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Förändringar i förekomst av grönling i Igelbäcken

Abstract

Stone loach (*Barbatula barbatula)* recently steadily declined in numbers in most testfished locations in Igelbäcken creek close to Stockholm, Sweden. Its abundance seems not to be much affected by the alien speecies signal crayfish (*Pacifastacus leniusculus)*. More so, it seems that abiotic factors as water flow and habitat characteristics are the structuring forces of its population size and reproductive success.

Key words

Stone loach, Signal Crayfish, Igelbäcken, Competition, Co-occurrence

Introduction

The fulfillment of its ecological requirements is determining whether a species might be present in a habitat. Its abundance in turn is structured to a high degree via interacting with other species by the means of predation and competition for food and habitat. The introduction of an alien species to a new habitat puts pressure on species with similar live needs.

The introduction of signal crayfish (*Pacifastacus leniusculus*) to Sweden largely replaced the native crayfish species (*Astacus astacus*) in Sweden (Söderbäck 1995, in Guan & Wiles 1997), mostly due to its role as vector of crayfish plague (*Aphanomyces astaci*). Signal crayfish might considerably influence the abundances of benthic fish species by competing for food and shelter, via burrowing by acting as an ecosystem engineer, and by directly predating on eggs or even adult fish (Guan & Wiles 1997). An inverse correlation between the abundance of signal crayfish and the two most common ground-dwelling fishes, stone loach (*Barbatula barbatula*) and bullhead (*Cottus gobio*) was found in a survey of a British river (Guan & Wiles 1997). Applying competition experiments, Guan & Wiles (1997) were also able to show that crayfish outcompetes both fish species for shelter possibilities, leading to significantly higher mortality rates among them. In a study in southern Sweden, in presence of both brown trout and signal crayfish, stone loach activity was negatively correlated with the abundance of adult trout (Nilsson 2006). Avoiding one predator might at the same time make a prey more vulnerable to another predator, which can lead to a synergistic effect, lowering prey survival over proportionally. This might for example be the case with stone loach avoiding piscivorous fish by trying to hide in shelters kept by crayfish (Guan & Wiles 1997), As an increasing habitat complexity decreases niche overlap, high habitat variability might maintain species coexistence (Nilsson 2006).

Igelbäcken flows for over 10 km through a varied landscape north of the city of Stockholm before entering the Baltic Sea. Its natural assets as a high fish abundance (average density of more than 150 individuals per $100m^2$) and high recreational values make Igelbäcken one of the most precious watercourses in the entire region. The creek is nevertheless considerably affected by human activities; around 90 % of its stretch is straightened and devoid of a large extent of its original vegetation. There are four barriers for migrating species (Hallnäs 2001). The creek lost almost a third of its catchment area in the 1970s as a result of the building of a drainage system for newly raised suburbs in the surrounding, Furthermore, large parts of its catchment area have been drained, leading to periodically too little water inflow (Hallnäs 2001).

The stone loach is in Sweden, among others, found in Igelbäcken, where it dominates the fish community. This population probably stems from fish kept in ponds at the

royal castle Ulriksdal in the mid-eighteenth century (Lundberg & Svanberg 2010). In 1999, an expanded biological inventory showed that stone loaches lost around half of their habitat within ten years as a consequence of lacking water (Lundberg & Andersson 2000). The following years brought wetter conditions and hence survival rates of stone loaches increased. In summer 2002, Stockholm's water company (Stockholm Vatten AB) started a water replenishment program with the aim of preventing further drying-up events (Lundberg 2006). Consequently, stone loaches returned to the upper parts of the creek (Lundberg 2006). Having been red-listed nationally, improvements with respect to the species habitat, implemented according to the "Action Plan for the conservation of stone loach" (Lundberg 1998), led to a recovery of the fish in Sweden in general (Lundberg 2006).

The native crayfish has last been observed in Igelbäcken in 1989. During the 1990's, signal crayfish has illegally been released. As larger signal crayfish can predate upon stone loaches and smaller individuals show a similar diet as the fish (Guan & Wiles 1997), as both species are sharing a similar niche, by living on stony bottoms and being largely night-active, signal crayfish must be considered as having the potential of outcompeting stone loach in creeks like Igelbäcken (Hallnäs 2001).

This paper intends to shortly present the development of Igelbäcken's stone loach population and to follow up the question whether it was affected by the abundance of signal crayfish and other fish species.

