes of decline to see if action can be taken to slow decline.

![Shoveler: Scotland](image)

Cormorants

Loch Leven is one of five sites in Scotland of European wildlife importance for wintering cormorants and it is the only inland site. It is likely that Loch Leven is a long-established site for cormorants as suggested by the naming of one of the small islands, Scart Island, the old Viking name for cormorants.

Cormorants are the other SPA species at Loch Leven with a WeBs Alert. In recent years this species has seen a declining trend across Scotland. At Loch Leven in the medium term the decline has been more marked. However it is now suspected that fish stocking policies on the site may have resulted in artificially increased cormorant numbers and that these numbers are now reaching a more 'natural' level.
Breeding Birds

Once hosting up to 1,000 nesting pairs, Loch Leven is still one of the largest concentrations of breeding duck in inland Europe. The most numerous breeding duck species are tufted duck and mallard, with smaller numbers of gadwall, shoveler, shelduck and pochard. Teal, pintail and wigeon have all been recorded since the reserve was established.

The large area of water offers space and security from human disturbance and predators, the shorelines provide cover for broods and the islands provide ideal nesting places. St Serf’s Island, the most important nesting area, combines safety from disturbance and predators such as foxes and suitable nesting sites with the added benefit of a nesting colony of gulls. The gulls nest colonially and act together against predators in the area, driving them away and making the island a safer place for other species to nest. However since the demise of the black-headed gull colony in 2007 protection is provided by lesser black-backed & herring gull with the payoff to broods being that following hatching some juveniles will be predated by these gulls.
As soon as the eggs hatch out, and often under the cover of darkness, the female duck takes her young (known as duck broods) to the shoreline around the edges of the loch and islands, often having to travel over large stretches of open water. The shoreline vegetation of reeds and overhanging willow offers shelter from predators and these are ideal places for the emerging flies on which the ducklings feed. These areas are known as duck “brood rearing” areas.

Dabbling ducks like mallard, shoveler, teal and gadwall, enjoy good feeding in the extensive shallows while the slightly deeper water is highly suitable for diving ducks such as tufted duck and pochard.

Great crested grebe & little grebe nest in the reed beds of the loch margins along with coot and moorhen.

There is also a heronry on Castle Island and Alice’s Bower this numbers around 20 nests each year with the majority on Castle Island.

Reserve staff have been monitoring breeding ducks at Loch Leven since the late sixties. Until 2004 this was mainly done by monitoring nests on St Serfs, either whole island counts or sample quadrats with some boat based surveys. Since 2004 the preferred method has become boat based pairs and brood counts (following Gilbert et al) a method which is less intrusive to the nest colony. However following concerns regarding nesting duck numbers in 2014 a full island nest survey was completed replicating the methodology of previous whole island counts.

- Between 1966 and 1970 all of the duck nests on St Serfs Island were intensively monitored and the total number of tufted duck nests ranged between 250 and 485 nests and averaged at 368 nests. Since then there have been a number of estimates of the number of nests on St Serfs. In 1981, there was the highest ever recorded count with over 550 nests however subsequent estimates have been slightly lower, with estimates between taken 1993 and 2004 averaging at 327 nests. In 2014 the number of nests was estimated at 130. This decline is at least in part attributed to the presence of foxes on the island between 2005/6-2008/9. However from what brood data is available from early boat based counts the number of broods/juveniles counted from this small population is not reduced to the same level as the reduction in nests might lead the observer to anticipate.

- The duck colony on St Serfs is also an important site for breeding mallard and although numbers vary from year to year mallard nesting numbers had remained fairly stable over the decades. The average number of mallard nests on St Serfs between 1993 and 2004 was 429 nests, which is similar to the average of 441 nests found during the intensive work in the late 1960’s. In 2014 the numbers of nests on St Serfs was only 117 however the peak number of juveniles at ≥ 3wks was 107 which compares favourably
with the juvenile counts recorded when the nest population was much higher. Indicating a smaller but more productive mallard population.

- St Serfs Island is an important nesting site for gadwall with an average of 36 pairs in the late sixties. From the numbers noted in the 60s a gradual increase occurred to around 50 pairs during the early 1990s, following this they declined but have once more recovered with juvenile productivity in 2014 on a par with the best years on record.

- Wigeon is a species that has undergone a significant decline at Loch Leven as a breeding bird. During the late sixties there were an average of 31 pairs breeding and in the early 1980s there were an average of 39 pairs. The population then crashed dramatically over the space of a couple of years and by 1986 only eight pairs nested on St Serfs. Since 1986 none have been recorded with broods.

Research work undertaken in the 1970s identified a lack of suitable duck brood rearing habitat on Loch Leven. The main recommendation for reserve management was to alter the shoreline to establish more cover and improve it for ducklings and to keep human disturbance on the nesting area to a minimum. Although large numbers of ducklings had hatched out on St Serf’s, there was only about 4km of fringing willows and reed beds scattered around the East of the loch and some islands, available as good brood rearing habitat. Counts of less than 100 ducklings were recorded in these areas. The lack of good brood rearing habitat was due to the effects of nutrient enrichment weakening the phragmites reeds and due also to the introduction of cattle, horses and sheep to the shoreline since the late 1930s. These factors together wiped out the fringing long vegetation and overhanging willows.

Subsequent removal of stock, the planting out of willow whips along the shoreline and additionally, the installation of the 3.5km of gabion baskets between 1982 - 84, has resulted in the restoration of a narrow band of reed beds and willow carr to more than 10km shoreline. These reed beds are now also beginning to establish beyond the sheltered confines of the gabions.

