

FEARNA STORAGE

Fearna Pumped Storage Hydro Scheme CAR Licence Report

Appendix K – Summary of the Status and Mitigation of Impact on Arctic Charr

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Loch Fearna Pumped Storage Hydro Scheme: Summary of the status and mitigation of impact upon Arctic charr

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Background

This short note provides a view on the proposed Fearna/Quoich Pumped Storage Hydro scheme in relation to the Arctic charr, *Salvelinus alpinus*. This view has been informed by a review of the documents listed in Appendix 1 and specialist knowledge of this species. I address three principle questions:

1. What is the status of Arctic charr in the development area?
2. What are the major potential impacts upon that species?
3. Which mitigation is the most likely to be appropriate for this species at this site?

The status of Arctic charr in the development area?

There are records of Arctic charr in the development area. Most important in the context of the proposed pump storage development are Lochs Quoich and Fearna.

There are robust records of charr collections (from scientists) in Loch Quoich up until the mid 1990s. To the best of my knowledge there have been no attempts at specimen collection since then. A survey using eDNA detected the presence of charr in Loch Quoich in 2018, a second in 2023 did not detect charr but a much more comprehensive eDNA sampling and analysis, completed in February 2025 confirmed the presence of charr there.

There are no records of Arctic charr having been collected from Loch Fearna, nor are there any informal angling reports or sightings of this species from this loch. Water samples taken from Loch Fearna for eDNA analysis in 2023 did not detect Arctic charr there, despite a relatively robust sampling strategy.

Taken together, the evidence strongly points to the absence of an Arctic charr population in Loch Fearna but very clearly an extant population in Loch Quoich.

There are a number of population characteristics that may have a bearing upon proposed development impacts on Arctic charr in Loch Quoich.

Population size: there are no robust data on the size of the charr population in Loch Quoich. Although highly speculative, the absence of a clear detection of charr in eDNA sampling in 2023 and the more comprehensive sampling in February 2025 which detected Arctic charr in the loch at only 5 of 20 sampling sites might indicate that the population is modest in size.

Spawning behaviour: the Arctic charr in Scotland is primarily a lake dwelling species, but there are a small number of records of river use by the species. These mostly comprise records of charr using flowing water for spawning. At sites where river spawning is recorded,

it is likely that only a small proportion of all spawning in any year occurs in inflowing rivers. There are multiple records of charr detected downstream of Loch Quoich in the outflowing river, the Gearr Garry, downstream of the Quoich Dam. It has previously been assumed that these are of charr that have been entrained in outflow water from Loch Quoich. Since the construction of the Quoich Dam, the return of charr from the Gearr Garry to Loch Quoich is not possible. There are no physical records of charr from waters flowing into Loch Quoich. The 2025 eDNA survey examined samples taken from 15 river samples, each taken in the very lowest reaches of an inflowing stream (thus providing a DNA signature for the upstream components of the river) and in February when eggs of Arctic charr would still be incubating. This work did not detect Arctic charr in any of the samples. Thus the strong probability is that the charr of Loch Quoich are not using inflowing rivers to reproduce, but spawn in the lake littoral zone, the most commonly used habitat for spawning by charr in Scotland.

The habitat type required for successful spawning comprises washed gravel to cobble substrate sizes, free from high levels of small silt particles (which result in egg suffocation). Spawning time varies between populations in this species and between years. The timing of spawning has never been determined for the Loch Quoich population but the vast majority of populations in Scotland spawn between mid-September and mid-November, with eggs (and newly hatched alevins) incubating in the benthic substrate until around April.

Multiple morphs: In a number of sites across the range of this species, multiple morphs inhabiting the same lake have been detected. Most frequently this takes the form of genetically and ecologically distinct groups that occupy alternative foraging niches, usually exhibiting as plankton feeding and a macrobenthic invertebrate feeding morphs. There are a number of places where this occurs in Scotland (for example Lochs Rannoch, Awe, Dughail and Ericht). Where multiple morphs do occur, they are of particular scientific and conservation value. It is not known from currently available data if there are two or more morphs at the Loch Quoich site. Morphs cannot be detected using the eDNA techniques used to identify species presence. Identifying morphs would require traditional destructive sampling and a relatively large sample. Gill netting being the only realistic methodology for this site. In my view, an effective assessment of the potential for impact of this development on the Arctic charr population can be made by assuming that plankton and macrobenthos feeding charr are to be found at this site.

What are the major potential impacts upon Arctic charr?

Chapter 11 of the EIAR identifies the potential impacts of the development to Arctic charr.

During the Construction Phase there are three potential impacts identified as potentially significant.

Temporary water level drawdown: the identified impact with the greatest potential effect upon the Arctic charr population in Loch Quoich during construction is the drawdown of the water level to enable construction activity. The risk from this effect is that reduced water level during the egg incubation period has the potential to result in developing eggs laid in the shallow littoral zone becoming dry and thus dying.

Mitigation of this effect - is simply achieved by only lowering the water level outside the sensitive period of the year from October to late April. If this mitigation is in place, then my view is that this effect can be avoided.

Water quality: the effects of run-off and dust deposition may impact water quality. This has the potential to result in low water quality and possibly sediment deposition (from dust). This effect is likely to be geographically localised to the construction zone. Outside the spawning and incubation season (which is mid-September to April) this effect will be negligible on plankton feeding charr (which will be in the open water of the loch pelagic zone) and small for littoral macrobenthos feeding charr, as the affected area will comprise a small proportion of the total littoral area.

