Cottus gobio (Linnaeus, 1758), a new fish-species in Nord-Trøndelag County, Norway

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Cottus gobio, a freshwater sculpin, was discovered by electrical fishing in rivers draining to Murusjøen in Lierne, Nord-Trøndelag County in the middle of Norway. Until now, this sculpin has only been found in a few river systems in the south-eastern and north-eastern parts of Norway. Species specific characters (glands and fins) were used to distinguish *C. gobio* from the close relative *C. poecilopus*. The sculpin dominated the catches in all the investigated rivers. In August 2008 in the River Fiskløysa, a total of 194 specimens were collected. Their length varied from 37 mm to 105 mm, indicating the presence of both juvenile (age 0) and adult individuals. In September 2008, qualitative sampling was conducted in another part of Fiskløysa and in the rivers Kveelva and Murubekken. In River Fiskløysa, the species was not registered above a presumably impassable waterfall about 1.6 km from Lake Murusjøen. In River Kveelva sculpins were caught below a nine meters moderate waterfall, close to the outlet of Lake Kvesjøen, but no sculpins were registered above the waterfall. This indicates that the waterfall is a possible barrier for further upstream dispersal into Lake Kvesjøen. Sculpins were also registered in River Murubekken.The paper discusses possibilities for *C. gobio* being spread naturally or artificially into the river systems in Lierne. It is predicted that the dispersal most likely has been natural from populations in Sweden, as there are no distinct barriers preventing the sculpin from spreading westwards. The time-period of the dispersal, however, is still unknown, and the sculpin may still be expanding its home range in these water systems.

Keywords: *Cottus gobio*, distribution, dispersal, species specific characters, Murusjøen, Nord-Trøndelag.

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INTRODUCTION

Cottus gobio (Linnaeus, 1758) is one of three known freshwater sculpins in Norway, *Cottus poecilopus* (Heckel, 1837) and *Triglopsis quadricornis* (Linnaeus, 1758) being the other two. The maximum length of *C. gobio* is normally 12-15 cm, although specimens of 18 cm have been reported (Muus & Dahlström 1968). Growth rates depend on environmental conditions. Maitland & Campbell (1992) reported that the species normally grows 40–50 mm the first year, attaining 60 mm after two years and 70–90 mm after three years. According to a review from Tomlinson & Perrow (2003), the species generally live for 3 – 4 years, although individuals at an age of 10 years have been reported.

Cottus gobio is a stationary territorial benthic feeder which shows a well developed homing instinct (Mills & Mann 1983). The physical preferences of the freshwater sculpins (Fam. Cottidae) are typically the same as for many salmonids (e.g.

Andreasson 1969; Gabler & Amundsen 1999; Hesthagen et al. 2004). With the development of often high densities, they may dominate the fish biomass in creeks and rivers (Mills & Mann 1983; Glova 1987). The presence of sculpins has been reported to influence the salmonids in a negative way through competition for food (Brocksen et al. 1968; Mann & Orr 1969; Andreasson 1971; Gabler & Amundsen 1999; Hesthagen et al. 2004; Amundsen & Gabler 2008) and space (Gaudin & Caillere 1990). Several studies have addressed competitive interactions between *C. gobio* and brown trout (*Salmo trutta* Linnaeus, 1758*)* (e.g. Hartley 1948; Crisp 1963; Andreasson 1971; Gaudin & Caillere 1990), but studies of coexisting Atlantic salmon (*Salmo salar* Linnaeus, 1758) and *C. gobio* in northern Norway have indicated a segregation in both habitat (Jørgensen et al. 1999) and food utilization (Gabler et al. 2001).

Their biology is peculiar, having an androgynous system where the males build nests for the females. The spawning time on the British Isles, is from February – June (Fox 1978), while in Norway the spawning period is between March – May (Pethon 2005). After spawning, the males guard the eggs, which hatch about four weeks later (Desmond 1955). When hatched, the offspring is no longer guarded. In this period, they are vulnerable to both cannibalism and predation.