Recent surveys show that whilst the numbers of nests is reduced on historical levels, probably largely as a result of fox predation, that the number of broods and juveniles produced by this smaller population is comparatively high i.e. the smaller population is more productive. The size of broods reaching $\geq$ 3wks (and therefore likely to survive to fledging) remains directly comparable to historic data. These results lend weight to the conclusion that the measures to improve brood habitat and water quality have been a success.

In addition to the nesting ducks on St Serf’s, there are also nesting gulls; a mixed colony of lesser black-back gull & herring gull (referred to as large gulls), and a currently absent colony of black-headed gulls. Common gull and greater black-back gull also nest in small numbers on the island too.
Until 2006 there were black-headed gull colonies generally present in the north of the island. In 1998 there were an estimated 6,832 nests by 2004 this had declined by 53% to 3,226 in 2004. In 2006 the black headed gull colony deserted completely, this event is at least in part attributed to the arrival of foxes on the island. In addition, lesser black-backed and herring gulls became fully established in the early 1980’s and the colony of black-headed gulls appears to have shifted locations around the island following the expansion of the large gull colony. There have been attempts by small numbers of black-headed gulls to establish on the island but to date these have not been successful.

Since culling of large gulls ceased in 1996, their numbers rose rapidly until they stabilised in 2001. The population of large gulls then crashed in 2007 probably attributable again to foxes being present on the island for a second consecutive year.

Concerns have been expressed that this large gull colony has resulted in increased predation of very young ducklings less than 10 days old. Further research work does not support this, as the number of juveniles reaching ≥ 3wks (and therefore likely to survive to fledging) has not decreased in association with the establishment of the large gull colony.

SNH research in 2014 has also shown a strong correlation between the gull colony and duck nests with 100% of tufted duck, 100% of Shoveler and 93% of all duck nests located within the gull colony. Providing weight to the argument that to cull the gulls may be counterproductive.

### Tufted Duck

Records show that tufted duck first began breeding at Loch Leven in large numbers after 1850. It is now the most important breeding site in Britain, with nationally important numbers of up to 400 pairs nesting here, mainly in high densities on St Serf’s Island. Numbers fluctuate from year to year and are regularly monitored.
Male tufted duck begin establishing territories on the loch, for feeding and attracting females, from early March until mid-April. These territories are sites that will be the best places for raising young.

Tufted duck nest later than other duck species, with the peak egg laying period not occurring until late May / early June. They use the tussocky grass of St Serf’s Island to build their nests in, under the protection of the resident gull colony that sees off predators such as rats, jackdaws or mink. After hatching the mother leads her young brood from the nest to the established territories around the shoreline where protection and plentiful food are found among the over-hanging or emergent vegetation. However, unlike other duck species tufted duck broods will also venture into more open water to feed.

The first tufted ducks begin to moult in late June, joined by birds from other areas, flocking together for safety in sheltered and disturbance free areas of the loch. In common with other wildfowl tufted duck moult all of their flight feathers in a short period and become flightless and very vulnerable at this time.

Around August, tufted duck from other breeding sites arrive at Loch Leven in large numbers leading to a peak count of these birds in September/October of up to 4,500. Tufted duck are diving ducks and feed in the deeper parts of the loch (4-5m).

Tufted duck marked at Loch Leven in the summer have been shown to disperse to Ireland for the winter, while some drakes born at Loch Leven have been recovered in Scandinavia and Germany, possibly having paired with females from these areas on their wintering grounds and returning with them to breed.
Moulting Birds

Numbers of birds start to build up in August as many birds use the loch to moult, shedding their summer plumage and growing new feathers ready for the winter. As they are often flightless at this time they use the wide-open space of the loch to keep away from danger and stay on the water, gathered together in flocks. For example in excess of 600 mute swans use the loch to moult, forming spectacular white rafts visible from the surrounding hills.

Mammals

Loch Leven NNR is home to a variety of mammals. Otters use the burns that feed the loch and surveys have shown them to be present throughout the reserve. The scarce water shrews and water voles inhabit the banks of ditches and burns. Although we know water voles are present little is known of their status on the reserve.

A total of six species of bat; Daubenton, brown long-eared, noctule along with Nathusius, soprano & common pipistrelle have been recorded. Bat boxes are checked in most years by the local bat group.

Red squirrels are regularly seen on the reserve with the woods at Levenmouth, Grahamstone & those near Kinross hot spots for this species. Grey squirrel numbers are controlled and this has been effective in the re-establishment of red squirrels around the loch.

As with many of the site’s mammals Loch Leven is a refuge for these species within Kinross-shire.

Pest species of fox, mink and brown rat are present on the reserve and traditionally have been controlled particularly when present on St Serfs to protect the duck nest populations.

Fish

The fish community of Loch Leven numerically is dominated by brown trout and perch with the latter being more abundant whilst in terms of biomass brown trout is greater (I.J. Winfield 2015, Internal CEH report). The brown trout of Loch Leven are famous for their unusual colour and high quality, and the recreational fishery equally renowned across the globe. Trout feed on invertebrates, which in turn are supported by the large beds of aquatic plants. Other fish still present include sticklebacks, pike, eels, and minnows. Arctic char, salmon, and flounder all feature in historical records but were probably impacted on by the lowering of loch levels (Arctic char), river pollution and the damming of the River Leven (salmon) in 1830. Commercial eel fishing declined in the 19th century and came
to an end in 1901. For many years the species was not recorded at all but in recent years there is evidence that it has returned albeit in low numbers. Brook lamprey and stone loach are also listed in early records but are probably restricted to tributaries.

The story of the survival and productivity of the brown trout in Loch Leven is extremely complicated and has been the subject of intensive study. The tributaries which run into Loch Leven are a vital part of what is once again a natural, self-sustaining brown trout population and recreational fishery.

