Luke
NATURAL RESOURCES
INSTITUTE FINLAND

C8.1 Historical and potential sea-spawning grayling locations – map product

20.12.2024

BIODIVERSEA
for marine nature

LIFE20 IPE/FI/000020 LIFE-IP BIODIVERSEA

Co-funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them.

Abstract

Coastal grayling, a unique and endemic fish species of the Baltic Sea, exists as two ecotypes: the sea-spawning grayling and the anadromous river-spawning grayling. In Finland, grayling is critically endangered and protected under national legislation. Historically widespread along the Finnish coast, the sea-spawning grayling has experienced severe population declines probably due to factors like overfishing, eutrophication, predation, and habitat degradation. Distribution surveys conducted between 2020 and 2022 using larval searches and habitat mapping focused on historical spawning areas. Results revealed active natural reproduction in two northern locations: the Krunnit area in Ii and the Selkä-Sarvi islands in Tornio, confirming the presence of a genetically uniform stock. No larvae were observed in former key habitats of the Bothnian Sea or Quark, highlighting the species' precarious status. Environmental conditions, such as algae coverage and fish community composition, varied significantly along the north-south gradient, affecting habitat suitability. The findings emphasize the urgent need for conservation efforts to protect remaining populations and restore historical habitats. Continued monitoring, and habitat management are critical for supporting the recovery of this ecologically and culturally valuable species in the Baltic coastal ecosystem.

Background

Two ecotypes of grayling live in the coastal area of the Baltic Sea, a sea-spawning grayling and an anadromous river spawning grayling. In the Finnish coastal area grayling is protected species (Government decree on Fishing 1360/2015) due to critically endangered status (Urho et al. 2019). Globally, coastal grayling is an unique ecotype and endemic species for the Baltic Sea. Grayling can reach length up to 60 cm and age of approx. 15 years (Kottelat & Freyhof 2007). Sea- spawning grayling is a fish that spawns in the spring in shallow waters on barren islets and reefs in the outer archipelago (Enholm 1937). It requires clean water and gravel and rocky bottoms for its spawning and habitat areas (Broman et al. 2016). The sea spawning grayling feeding range is relatively limited, and it assumed that it typically does not undertake long feeding migrations (Hurme 1967). The scientific literature on the both, coastal and anadromous ecotypes is limited and mostly from old national reports. For the stock enhancement, there’s an evident need for updated data and knowledge on species status.