Mitigation of this effect – is achieved by rigorous pollution control measures during construction. If this mitigation is in place, then my view is that this effect can be reduced to negligible.

Quarrying: the effects of run-off and the introduction of sediments to the loch as the result of quarrying. This has the potential to create poor water quality in the littoral zone as the result of the introduction of sediment. Outside the spawning and incubation season this effect will be negligible on plankton feeding charr (which will be in the open water of the loch pelagic zone) and small for littoral macrobenthos feeding charr, as the affected area will comprise a small proportion of the total littoral area.

Mitigation of this effect – is achieved by rigorous pollution control measures during quarrying. If this mitigation is in place, then my view is that this effect can be reduced to negligible.

During the Operational Phase there is one identified potential major impact for which additional comment may be informative.

Water level fluctuations: the most important potential effect of this would be to expose Arctic charr eggs, deposited in the littoral zone, to air, resulting in mortality. Effects on charr of water level fluctuations outside the spawning and incubation period (September to April) are likely comparatively inconsequential.

The water level fluctuations in Loch Quoich that result from the combination of the operation of the conventional hydro generation scheme there and natural variation in hydrological conditions, have been examined during spawning and incubation periods from between 2016 and 2024. These data show that in five of the eight years, water levels fell between the likely spawning period and end of the incubation period, potentially stranding eggs. The maximum decline in water level between these periods was 5.5 m and the lowest was 0.77m. In the remaining three years, water levels were higher during the incubation period than during the spawning period (range 0.2 m to 0.81m). These range fluctuations are all well within the operating constraints of the current conventional hydro scheme of 26 m. As charr in Loch Quoich are likely to spawn in the depth range of 1 to 10 m, it is probable that in four of the years when water levels declined, there was a negative effect on spawning success resulting from egg mortality. In years when the decline was less than 1 m, or there was water level rise, egg stranding was unlikely to be a source of mortality.

The operation of the proposed pump-storage scheme has the potential to superimpose a shorter duration (hours to days) frequency water level change on top of the longer-term existing pattern of change. The maximum water level change resulting from the proposed operation of the pump-storage scheme is 3.2 m within 24 hours. If, as is likely, a drawdown of this magnitude occurs during the egg incubation period, then there is the likelihood of egg stranding. Hindcasting this effect to years for which there are data (from 2016 to 2024) a 3.2 m drawdown would likely impact all years; that is both in years where there was an increase in water level between egg laying and incubation (because the water level rise is relatively modest (<1m)) and in years where there was a water level decline. In none of these years

(2016 to 2024) would it be likely that all eggs in the spawning area were stranded and lost, but in some years a reasonably high proportion might be.

Mitigation of this effect – one route to mitigating this effect would be to create high quality spawning areas in deeper water beyond the drawdown depth of the combination effect of the pump storage operation and the conventional generation. In addition, to simply mitigating the effect of the pump storage it is highly likely that a well conceived mitigation plan would result in an environmental net gain, compared with the current position for Arctic charr.

There are no empirical data on the size of the spawning population of Arctic charr in Loch Quoich (although it is currently likely to be relatively small – see above). However there are data for other lochs in Scotland. One reasonable comparison would be the Arctic charr population in Loch Doon. Here the density of charr has been measured at 1.3 fish/Ha (Winfield and James 2018). The density in Loch Quoich is likely lower than this. However applying this Loch Doon density to Loch Quoich indicates a potential spawning population size of 2270 fish, resulting in 1135 potential redds (nests) in any year. In high quality spawning substrate areas, charr redd density has been shown to be around 2 redds/m². Thus creating new spawning areas of 600 m² in extent is highly likely to provide sufficient spawning sites for the whole population in Loch Quoich.

Spawning site creation would take the form of the establishment of two spawning areas located around 57.083° N 5.279° W and 57.076° N 5.293° W each of around 300 m². The spawning sites would be composed of a ca. 200 mm deep bed of gravel to pebble substrate of 4 to 35 mm diameter. This would be laid at a 180m AOD, a depth below that of the lowest water level measured in Loch Quoich between September and May in the last decade.

The advantage of this mitigation is that it will provide optimal spawning and incubation substrates at a depth below the drawdown zone.

The negative element of this approach as a mitigation is that it is likely that a proportion of the population may continue to spawn in good quality spawning areas that are within the likely drawdown zone and thus are subsequently exposed to air. However, surveys of the quality of spawning habitat (albeit geographically limited) indicate that there is currently a shortage of good spawning habitat. As a result, the provision of artificial habitat combined with a robust management regime to ensure its enduring quality, is very likely to attract charr to use these optimal spawning sites in preference to sub-optimal (semi) natural ones.

Appendix 1 A list of documents provided through Gavia Environmental reviewed.

- Ness District Salmon Fishery Board Consultation Response
- A Briefing Note to SEPA and NDSFB – Fearn PSH Briefing Doc
- NDSFB Response to Briefing Note
- Gavia Environmental eDNA report University of Glasgow
- EIAR Fearn PSH – chapter 2 The Proposed Development Issue 31.7
- EIAR Fearn PSH – Chapter 11 Aquatic Ecology v0.3
- EIAR Appendix 11.1 Fearn Aquatic Ecology Surveys
- EIAR – 11.2 Southern Access Route Aquatic Ecology Surveys
- Loch Quoich weekly average water levels during charr spawning 2016 to 2024
- Loch Quoich Level Data 30.1024 Weekly Analysis