**Plants**

The site has an outstanding number of vascular plant species that grow around the loch shore, including 3 species (coral root orchid, Loch Leven spearwort and lesser water-plantain) that are listed on The International Union for the Conservation of Nature (IUCN) Red list for vascular plants. Other species, which are rated as “nationally rare” or “nationally scarce”, include holy grass, threadrush and mudwort.

Plants such as mudwort, threadrush, lesser water plantain and Loch Leven spearwort are plants of loch shores which depend on intermittently exposed areas of mud, sand or gravel and need some erosion or active management to keep these areas free from reeds and other aquatic plants. Holy grass smells strongly of marjoram and was of traditional cultural importance in medieval times as it was dried and used as incense or as a *strewing herb* in churches. It is present around the edge of the loch in marshes which occasionally flood.

Monitoring of thread rush and Loch Leven spearwort has shown that some populations of the thread rush appear to have been lost to reed bed and willow scrub, which may have been a result of the habitat enhancement work. The extensive population of Loch Leven spearwort is close to the existing gabions but does not seem to have been affected. Surveys of holy grass have shown that it may have disappeared from several previous locations, possibly due to scrubbing over by willow and a coarsening of the vegetation. However in recent years its range is spreading and new sites within the reserve are frequently recorded. Active management through scrub removal and mowing is aimed at restoring species rich habitat around fringes of the loch.

The nationally scarce coral-root orchid is found at one location on the reserve and this is its only known site in Kinross-shire.
Invertebrates

Invertebrates are a critical part of the ecosystem of Loch Leven with many birds, fish and other animal life depending on them. Hatches of small flies in the summer months form clouds of protein rich food for growing ducklings.

A host of aquatic snails and other invertebrates are supported by large quantities of submerged plants.

Some of these invertebrates are rarities, including *Thanatophilus dispar* a carrion beetle of the loch strandline, *Macrolea appendiculata*, a reed beetle whose larvae feed on the roots of water plants, *Anthicus scoticus*, a small ant beetle of strand line refuse, and *Chersodromia cursitans*, a small predatory fly found on the sandy shores of the loch.

Dragonflies and damselflies, abundant at the start of the 20th century, declined to a point where they were thought to be absent. This was in line with national and European trends on water bodies where enrichment of the waters was thought to be a significant factor. At the turn of the 21st century, with water quality recovering, the common hawker, common darter and black darter dragonflies and the blue-tailed, large red and common blue damselflies had all been recorded in ponds around the loch with the most recent addition being the now abundant azure damsel.

A team of dedicated volunteers monitor not only dragonflies and damselflies but also butterflies and bumblebees. This monitoring has been carried out since 2008 over a series of fixed transects and is now developing into an important long term data set with additional botanical notes.

Habitats

The NNR comprises a range of habitats from open water with extensive floating beds of aquatic plants, through emergent and shoreline vegetation, bog, grassland, scrub, and finally mixed woodland reaching up to open hill. Seven well-vegetated islands punctuate the loch ranging in size from a few metres across to 42 hectares.
Open Water

Loch Leven is unusual because it is large and naturally eutrophic (nutrient-rich) in contrast to most large lochs in Scotland, which are oligotrophic (nutrient poor). The loch was selected as a Ramsar wetland site primarily for its water birds but also because it is a particularly good example of its water body type.

Whilst the nutrient rich waters are important in supporting a great wealth of wildlife, nutrient levels that are too high start to cause problems within the ecosystem. The vegetation at Loch Leven has changed markedly over the twentieth century reflecting a decline in the water quality due to nutrient enrichment from industry, sewerage treatment works and agriculture. Extensive reed beds and other emergent plants fringing the shore of the loch in the past had largely disappeared. The aquatic plants submerged within the loch have changed too in response to the changing nutrient status of the loch. However it has been the recurrent algal blooms, a response to the artificially high nutrient levels that have caused most alarm. Work initiated through the Catchment Management Plan in the 1990s has arrested the decline and the loch is now showing signs of recovery.

Emergent and shoreline vegetation

Reed beds occur in ungrazed, sheltered areas most notably at Levenmouth, the Factor’s Pier, Reed Bower Island, and behind the gabions that protect the east shore. The shoreline vegetation is particularly important for breeding wildfowl. The overhanging willows and tall emergent plants such as reed canary grass provide shelter for ducks from predators, disturbance and bad weather. In parts of the more exposed shoreline smaller plants such as common spike rush predominate with occasional patches of Loch Leven spearwort.

Much of the focus of reserve management has been to restore the extent of fringing vegetation and success can be measured by the increase in shoreline vegetation from a low of around 4km in the 1970’s to over 10 km in 2006.
Submerged aquatic vegetation

The submerged aquatic vegetation in Loch Leven has changed since the mid-nineteenth century as the loch became progressively more eutrophic. However it still maintains its species-rich flora. The shallow nutrient-rich waters mean large beds of submerged plants can thrive. With almost half the loch less than 2 metres in depth, large beds of pondweeds, stoneworts and other aquatic plants can cover up to 45% of the loch surface.

Research during the 1970’s clearly showed that nutrient enrichment, leading to algal blooms, had reduced the diversity of the loch’s flora and fauna. Much has been achieved under the auspices of the Loch Leven Catchment Management Plan (LLCMP) and an earlier action programme to reduce phosphorus inputs to the loch and restore the water quality.