Materials & Methods

Since 1999, Igelbäcken is monitored annually by the Swedish Museum of Natural History upon assignment of the county's administrative board. The individual places are sampled using the electro fishing method (Andersson & Lundberg 2009). The data is available to the public through the Swedish Electrofishing database SERS (2006).

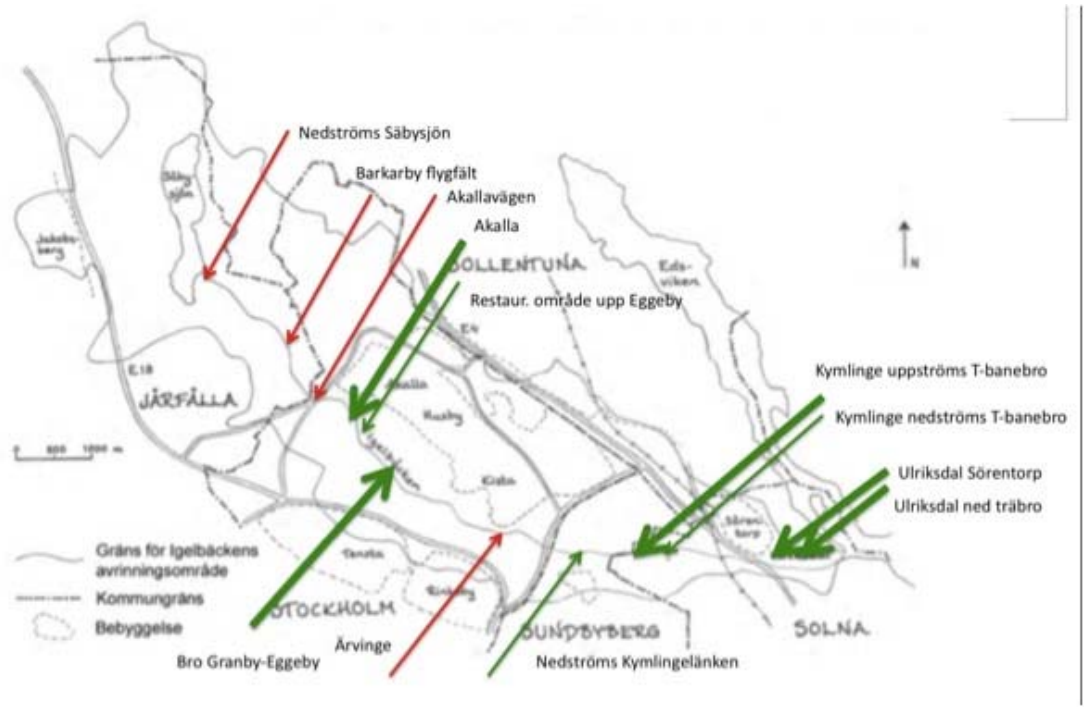

Fig. 1. The 14 locations in Igelbäcken testfished during the last 20 years. At Barkarby flygfält and Akallaavägen, two adjacent locations each are marked with only one arrow. Green arrows mark locations where stone loach has been observed at least one occasion. Bold arrows mark locations with at least three independent observations. Red arrows mark locations were no stone loach was observed.

There are 14 locations in Igelbäcken, which have at least been testfished once in the last 20 years (Fig. 1). The locations “Ulriksdal-Sörentorp” and “Granby-Eggeby” have the longest time series consisting of ten visits each. In eight locations stone loach was observed at least on one occasion. In six locations, not one single individual of stone loach was caught. The five locations “Akalla”, “Granby-Eggeby”, “Kymlinge (upp. T-banebro)”, “Ulriksdal-Sörentorp” and “Ulriksdal (ned träbro)” showed a presence of stone loach on at least three different occasions and are the one considered as from now on.

Results

Overall, the stone loach population in Igelbäcken seemed to have steadily declined in both locations with a sample record of more than ten years, Granby-Eggeby and Ulriksdal-Sörentorp, after the short recovery in the beginning of the 2000’s (Fig. 4; see Annex). The decrease was faster in the case of Granby-Eggeby, where the most recent value of 2008, 110.7 individuals/100m^2 makes up for only 24.3 % of the maximum value of 2003 (455.3 ind./100m^2). In Ulriksdal-Sörentorp, where in every consecutive year since 2002 a lower density was measured than in the previous year, the corresponding numbers for 2009 are 67.8 ind./100m^2, which is only 20.4 % of the maximum value of 2002 (332.5 ind./100m^2). In the other three locations, the picture was more varied. In Akalla, after a testfishing break of three years, only 29.2 ind./100m^2 were found in 2008, which is considerably lower than the 103.6 ind./100m^2 and 106.5 ind./100m^2 of 2004 and 2005, respectively. Ulriksdal (ned träbro) did show a rather high variability between years, but no consistent tendency. An opposite development was taking place in Kymlinge, with the highest density of stone loach so far measured in Igelbäcken (795.9 ind./100m^2, in 2009).