In Norway, *C. gobio* is until now, only known from a few locations in Østfold County (The Norwegian Biodiversity Information Centre, 2008). The species has also been reported from Utsjoki, a Finish tributary to River Tana (Pihlaja et al. 1998; Jørgensen et al. 1999). More recently it has been reported from the main river Tana on the Norwegian side of the border, where it is migrating both downstream and upstream (Eero Niemela, Finnish Game and Fisheries Research Institute, Teno River Research Station, Utsjoki, pers. comm.). Worldwide, *C. gobio* is widely distributed, from Greenland and Scandinavia in the north to Italy in the south (Smyly 1957; Mills & Mann 1983). It is categorized as "near threatened" on the Norwegian Red List (Kålås et. al. 2006), but is also registered as an alien species representing a high risk to Norwegian ecosystems (The Norwegian Biodiversity Information Centre 2009). On the IUCN Red List the species are categorized as LR/LC (lower risk / least concern) (International Union for Conservation of Nature and Natural Resources, 2007).

This study proves data on the presence and abundance of *C. gobio* in the rivers Fiskløysa, Murubekken and below a waterfall in Kveelva, which all discharges into Lake Murusjøen in Lierne, Nord-Trøndelag County in the middle of Norway. The paper also discusses how long the species has been in the

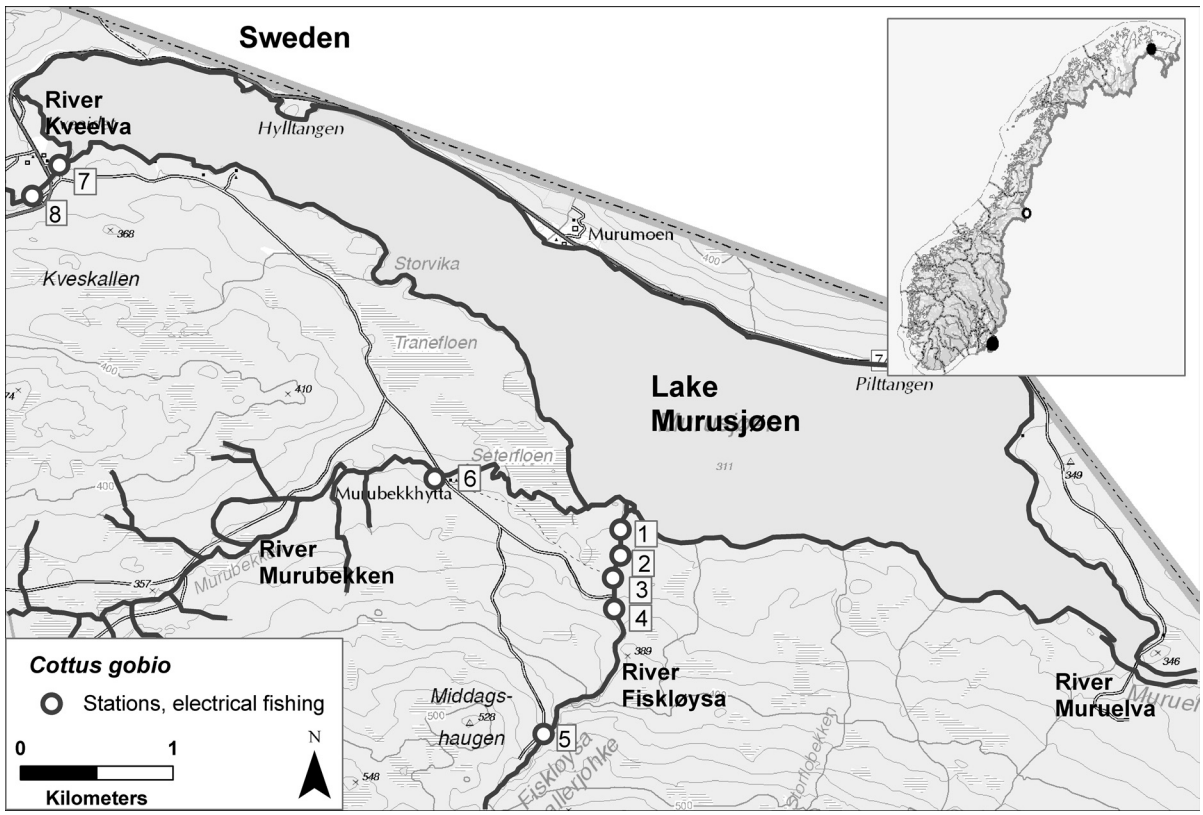

Figure 1. The study area around Murusjøen, in Lierne, Nord-Trøndelag County, Norway. Stations 1-4 were investigated in August 2008, stations 5-8 in September 2008. Filled circles show earlier known populations in Norway while open circles shows sampled locations.

system, and whether it is most likely introduced by man or by natural dispersal.