There is now evidence of a recovery with the beds of pondweeds and stoneworts starting to extend back out into deeper water as the water clarity has improved. Macrophyte coverage in Loch Leven in 1999 was extensive in areas of the loch that were less than 2.0m deep. Two surveys in the 1990s both recorded 12 submerged and floating-leafed species and there was some localised increase in species richness. Work in 2006 recorded submerged plants at a depth of over 4.5 metres which is at the depths recorded by West in 1910. Long-stalked pondweed (*Potamogeton praelongus*) was rediscovered in 2008; this species, often an indicator of eutrophication grows at depth and requires good water clarity. Absent during the 20th century its return is attributed to improvements in water quality (Dudley et al. 2012)

During 2014 a total of 20 macrophyte species (submerged & floating leafed) were recorded. Looking at the historic data, this is the most aquatic macrophyte species recorded in a single year at Loch Leven since 1910. It is believed that there are even more present because at least 4 species not recorded in 2014 were recorded in the previous 10 years (Gunn, I. pers com.)

This has had consequent impacts on the invertebrate diversity and abundance. The increase in cover of aquatic plants and associated abundance of insect life, especially aquatic snails, will ensure there is a continuing good supply of food for fish life, wintering waterfowl, breeding ducks and other birds such as swifts, swallows and osprey.

Islands

The islands on Loch Leven are immensely important for breeding waterfowl species, providing sanctuary from predators such as foxes and being relatively disturbance free. The tussocky structure of the grassland on St Serfs provides ideal nest sites for these birds and the edges of the islands provide habitat and shelter for birds and other animals.
Grassland

The grassland habitat around the loch was formerly more extensive and the wet unimproved pastures around the loch contain nationally and locally rare plants. However with a decline in grazing, much of this habitat had been encroached by scrub. One of these wet grasslands, Carsehall Bog, supports many orchids, such as lesser butterfly orchid and purple marsh orchid. Some scrub encroachment had occurred as grazing levels were reduced. Increased grazing since 2009 and the removal of encroaching scrub, primarily gorse, willow and silver birch by cutting has restored these areas. Numbers of lesser butterfly orchid have increased accordingly and the overall flora diversity of these areas broadened. Almost 100ha of grassland and wet pasture on the NNR is now actively managed through mowing and grazing by SNH with a further c150ha managed by the RSPB.

Mixed Woodland

Scots pine and birch form the majority of woodland within the reserve providing habitats for the common woodland birds and potential nesting habitat for osprey. The largest areas of woodland are found at Levenmouth Plantation and the Black Wood together with the woodland on Vane Hill, now regenerating after grazing animals were removed in the late1960’s.
Summary
Loch Leven is a site that is celebrated for its internationally important birds but the unique nature of the loch – size, water type, and relatively undisturbed – makes it an important site for other wildlife. The habitats that surround the loch support rare & diverse plants, making the whole site interesting to the all-round naturalist.
3 History before the Loch became an NNR

Loch Leven’s natural history is inextricably linked with the cultural heritage of the area. Kings, queens and nobleman have all had an influence on the present day makeup of the site.

Timeline

<table>
<thead>
<tr>
<th>Era</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron Age?</td>
<td>Crannog or lake dwelling constructed (off Kirkgate Park).</td>
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<tr>
<td>5th Century</td>
<td>Records tell of a fortress or stronghold on Castle Island from this period.</td>
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<tr>
<td>6/7th Century</td>
<td>The first evidence of a religious habitation established on St Serf’s Island – a “Humble hallowed cell…” is recorded.</td>
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<tr>
<td>10th Century</td>
<td>Priory status is given to the St Serf’s religious settlement.</td>
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<tr>
<td>11th Century</td>
<td>Macbeth, King of Scotland, grants land to the monks of St Serf’s.</td>
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<tr>
<td>12th Century</td>
<td>Monks from St Andrews build the Priory on St Serf’s Island.</td>
</tr>
<tr>
<td>13th Century</td>
<td>The current Leven Castle was probably constructed around this time. It survived various sieges during the 14th century and was granted to the Douglas family in 1372 by King Robert II.</td>
</tr>
<tr>
<td>1314</td>
<td>King Robert I granted rights to the Abbot of Dunfermline to fish the loch with “one coble and two sets of four nets”</td>
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<tr>
<td>1560-1</td>
<td>The Priory on St Serf’s Island was abandoned.</td>
</tr>
<tr>
<td>1567-1568</td>
<td>The castle was used as prison for many years. The most famous prisoner held was Mary Queen of Scots, who in 1567 whilst imprisoned here, was forced to abdicate in favour of her infant son James VI. In 1568 she was helped to escape, and with her captors still inside, the castle keys were thrown into the waters of Loch Leven.</td>
</tr>
<tr>
<td>1675</td>
<td>Sir William Bruce (1630 - 1710) bought the Castle and a sizeable estate and then built Kinross House, overlooking the loch and the castle.</td>
</tr>
<tr>
<td>c. 1770</td>
<td>Kinross House passed into the possession of the Montgomery family.</td>
</tr>
<tr>
<td>1827</td>
<td>An Act of Parliament was passed “for recovering, draining and preserving certain lands in the counties of Fife and Kinross; and for better supplying with water the mills, Manufactories and Bleach fields and other works situated on or near the River Leven in the said county of Fife.&quot; Work building the sluices and lowering the loch was completed by 1831.</td>
</tr>
<tr>
<td>1873</td>
<td>Netting was stopped, since when only angling has been allowed on Loch Leven.</td>
</tr>
<tr>
<td>Era</td>
<td>Activity</td>
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</tr>
<tr>
<td>1901</td>
<td>The Society for the Protection for Birds (later to become the RSPB) appointed its first watcher, to protect breeding pintail on St Serf’s Island.</td>
</tr>
<tr>
<td>1959</td>
<td>Curling on the ice at Loch Leven - the last time conditions were suitable for The “Grand Match” or &quot;bonspiel&quot;, was 1959.</td>
</tr>
<tr>
<td>2011</td>
<td>Kinross House and three islands including Castle island are sold by the Montgomery’s</td>
</tr>
</tbody>
</table>

**Cultural Heritage**

Castle Island has been fortified since the 6th century. However the stonework visible today is of a castle constructed around the 13th century. It has survived various sieges throughout its history and was used as a prison for many years, its most famous resident being Mary Queen of Scots who was imprisoned here in 1567 and escaped the following year. Loch Leven Castle has been a ruin since the 18th century.