Historical distribution of sea-spawning grayling

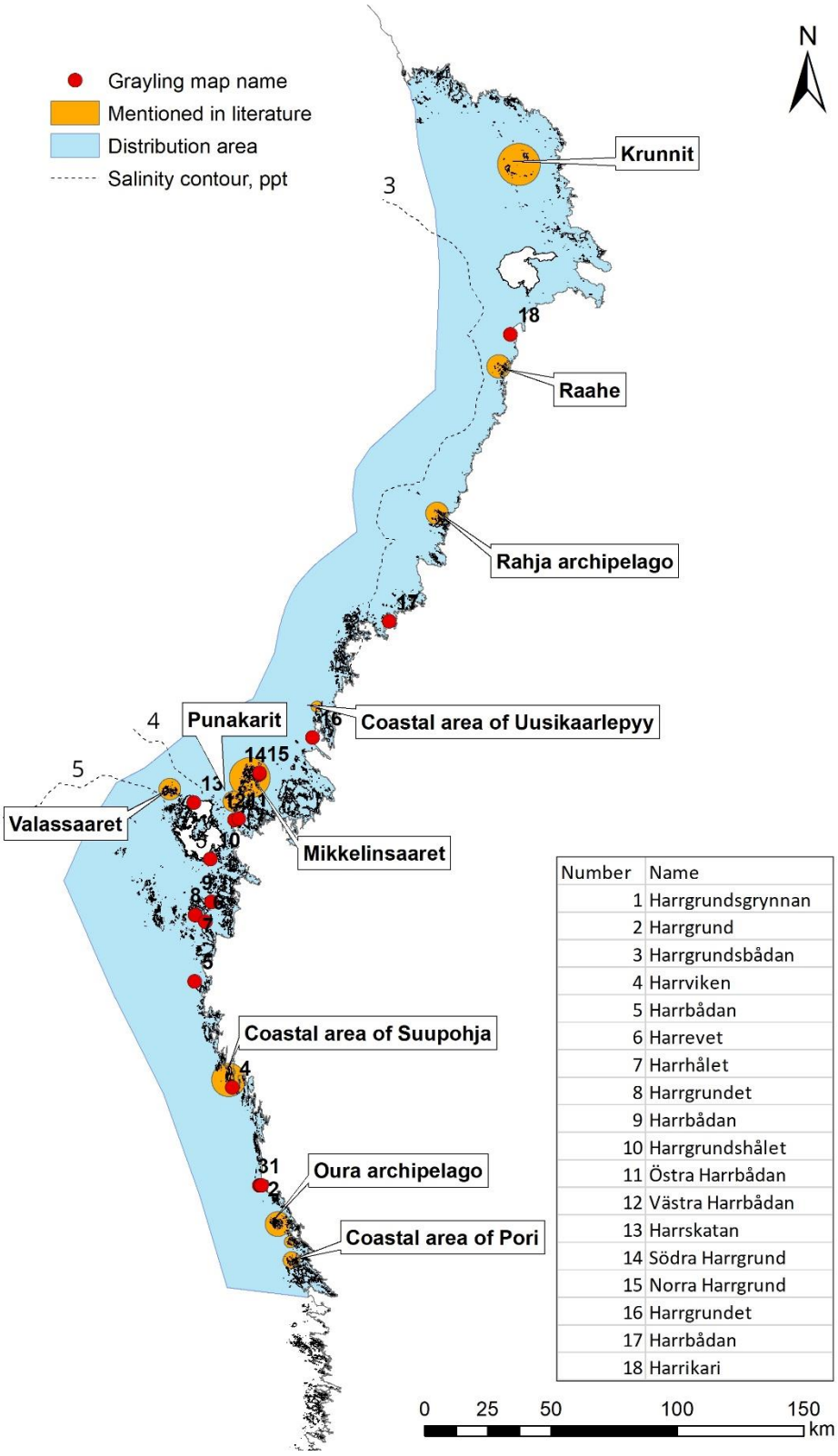
The sea-spawning grayling was originally a common species along the Finnish coast, from Pori region in the Bothnian Sea to the northernmost part of the Bothnian Bay (Enholm 1937; Hurme 1966). In Åland, the grayling was listed as part of the typical fauna in the 19th century (Djurberg 1809), although no other observations of the species have been reported, and thus the old record should be interpreted with caution. In Sweden, the primary distribution area extended to the southern part of the Bothnian Sea, up to the estuary of the Dalälven River (Enholm 1937, Havs- och vattenmyndigheten 2017), though it remains uncertain whether these were river-spawning migratory grayling or a sea-spawning ecotype. Enholm (1937) wrote that distribution sea-spawning grayling might be limited to salinities below 4 ppt, but south from Quark salinity is commonly higher than that outside estuary areas.

Coastal grayling population declines have been reported to start as early as in the 1930s (Enholm 1937). Earlier, when stocks still had good status, local hotspots of sea-spawning grayling populations were found along the coastal areas off Pori and Merikarvia, in smaller numbers off Siipyy and Kristiinankaupunki, and especially in the Quark region. Former sea grayling habitats are reflected in the coastal toponymy, with

islands and shoals named after the grayling, particularly in the Quark region. North from Quark, in the Bothnian Bay area, grayling populations were possibly primarily based on migratory grayling ascending rivers to spawn (Hurme 1966), but a strong population of sea-spawning grayling existed, for example, in the Ii Krunni island area. No specific written reports exist for grayling in the northernmost part of the Bothnian Bay, but the species was likely a common in the coastal area (Figure 1).

Grayling was first protected in Finland from spring fishing during its spawning season under the 1951 Fishing Act (Government decree on Fishing 503/1951). The decline of sea grayling populations continued, with reports of declining catches in grayling literature (Hurme 1966), but it was not until the 2000s when the critical situation of sea-spawning grayling was recognized in research projects carried out in Merenkurku (Alanärä et al. 2006; Hudd et al. 2006) and surveys targetd to fishermen (Grahn-Börkqvist 2007, Ruotsalainen 2011). Based on anecdotal data, sea-spawning grayling were regularly caught in the Merikarvia archipelago and the Valassaaret islands until 1990s, but today they are nearly absent. Still occasional reports from fishermen describe individual grayling sightings along different parts of the coast in the former distribution area. Some of these observations may also be grayling that have migrated from rivers into the sea.