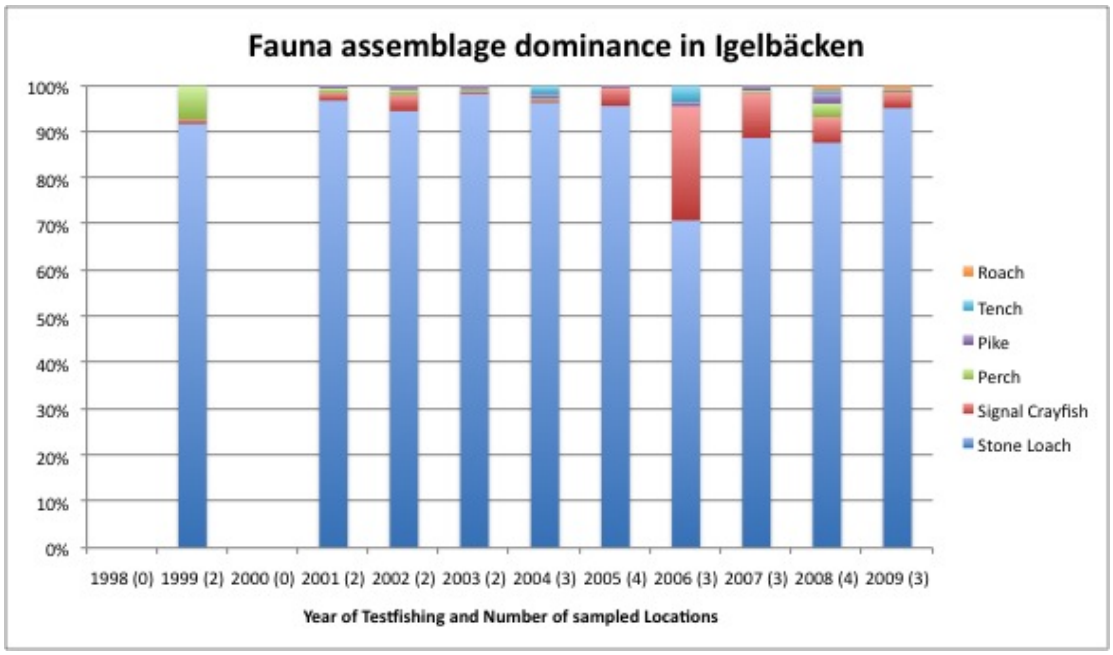

Fig. 2. Fauna assemblage dominance in Igelbäcken for several years with data from different locations pooled together.

All testfishing results pooled together shows that the dominating species in Igelbäcken since 1999 has been stone loach, which solely stands for 90 % or more of individuals annually observed (Fig. 2). Only in 2006, with a considerable amount of signal crayfish caught, the stone loach dominance decreased to a value of only 70.9 %. After 2006, when signal crayfish was standing for 24.7 % of all sampled animals,

the respective percentage steadily decreased in the following years, from 9.7 % in 2007, 5.6 % in 2008 to 3.3% in 2009. Signal crayfish has yet been observed in four of the five locations, being absent only in Akalla.

The water flow on the very day of testfishing correlated only to a small amount with the observed number of stone loaches at all locations (linear regression, $R^2 = 0.122$). There is however at both locations with a long sample record a correlation between annual mean water flow and stone loach density ($R^2 = 0731$ and $R^2 = 0.517$ for Granby-Eggeby and Ulriksdal-Sörentorp respectively; Fig. 3).