In 1675 Sir William Bruce bought the Castle, along with a sizeable estate and proceeded to build Kinross House, a fine Palladian mansion that overlooks the loch and castle.

![Image of Loch Leven Castle](image)

In 1668 Kinross Curling Club is reputedly the oldest in the world. In winters when six inches of ice occur on the loch traditional games are played on Loch Leven with the Loch Leven Province and Blairhill Trophy competitions being held. In hard winters the most famous of tournaments, the “Grand Match” or "bonspiel", has been staged at Loch Leven with 300 sheets of ice (8 curlers per sheet) being used. The last time conditions were suitable for this extravaganza was 1959. However when the loch froze in 2010/11 there was once again talk of a Loch Leven Bonspiel and although this did not happen a couple of informal ends were played.

**Land use history**

Until the 1830s Loch Leven was surrounded by extensive marshes. The loch regularly flooded over the winter meaning the shoreline constantly changed. The extent of marshland is depicted on the early maps of the area, and it is known that bitterns, marsh harriers and greylag geese bred around the loch in these areas.
In 1830 a major drainage scheme was started which would see enormous changes in the loch. Designed to benefit industry, particularly the textile manufacturers situated along the River Leven the scheme aimed to ensure a more consistent water supply for the mills. At the same time it would drain the marshland around the Loch so that it could be used for farming, the scheme reportedly cost £40,000, nine times the original estimate!

The water level of the loch was lowered by 1.5 metres (m) and the sluices allow the level to be dropped a further 1.4m if required. This reduced the surface area of the loch by about a quarter and four new islands emerged as a result - Alice’s Bower, Roy’s Folly, Scart Island and the Green Isle. The scheme also involved straightening the River Leven and the Gairney Water; their old meanders can still be seen on contemporary aerial photos.

After completion the level of the loch was no longer determined by local rainfall but instead by the demands of industry downstream, a situation that continues to the present day with water flow in the River Leven determined by the River Leven Trustees.

The drainage scheme allowed the marshes to be turned into farmland. Vegetation colonised the new shoreline, and records show there were extensive reed beds; in some places local farmers were cutting reeds for thatch as late as the 1930s.

In the nineteenth century plants more characteristic of oligotrophic (nutrient-poor) lochs were also recorded at Loch Leven, but typical plants such as lake quillwort, pillwort, and water lobelia had already disappeared by the early twentieth century. In 1910 twenty species of submerged aquatic plants were recorded including eight species of pondweed (important food plants for waterfowl). Also at this time in some shallower muddy areas Canadian pondweed grew “with such extraordinary vigour that in summer, when the plants are near the surface, it is very difficult to row a boat through them”. In fact during the 1940’s it was reported that plant growth over much of the loch was so dense that channels had to be repeatedly cut to allow boats to pass.

After the Second World War the rate of nutrient enrichment accelerated. Increased fertiliser run off from the surrounding farmland and the discharge of domestic sewage and industrial effluent affected the nutrient levels. The reduced water clarity confined plants to areas less than 2m deep. This led to a reduction in the diversity and numbers of plants in the loch. The remaining plants were typical only of nutrient rich waters. By 1965 many of the plants recorded in the early 1900’s had gone. The decline in rough stonewort from the prodigious growth in 1910 to sparse amounts in 1970-71 was probably a result of this process.
By 1972 little of the shoreline vegetation remained, coinciding with an increase in the number of cattle, sheep and horses grazing around the loch. Increased grazing pressure may have been one of the factors that caused the disappearance of the reed beds nutrient enrichment also weakens reeds. The reduction in vegetation exposed the shoreline to the ravages of wind, wave and ice causing erosion and preventing new plant growth. In the 1980’s gabions (stone-filled metal cages) were installed in the southeast of the loch to provide protection from wave action, and reeds were able to re-establish behind these.

Research has shown that pollution of the loch’s water has been partially responsible for triggering algal blooms. Since the 1970’s a concerted effort has been made to improve the quality of the water discharged into Loch Leven, particularly to reduce phosphorus. Major reductions in phosphorus loading occurred in the late 1980’s / 1990’s by addressing the source of these discharges. The woollen mill in Kinross, previously a major discharger of phosphorus, ceased their discharges and four sewage treatment works were improved, thus reducing the pollution to the loch. Pollution from agricultural land still contributes to the high phosphorus levels entering the loch. However improvements in water clarity and the return of aquatic plants to deeper water have occurred as water quality has improved. Once again large weed beds are establishing during the summer months and some areas of the loch can become almost un-navigable due to the extensive reed beds.

The Fishery

The management of Loch Leven NNR is intimately linked with the management of the fishery. When the NNR was declared, the agreement allowed continued management of the fishery by Kinross Estate.

Throughout history Loch Leven has been renowned for its fish. In 1314 King Robert I granted rights to the Abbot of Dunfermline to fish the loch with “one coble and two sets of four nets” (a coble being a boat). Historical records show brown and sea trout, salmon, pike, arctic char, perch, brook lamprey, flounders, and eels were present in the loch.