The factors contributing to the decline of sea grayling populations are being investigated in the Biodiversea project. Based on earlier assessments with weak data (Urho et al. 2019), these likely involve a combination of different simultaneously impacting factors, such as intense fishing pressure, increased natural mortality due to predation, eutrophication, and possibly changes at the food web level. For migratory grayling that spawn in rivers and streams, the decline is likely related to the construction of drainage basins and the significant deterioration of river water quality during the 20th century, thus affecting directly to the reproduction possibilities. Severe decline of local sea-spawning grayling populations, such as those in the Bothnian Sea and Quark areas, appears to have occurred over the past fifty years, with strongest change during last two decades.



Number	Name
1	Harrgrundsgrynnan
2	Harrgrund
3	Harrgrundsbådan
4	Harrviken
5	Harrbådan
6	Harrevet
7	Harrhålet
8	Harrgrundet
9	Harrbådan
10	Harrgrundshålet
11	Östra Harrbådan
12	Västra Harrbådan
13	Harrskatan
14	Södra Harrgrund
15	Norra Harrgrund
16	Harrgrundet
17	Harrbådan
18	Harrikari

Figure 1. The historical distribution of sea-spawning grayling in the Finnish coastal area (blue color) and hotspots specifically mentioned in old literature (orange). Locations named with a grayling derived name are marked with red dots. Salinity contours indicate the salinity limits for different coastal areas (Salinity data Generated using E.U. Copernicus Marine Service Information).

Current distribution of sea-spawning grayling

The distribution of sea-spawning grayling was studied through larval surveys conducted between 2020 and 2022, primarily during June each year. The surveys in 2020 and 2021 were funded by the Finnish national Velmu program, while the 2022 surveys were conducted under the Biodiversea project. Survey areas were selected based on historical data from literature review on sea-spawning grayling observations from the Bothnian Sea, Quark and the Bothnian Bay. The focus of larval survey was mainly on outer archipelago areas where the most recent observations of grayling had been made.

Sea-spawning grayling larvae were searched for near the shoreline in shallow waters, as previous study (Hudd et al. 2006; Broman et al. 2016) indicated they prefer sheltered areas along the open shorelines. In these areas, water depth is typically 5–30 cm. Larval surveys relied on visual observations and were conducted only when maximum wind speeds were 7 m/s or less. The surveyor used polarized sunglasses to reduce surface water reflections and the mapping was done with sun in the back, if possible. During the surveys, the examined shores were photographed with a drone while searching for larvae, producing an orthomosaic image covering each research area at high resolution. Additionally, the shoreline temperature at the time of observation, wind strength and direction, and wave height were measured. Algae coverage was assessed as a percentage of area covered, and the seabed type was classified into six categories based on coarseness.

A dipnet was used in the surveys to catch grayling larvae or other fish for identification, a method also used in other studies for catching larval pike (Veneranta et al. 2013; Pursiainen et al. 2022). All fish observations were recorded. The number of observed grayling larvae was counted, and they were collected as samples to confirm species identification and size later (Figure 2). Additionally, the rough numbers of visually observed three-spined sticklebacks, nine-spined sticklebacks, and minnows were visually estimated. However, precise counts were not possible due to the speed and movement of these schooling fish.

Figure 2. Research engineer Hannu Harjunpää spotted sea-spawning grayling larvae at shore of Linnanklupu island near Selkä-Sarvi. Length of early-stage larvae is approx. 15 mm.

In total, surveys were conducted along 98 transects across 11 areas from the Bothnian Sea to the Bothnian Bay. Some transects were surveyed only once, while others were surveyed up to three times to ensure proper timing for juvenile observations. The total length of surveyed separate shorelines was 28,860 meters, averaging 294 meters per shoreline, with a total surveyed shoreline of 43,940 meters (Figure 3).

Sea-spawning grayling larvae were found in 2021 and 2022 along ten separate transects. All observation sites were located in the Krunnit area in Ii and near the Selkä-Sarvi area islands in Tornio. No larvae were found in the former known distribution areas of sea-spawning grayling in the Bothnian Sea or Quark. The lack of larval observations does not rule out the possibility that sea-spawning grayling exists in these areas, but indicates that stock is weak.