MATERIAL AND METHODS

The specimens were sampled in August and September 2008 using electrical fishing equipment. In River Fiskløysa, four sampling stations were established and each of them was sampled three times, starting downstream. The size of the sampling areas varied between 120 m^2 and 260 m^2, and with depths from 20 to 100 cm. As the number of fish might not be reduced in the second or third turn of fishing, Zippins removal method could not be used to calculate the density of fish (Zippin 1958; Bohlin et al. 1989). As a result, the calculations were done according to Ugedal et al. (2003), who suggest that 50 % of the fish are caught at each removal. All year-classes were included in the calculations of fish densities.

In September, the rivers Murubekken, Kveelva and Fiskløysa were investigated to register the occurrence of *C. gobio*. Thus, the electrical fishing was only qualitative, and lasted approximately 30 minutes on each location. In Kveelva, two locations were investigated, upstream and downstream a nine meters waterfall. In River Fiskløysa, a location was established upstream of a plausible impassable waterfall, approximately 1.6 km upstream from Lake Murusjøen. In River Murubekken, one location was investigated.

Except a small number of fish that was kept for species identification, all captured individuals were released back into the river after length measurements. The material is deposited in the collections at the Norwegian University of Science and Technology, Museum of Natural History and Archaeology, Trondheim, Norway.

The study areas are shown in Figure 1, positions are referred in Table 1.

In the laboratory, *C. gobio* was distinguished from *C. poecilopus* by use of microscopy and picture analysis. Andreasson (1968) and Pethon (2005) were used as literature for species identification. Among many characters mainly three were used: 1) number and placement of mucus glands beneath the chin 2) pattern on ventral fins and 3) length of inner ventral fin ray.

RESULTS

Characters used to distinguish *C. gobio*. from *C. poecilopus* are shown in Figure 2, showing *C. gobio* from River Fiskløysa (pictures A I-III) and *C. poecilopus* from River Glomma (B I-III).

Table 1. Positions of the different sampling locations. Coordinates refers to the grid 33W, UTM WGS84.

River	Station	Position
Fiskløysa	1	453510 / 7149550
Fiskløysa	2	453500 / 7149300
Fiskløysa	3	453470 / 7149170
Fiskløysa	4	453430 / 7148970
Fiskløysa	5	453020 / 7148140
Murubekken	6	452270 / 7149790
Kveelva	7	449850 / 7151800
Kveelva	8	449670 / 7151610

Table 2. The number of *Cottus gobio* sampled in River Fiskløysa (August and September) and Rivers Murubekken and Kveelva (September). Numbers in brackets show density in terms of individuals per 100 m^2. Due to different sampling methods, calculations could not be carried out for all stations

River	Station	Density
Fiskløysa	1	117 (74)
Fiskløysa	2	37 (16)
Fiskløysa	3	26 (24)
Fiskløysa	4	14 (13)
Fiskløysa	5	0
Murubekken	6	4
Kveelva	7	6
Kveelva	8	0

The number and placement of mucus glands distinguish the two species, as *C. gobio* only has one gland along the central axis of the chin, while *C. poecilopus* has two, one on each side (picture A-B, I). The dark cross lined patterns on the ventral fins of *C. poecilopus* is missing on *C. gobio*, making the fins look almost white (picture A-B, II.). In addition, the forth and inner ray of the ventral fin is more than half the total length of the fin in *C. gobio,* while the fin of *C. poecilopus* is much shorter (picture A-B, III.) (cf. Andreasson 1968; Pethon 2005).

In August 2008, a total of 194 specimens of *C. gobio* were collected in River Fiskløysa. The length varied between 37 mm to 105 mm, indicating the presence of both juvenile (age 0) and adult individuals (1 - 3 years).

In September 2008, four sculpins were caught in River Murubekken. In River Fiskløysa, no sculpins were caught at station 5, 1.6 km upstream from Lake Murusjøen, just above what is thought to be the natural obstruction for fish migration.