By 1831 the construction of the sluices and lowering the loch level by 1.5 metres resulted in a reduction in the number of species of fish within the loch with sea trout, salmon, and lamprey becoming isolated from the sea by physical barriers, and the arctic char dying out following the reduction in water levels. Eels, once
fished by the tonne, became victims of pollution of the River Leven and disappeared in the 19th century with the rise in industrialisation in the area.

In the mid 1800s the commercial fishing was leased by “tacksmen”, who caught the fish in large nets and exported them in wooden casks to Edinburgh, Glasgow and Manchester, as described in the two diaries of David Marshall (1847 - 1850 and 1859 - 1863). Netting was stopped in 1873, since when only angling has been allowed on Loch Leven.

Loch Leven was once regarded as the finest brown trout fishery in the world. Kinross Estate has kept angling records since 1872, recording catch by number and by weight every year however after 2002 these records become less effective as a record of actual fish caught as a result of anglers releasing fish they could have retained.

The Estate has, during different times this century, supplemented the wild fish with hatchery-reared fish with extensive stocking between 1983 and 2006 including with non-native rainbow trout. Between 1900 & 1970 the annual catch frequently exceeded 40,000 brown trout. Post 1970 there was significant decline in the annual catch accompanied by a marked increase in individual weight. These declines led to various different stocking policies to offset the deterioration of the fisheries performance. (I.J. Winfield et al. in Hydrobiologia).
The above slide courtesy of CEH shows how fishing quality has changed over time.

In 1882 Kinross Estate opened up rearing ponds to supplement the natural recruitment of brown trout to the loch; surplus fry reared in the ponds were sold to other fisheries. This appeared to have little effect on the catch by anglers and the practice was discontinued by 1936, when management of the loch became
more passive. Controlling predators, netting pike, and preventing trout running the burns until the end of the legal fishing season became the main activities. In the 1970’s catches began to decline, and in response the Estate reinstated the hatchery and fishponds in the 1980’s.

As catches of trout continued to decline, the estate introduced North American rainbow trout in 1993 for the first time to supplement the fishery. Stocking with Rainbow Trout ceased in 2005 with the fishery once more seeking to become a place celebrated for brown trout. Recent seasons have seen the fishery become recognised for the size and quality of fish.

In 2013 the fishery record was smashed when the first ever double figure brown trout was caught by Alan Campbell on 7th May 2013 and weighing in at 11lb 5 3/8oz. The previous record had stood for 101 years at 9lb 13oz with specimen caught by Colonel Bob Scott on 8th September 1911. Other specimens close to this weight have been caught in recent years and now fish around the 4-5lb mark are quite regular, such catches are rapidly establishing the loch as a venue for big trout. This said the numbers of smaller trout being caught is also encouraging and anglers in recent years now release much of what is caught.

Shooting of wildfowl has been a sport long exercised on the loch and Kinross Estate still continues this tradition with around 34 days shooting in the winter.

**Summary**

Loch Leven has been the major focus of Kinross-shire from the landscape, natural history and cultural perspective throughout history. It has undergone major changes, due to the exploitation of fish and water. Its size and islands have made it a place where “retreats” have been established – the religious settlement of St Serf’s Island and the fortress of Leven Castle.

Man has had a profound effect on the loch. The combination of industrialisation and agriculture has altered both the physical and chemical makeup of the loch. Despite this effect, Loch Leven remains one of Scotland’s key landscape features and wildlife spectacles. The pressures on the loch and the need to protect this wildlife interest led to the designation of the NNR for research and conservation.
4 History and Management of Loch Leven NNR

After the Countryside Act 1949 legislation came into being Loch Leven was identified as a key site to become one of the new NNRs, although it only gained this accolade 15 years later.