The sea-spawning grayling larvae collected from northernmost area, Selkä-Sarvi was analyze for DNA to compare origin of fish to the earlier sea-spawning grayling broodstock that originates from Krunnit area. Both the Selkä-Sarvi and Krunni grayling populations were found to belong to the same genetic stock, despite a distance of approximately 40 kilometers between the areas. The surveyed transects were geographically located in similar areas regarding openness and habitat type, consisting of rocky and gravelly shores. Differences were observed along the south-to-north gradient in terms of substrate coverage and the abundance of three-spined sticklebacks. In the southern areas, the substrate was predominantly covered with filamentous algae, and the abundance of three-spined sticklebacks in the shallow waters was several times higher than in the northern parts of the Bothnian Bay.

The survey areas where natural reproduction was verified in the Krunnit and Selkä-Sarvi area are the most potential locations for sea-spawning grayling at the current state of the coastal environment and fishing legislation. The later stages of Biodiversea project will produce more precise insight on reasons behind decline of sea-spawning grayling stocks.

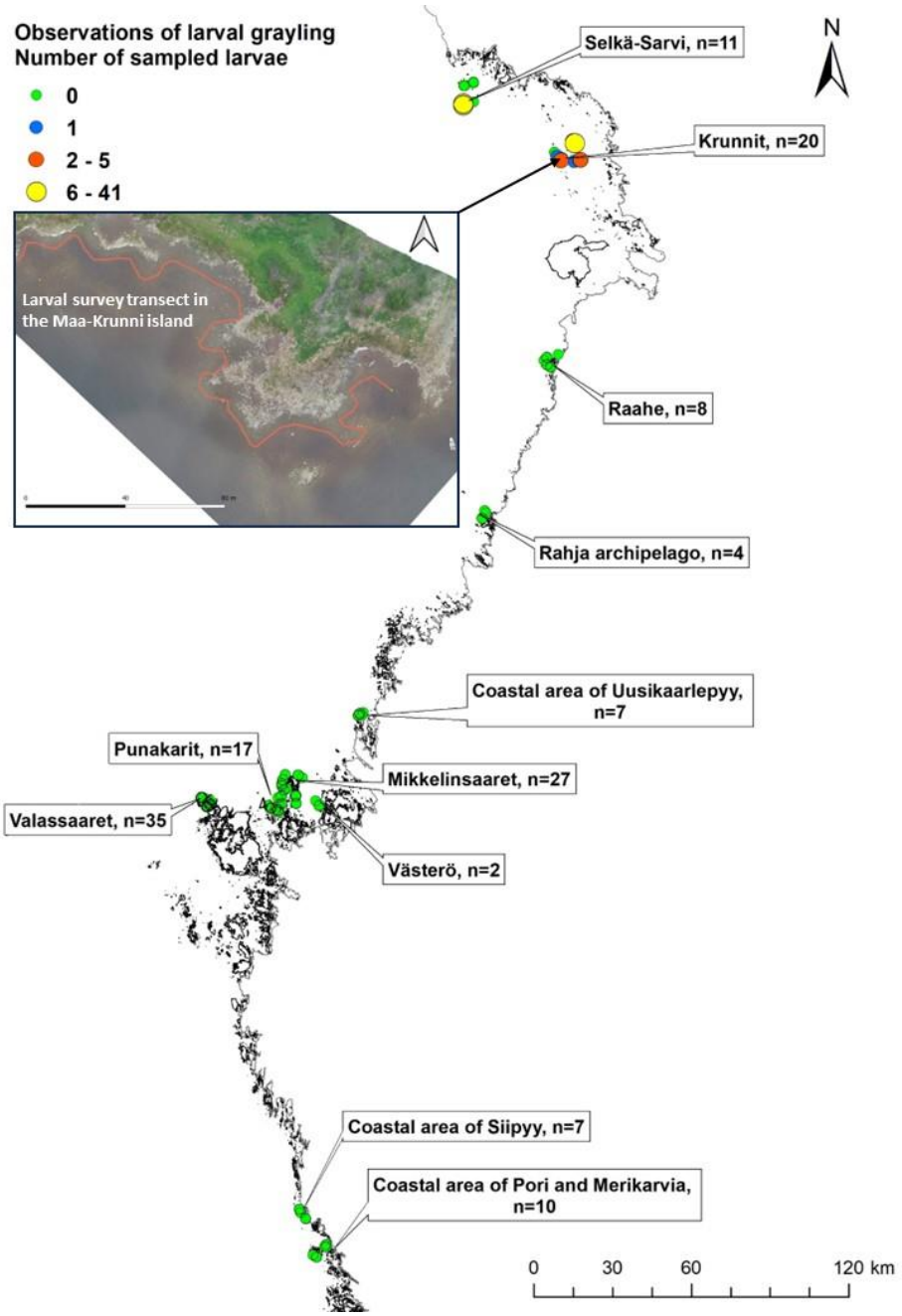


Figure 3. Current larval observations of sea-spawning grayling in the Gulf of Bothnia. Larvae were found only in the Krunnit and Selkä-Sarvi areas that are the northernmost surveyed locations. In each survey site, larvae were searched visually and for habitat analysis the shore was ortophotographed with a drone.

References

Baltic Sea Salinity. E.U. Copernicus Marine Service Information (CMEMS). Marine Data Store (MDS). Data from year 2023. (Accessed on 15-12-2024).

Broman, A., Blomkvist, D. & Bystedt, D. 2016. Harrens lekområden i Norrbottens skärgård. Rapport från Länsstyrelsen i Norrbotten, 8 s.

Djurberg, D. 1809. Kort Beskrifning om Åland, författad av Daniel Djurberg. Med Karta. Stockholm, 39 s. Tryckt hos Carl Delén, 1809.