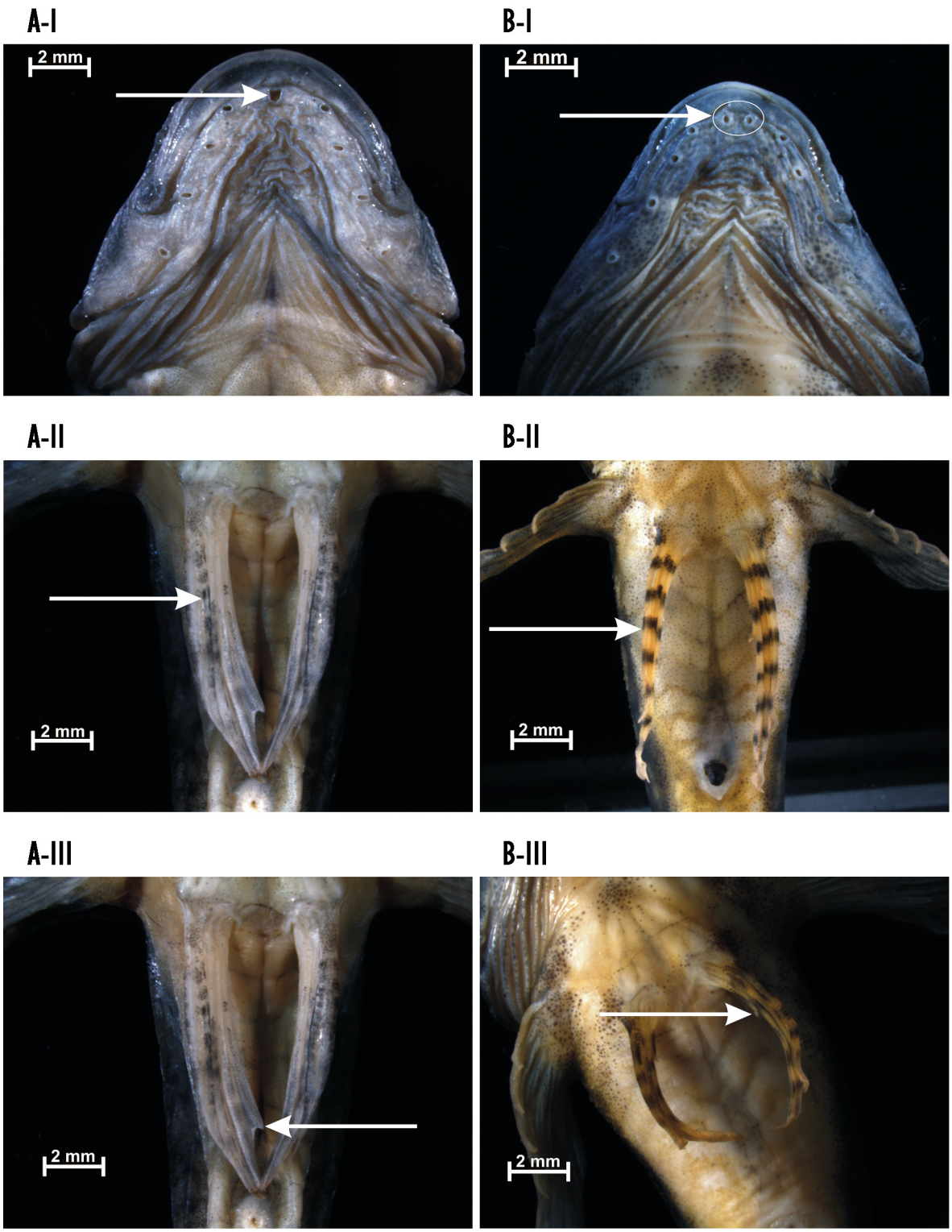

Figure 2. The main characteristics of *Cottus gobio* (AI-III) and *C. poecilopus* (BI-III). Photo: Jarl Koksvik.

In Kveelva, six sculpins were caught on a section between Lake Murusjøen and a waterfall close to the outlet of Lake Kvesjøen. However, no sculpins were caught upstream this waterfall. Table 2 shows the distribution of *C. gobio* in the different locations.