Key events in the story of the NNR

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
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<tbody>
<tr>
<td>1949</td>
<td>The first proposal to establish a Nature Reserve was made by the Scottish Wildlife Conservation Committee.</td>
</tr>
<tr>
<td>1964</td>
<td>Loch Leven NNR was declared on 3rd March 2014 to “maintain its attraction for all species of wildfowl and to safeguard all the characteristics that go to form this unique habitat”. Byelaws were introduced with the aim of protecting the site.</td>
</tr>
<tr>
<td>1966</td>
<td>An extensive research programme was undertaken under the International Biological Programme (IBP), to measure the ecological process of the loch. This combined efforts of the Nature Conservancy (now SNH), the Freshwater Fisheries Laboratory, the Wildfowl Trust (now WWT), and many others. The Royal Society of Edinburgh published the results in 1974.</td>
</tr>
<tr>
<td>1966-70</td>
<td>Major breeding duck research was undertaken that forms the baseline from which all further recording has been taken.</td>
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<tr>
<td>1967</td>
<td>The RSPB purchase Vane Farm as an education centre.</td>
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<td>1982-84</td>
<td>The construction of a gabion reef along the east shore to provide erosion protection to a 2.2km stretch of shoreline and allow overhanging willows, reedbeds and lagoons to re-establish.</td>
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<tr>
<td>1992</td>
<td>A serious algal bloom temporarily closes the fishery and leads to the establishment of the Loch Leven Area Management Advisory Group set up to try to address the pollution problems of the loch.</td>
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<tr>
<td>1992</td>
<td>RSPB re-vamp the Vane Farm facilities.</td>
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<tr>
<td>1993</td>
<td>Rainbow trout stocked in an attempt to boost the fishery.</td>
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<tr>
<td>1999</td>
<td>The Loch Leven Catchment Management Plan was produced designed to deliver a sustainable future for the loch, through influencing land use and river management practises within its catchment.</td>
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<tr>
<td>c1992</td>
<td>Pollution discharges from four sewerage treatment works and woollen mill ceased</td>
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<tr>
<td>2002</td>
<td>The NNR was extended to include RSPB’s Vane Farm Reserve and re-declared through a new 25-year agreement with Kinross Estate Company.</td>
</tr>
<tr>
<td>2004</td>
<td>Final year of rainbow trout being stocked into Loch Leven</td>
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<tr>
<td>Date</td>
<td>Event</td>
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<tr>
<td>2005</td>
<td>Publication of the Scottish Outdoor Access Code under the Land Reform (Scotland) Act advises on new rights of responsible access to the Scottish countryside and introduction of local access guidance for Loch Leven NNR.</td>
</tr>
<tr>
<td>2007</td>
<td>The first section of Loch Leven Heritage Trail (LLHT) Kinross to Burleigh is completed</td>
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<tr>
<td>2008</td>
<td>Official opening (November) of Loch Leven Heritage Trail from Kinross to RSPB.</td>
</tr>
<tr>
<td>2009</td>
<td>Scrub removal to increase area of suitable duck nesting habitat on St serfs.</td>
</tr>
<tr>
<td>2009/10</td>
<td>Loch Leven froze completely in both these particularly harsh winters when ice was up to 200mm thick.</td>
</tr>
<tr>
<td>2011</td>
<td>RSPB carry out large scale hydrological habitat creation their ground.</td>
</tr>
<tr>
<td>2012</td>
<td>LLHT extended around Factory Bay including a new hide.</td>
</tr>
<tr>
<td>2012</td>
<td>Carsehall ditch realignment and scrub clearance carried out.</td>
</tr>
<tr>
<td>2013</td>
<td>RSPB carry out large scale scrub removal on the Carden Strip to encourage wading birds.</td>
</tr>
<tr>
<td>2014</td>
<td>Last section of LLHT connecting RSPB to Kinross open to the public (spring)</td>
</tr>
<tr>
<td>2014</td>
<td>Loch Leven celebrated its 50th Anniversary as an NNR.</td>
</tr>
</tbody>
</table>

**Management of the Natural Heritage**

Given that the majority of Loch Leven NNR is the loch, management of the habitats focuses mainly on the small fringing shoreline zone and islands. Throughout its history, the management of the NNR has focussed on safeguarding the important natural heritage interest. This has largely been achieved through keeping disturbance-free conditions and maintaining characteristic habitats suitable for wildfowl and plants.

Management works have included:
- erosion control – the gabion baskets installed in the 1980’s. This has been successful in protecting the shoreline and creating well-vegetated still water lagoons and reed beds. These areas are used by waterfowl for feeding and safety;
- scrub control - Carsehall Bog is kept open by the removal of gorse, followed by traditional grazing; scrub has also been removed from Marys Knowe
- St Serfs - has benefited from removal of 2ha of scrub and wetland creation to improve duck nest habitat.
- create open water areas – at Carsehall ditches have been remeandered and new wetlands created. Along the southern section of the LLHT new wetlands have been created as a mitigation measure which in turn provides habitat for invertebrates and nesting birds.
- pest control – mink, fox, rat and jackdaw are controlled to prevent predation on nesting birds.
- lowland heath restoration – work has commenced on restoring the lowland heath at Grahamstone.
- encouraging shoreline vegetation through willow planting - this provides valuable habitat for duck broods as well as helping to prevent erosion;
- grassland management - grazing is let for 2 areas. The annual summer grazing of 100+ sheep on St Serf’s Island. Orwell Marsh and Carsehall are now grazed by cattle as one grazing unit. Burleigh Sands, Mary’s Knowe and Findatie are maintained by volunteers & staff using mowers and balers.

The RSPB have undertaken extensive management works, re-creating the wetlands between the visitor centre at Vane Farm and the loch and removing grazing from Vane Hill to allow the birch woodland to develop. Generally they manage land in a way favourable to birds that once bred or wintered in the area. A demonstration project of mire restoration was undertaken in the late 1990s.

Management of the water body as a habitat has been undertaken as part of a collaborative project covering the whole of the Loch Leven catchment. In the late 1970s the first steps were taken to tackle the causes of nutrient enrichment (eutrophication). In 1992 major algal blooms on the loch lead to the formation of the Loch Leven Area Management Advisory Group (LLAMAG) in 1993 who set about trying to address pollution problems of the loch. By the late 1990s a number of measures had been taken but recovery will take many years to show.

Since 2012 SNH has funded further work to raise awareness of the issue of agricultural diffuse pollution and to help farmers do what they can to reduce the risk of nutrient and soil losses. The latest project involved a series of workshops for land managers and potato contractors as well as one-to-one farm visits.

Research

In 1966 Loch Leven was selected to form part of a worldwide major research programme measuring the ecological process of the loch (the International Biological Project). This focussed on the flow of energy through the food chains up to fish and birds. The 5-year programme involved 41 scientists from a wide range of organisations highlighted the complexities of the site. Other very far ranging studies were also undertaken in relation to this on all aspects of the lochs ecology.

Studying birds at Loch Leven
Since then research has continued on the reserve with regular monitoring or surveys of:

- water quality;
- nesting duck;
- duck broods;
- breeding gulls;
- wetland birds (Wetland Bird Survey);
- wintering geese;
- cormorants and their impact on the fishery;
- wader productivity on RSPB Loch Leven;
- rare plants and invertebrates; and
- submerged macrophytes.

The wealth of data and monitoring recorded and the long time period over which this has occurred makes Loch Leven of global importance for the study of freshwater ecology.