Enholm, G. 1937. En undersökning av skärgårdsharren, Thymallus thymallus (L.) i Kvarken. Acta Societas pro Fauna et Flora Fennica 60: 454-477.

Grahn-Börkqvist, T. 2007. Förekomst av harr inom Korsholms fiskeområde. Undersökning över harrens utbredning på Korsholms fiskeområde. Aug. 2006 och oktober 2007. 11 s. ja 1 liite. Moniste.

Havs- och Vattenmyndigheten 2017. Harr i Bottniska viken – en kunskapssammanställning. Havs- och vattenmyndighetens rapport 2017:30, 44 s.

Hudd, R., Ahlqvist, J., Jensen, H., Urho, L. & Blom, A. 2006. Lek- och yngelproduktionsområden för havslekande harr i Kvarken. Vattenbruksinstitutionen, Rapport 53, Umeå 2006.

Hurme, S. 1966. Harjus Suomen merenrannikolla. Suomen Kalastuslehti n:o 7/1966. Kalataloudellinen tutkimustoimisto Helsinki, 4 s.

Hurme, S. 1967. Harjusmerkinnät Merikarvian Ouransaaristossa. Kalataloudellisen tutkimustoimiston tiedonantoja N:o 4. Joulukuu 1967. Maataloushallitus, Mariankatu 23, Helsinki.

Jensen, H. & Alanärä, A. 2006. Harrfiskets omfattning och karaktär vid kusten i Kvarkenregionen. Vattenbruksinstitutionen, rapport 45, Umeå 2006.

Kottelat, M. & Freyhof, J. 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.

Pursiainen, A., Veneranta, L., Kuningas, S., Saarinen, A., & Kallasvuo, M. 2021. The more sheltered, the better–Coastal bays and lagoons are important reproduction habitats for pike in the northern Baltic Sea. Estuarine, Coastal and Shelf Science, 259, 107477.

Urho, L., Koljonen, M.-L., Saura, A., Savikko, A, Veneranta, L. & Janatuinen, J. 2019. Fish. In: Hyvärinen, E., Juslén, A., Kemppainen, E., Uddström, A. & Liukko, U.-M. (eds.) 2019. The 2019 Red List of Finnish Species. Ministry of the Environment & Finnish Environment Institute. Helsinki. P. 549-555.

Veneranta, L., Urho, L., Koho, J., & Hudd, R. 2013. Spawning and hatching temperatures of whitefish (Coregonus lavaretus (L.)) in the Northern Baltic Sea. Advances in Limnology, 64:39-55.