In addition to sculpins, northern pike (*Esox lucius* Linnaeus, 1758), brown trout (*Salmo trutta* Linnaeus, 1758) and burbot (*Lota lota* Linnaeus, 1758) were registered during the field sampling. In August in the River Fiskløysa a total of seven brown trout, two northern pikes and two burbots were caught, and these species were totally outnumbered by *C. gobio*.

DISCUSSION

The species identifications show that the sculpins found in Lierne are *C. gobio*. Since this is a new discovery for this area, and the other known Norwegian populations are geographically far away, the dispersal of the species is not evident.

The existence of *C. gobio* in many watercourses in Sweden, and the natural immigration history of many eastern fish species into Norway after the ice recession, may be of importance. As the ice-sheet melted, the Ancylus freshwater lake was formed in Sweden, stretching from southern parts of the Baltic Sea and beyond the present Gulf of Bothnia. In addition, the post-glacial land uplift had not yet started. This made the dispersal of eastern species to the eastern parts of today's Norway possible. Even today, the altitude of Lake Murusjøen is only 311 m. a.s.l., and the water system drains towards Sweden. It is believed that eastern species like grayling (*Thymallus thymallus* Linnaeus, 1758) and northern pike migrated through this passage and inhabited the water system of Lake Murusjøen (Berger et al. 1999). During the Ancylus period, it is also thought that *C. gobio* had the opportunity to spread over the whole Baltic drainage area. Dispersal to the Swedish west coast and Norway is thought to have been prevented due to a salt water barrier (Koli 1969).

From its early dispersal to the lowlands around the Baltic area during the Ancylus period, *C. gobio* has been able to inhabit new inland areas by upstream dispersal. In fact, an overview over the occurrence of *C. gobio* and *C. poecilopus* in Scandinavia states the presence of *C. gobio* in the upper parts of River Ångermanälven (Lake Hetögeln), not far from the Swedish/Norwegian border and Lake Murusjøen (Andreasson 1972). Information also confirms that *Cottus* sp. (presumably *C. gobio*) has been present in Lake Hetögeln for decades (Knut Klefbom, lives near Lake Hetögeln, pers. comm. 2008). Since River Muruelven, which has the outlet from Lake Murusjøen (Figure 1), drains towards Lake Hetögeln, it seems quite possible that *C. gobio* has spread to the rivers Fiskløysa, Murubekken and Kveelva through natural upstream dispersal. The common whitefish (*C. lavaretus*) is also known to have dispersed to Lake Murusjøen through this passage during the last decades.

It is a well established fact that man has introduced species to numerous freshwater systems. Although prohibited, use of fish as live bait has caused a massive dispersal of the Eurasian minnows (*Phoxinus phoxinus* Linnaeus, 1758) into many Norwegian freshwater systems (e.g. Hesthagen & Sandlund 2004). Easily caught, *C. gobio* and *C. poecilopus* are also known to have been used as live bait, and it is believed that *C. gobio* is artificially introduced into River Utsjoki, a tributary to River Tana in Finnmark County (Eero Niemela, Finnish Game and Fisheries Research Institute, Teno River Research Station, Utsjoki, pers. comm.). Examples of different introductions and dispersal of fish species show that *C. gobio* theoretically, may have been artificially spread to Lierne. If the species has been introduced recently, it could explain the fact that nobody has been aware of its existence. However, with their anonymous way of living along the bottom and with an excellent camouflage which make them hard to spot, it is not impossible that they have been present for a long time.

Despite the fact that human introductions may have taken place, we find that natural dispersal from the geographically close Swedish populations is the most plausible explanation for the new registrations of *C. gobio* in Lierne. The species migration pattern in River Tana in Finnmark County, where the species now has dispersed 5 km upstream from the Utsoki outlet, also shows its ability for upstream dispersal (Eero Niemela, Finnish Game and Fisheries Research Institute, Teno River Research Station, Utsjoki, pers. comm.). The time-period of the dispersal is still unknown, and the sculpin may still be expanding its home range in these water systems. We recommend a comparison of DNA of the *C. gobio* population in Hetögeln and in Lierne, to determine the origin of the new population found in the latter area. We also recommend a monitoring programme, stating the *C. gobio*'s exact expansion near Lake Murusjøen and to determine whether the species is still widening its home range. If the latter is confirmed, it would be of particular interest to follow the interactions between the salmonids and the sculpin.

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