**Management for People**

Public access to the loch is not a new issue. As long ago as 1860 local people wanted access to the shore and loch and a celebrated case came to the Court of Session concerning the right to walk the shores and the public right to fish the loch. The decision went in favour of Sir Graham Montgomery against these wishes. The loch is still in private ownership but the 1964 Nature Reserve Agreement (NRA) brought in byelaws that gave people access to certain areas and kept large tracts of the reserve undisturbed.

The purchase of land in 1968 at Findatie by the Nature Conservancy Council (now SNH) gave an opportunity to extend public access. Byelaws, introduced with the declaration of the NNR, sought to manage peoples' behaviour and access to the reserve until they lapsed when new legislation was put in place. Until the advent of the Land Reform (Scotland) Act 2003 access for the public had been confined to a few controlled areas: Kirkgate Park, Burleigh Sands, RSPB Loch Leven and Findatie. Castle Island was accessible on boat trips organised by Historic Scotland. Management of these areas has been mostly concerned with keeping paths, signs and other infrastructure in good and safe condition.

Following introduction of the Land Reform (Scotland) Act 2003 and the Scottish Outdoor Access Code, SNH undertook detailed consultation regarding application of the access code at Loch Leven and opportunities for informal access to the site. SNH produced site-specific local access guidance for the reserve in 2005, subsequently revised in 2006. This local access guidance welcomes responsible access on and around the loch and provides advice on responsible access and minimising the risk of disturbance to birds when taking
access both on water and around the loch. Further revision in 2009 and subsequent amendments have been carried out with approval from the recreation users group which comprises representatives of recreation organisations including Ramblers Scotland, Sports Scotland and the Scottish Canoe Association.

Guidance for waterborne access and dog walkers is promoted through the website and the waterborne access guidance is on display at Kirkgate and Burleigh. In recent years levels of compliance with the waterborne access guidance has been low whilst compliance amongst dog walkers has increased over time. Reserve staff continue to carry out monitoring of visitors and report annually on numbers of visitors and associated levels of compliance with the guidance.

From 2005 SNH worked closely with The Rural Access Committee of Kinross-shire (TRACKS) to facilitate a path around the loch. The total cost of the project was £4M and SNH provided over £600K funding over seven years to the project – known as the Loch Leven Heritage Trail (LLHT). The potential disturbance to bird life has been one of the cornerstones of our comments on the plans throughout the process. The finalised specifications for the path have incorporated mitigation measures to ensure appropriate amounts of screening of birds from people and dogs on the trail. The result has been a high quality footpath with bird viewing hides, scenic view points and also interpretation at all main access points. Analysis carried out in 2013 of WeBS data before and after the construction of the trail indicated that these measures had been successful with no significant impact on numbers of wildfowl using the reserve.

There are 3 bird viewing hides on the trail and a further 3 accessible to paying visitors and RSPB members on the RSPB section of the reserve. In the harsh winters of 2009/10 & 2011/12 the hides at Burleigh and near the Factors Pier at Kirkgate were twice damaged by ice movement. The Burleigh one has subsequently been moved inland and the Kirkgate one has not been replaced as a suitable alternative location could not be found for the rebuild.

The RSPB’s land at Vane Farm, now part of the NNR, has been a key element in bringing visitors to Loch Leven. Over 70,000 people per year use the facilities offered there and the RSPB run a variety of programmes for school children and volunteers. The visitor centre boasts a shop, café, observation room, an educational room, toilets, woodland trail, and hides placed around the re-created wetlands on the shores of the loch.

All previous management plans state the desire for greater awareness of the NNR in the local community. Events, interpretation material, and the reserve manager’s talks to the local community have all been tried with varying degrees of success in getting the message across of the outstanding importance of this most valuable of wildfowl refuges. At a public meeting in 2004, which discussed
future management of the reserve, it was evident that local residents still did not generally understand this message. However more recently commissioned visitor surveys by Scotinform have indicated high levels of awareness that Loch Leven is a NNR, but less understanding of why it is important. However alongside wildness & tranquility other aspects related to the natural heritage such as wetlands and clear water and the NNR status were cited as key factors in attracting visitors. So it would seem appreciation if not understanding of the lochs natural heritage has developed during the period of the last plan.

**Property Management**

Three different parties own the NNR. The loch and the majority of the surrounding shore fringe is owned by Kinross Estate, First Sight estates owning Kinross House and the nearby islands with the RSPB visitor centre, adjoining wetlands and Vane Hill in the ownership of the RSPB. SNH has ownership of small areas of land at Findatie and Classlochie.

![LOCH LEVEN NATIONAL NATURE RESERVE OWNERSHIP](image)

**Summary**

The core issues of the reserve, of balancing the needs of people and wildlife, have remained a common thread throughout the life of the NNR. Due to its complex nature Loch Leven NNR has required coordinated management and has proved to be a good example of partnership working. The various landowners, anglers & wildfowlers, researchers, countryside workers, conservationists, and the local communities have all played their part in its management. Together they will be absolutely crucial in ensuring the good management of the NNR for future generations.
5 Document properties

Bibliography


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Photography

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Acknowledgments

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This second edition (2016) of the Story of Loch Leven NNR has been edited by Neil Mitchell (Reserve Manager) and Susan Luurtsema (Operations Officer – NNRs), and approved by Ewan Lawrie (Operations Manager – Tayside and Grampian).

Links

For information about reserves in general and further information about Loch Leven NNR please visit the Scotland’s National Nature Reserves website.

For information on the protected areas associated with Loch Leven NNR please visit SNHi.

Other useful links:

Scottish Natural Heritage www.snh.org.uk
Joint Nature Conservation Committee www.jncc.gov.uk