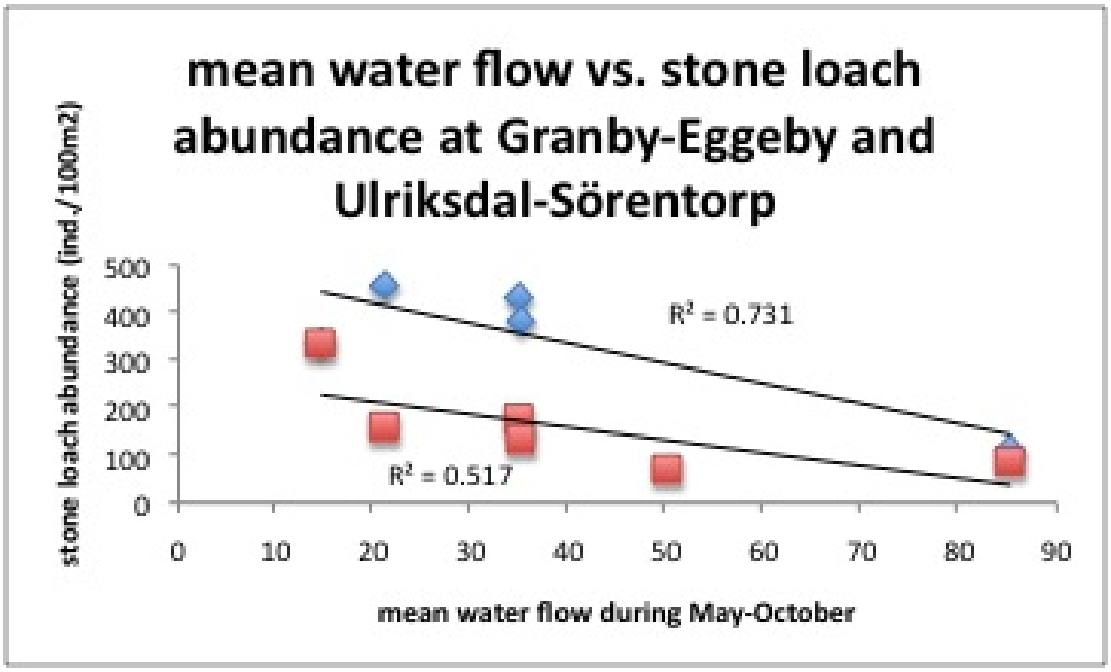

Fig. 3. Annual mean water flow during May - October vs. stone loach abundance for Granby-Eggeby (blue) and Ulriksdal-Sörentorp (red). Only years with a full record of water flow data (2000, 2001, 2003, 2004, 2008, 2009) as well as 2002 with few days missing were considered. Linear regressions are given with their respective coefficient of determination (R^2) -values.

Discussion

The interannual variability of stone loach abundance was strongest correlated with annual mean water flow (Fig. 3). This finding can though not at all explain the decline of stone loach abundance over the years in Granby-Eggeby and Ulriksdal-Sörentorp (Fig. 4), nor can strong competition or high predation levels by other species. It is rather the case that the top-predator pike, with on average one individual per 100 m stretch present, lacks importance as a structuring force for the stone loach population in the entire creek (Lundberg 2006). As crayfish is responding well to electrofishing (Alonso 2001), there is no possibility that signal crayfish should unnoticed have established a strong population in Igelbäcken. The steadiness of decline makes common interannual variability in population size very unlikely as a single reason behind the observed pattern.

As no correlation between the abundances of stone loach and of other species can be discerned, the focus has to turn towards habitat quality. In Nilsson's study (2006), habitat variability explained more of the observed patterns in stone loach abundance than did the abundance of the two co-occurring possible competitors, brown trout and signal crayfish. It seems thus most likely that the habitat's carrying capacity for stone loach at Granby-Eggeby as well as at Ulriksdal-Sörentorp has diminished over the years. The reasons behind this development remain to be examined.

The importance of habitat characteristics is shown in the example Kymlinge, where, after an executed restoration in 2005 high (Andersson & Lundberg 2009), the abundance of stone loach skyrocketed in few years only (Fig. 4). In addition to showing the highest overall density ever recorded in Igelbäcken, with more than 50 % of the individuals in 2007 being young of the year, their reproductive success was as well very high.

More samples are needed from both Akalla and Ulriksdal (ned träbro) in order to possess a meaningful time series. It is yet too early to give statements on the condition of their respective stone loach populations. Moreover, as Ulriksdal is sampled in May, its data is not really comparable with those of the other four locations normally visited in September. Spring sampling should show a higher amount of smaller individuals with a possibly higher mortality, which is likely leading to a higher interannual variability. Moreover, as water flow in spring generally is higher than later in the year, electrofishing efficiency might differ between seasons.

A precautionary approach requires for that signal crayfish remain to be seen as a potential large threat to stone loach populations in Igelbäcken. Since 2008, signal crayfish has colonized the whole stretch from Ulriksdal up to Barkarby airfield (Andersson & Lundberg 2009). However, in order to have a future vital stone loach population in Igelbäcken, it seems most important to ensure that foremost its habitat requirements are met.

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Annex

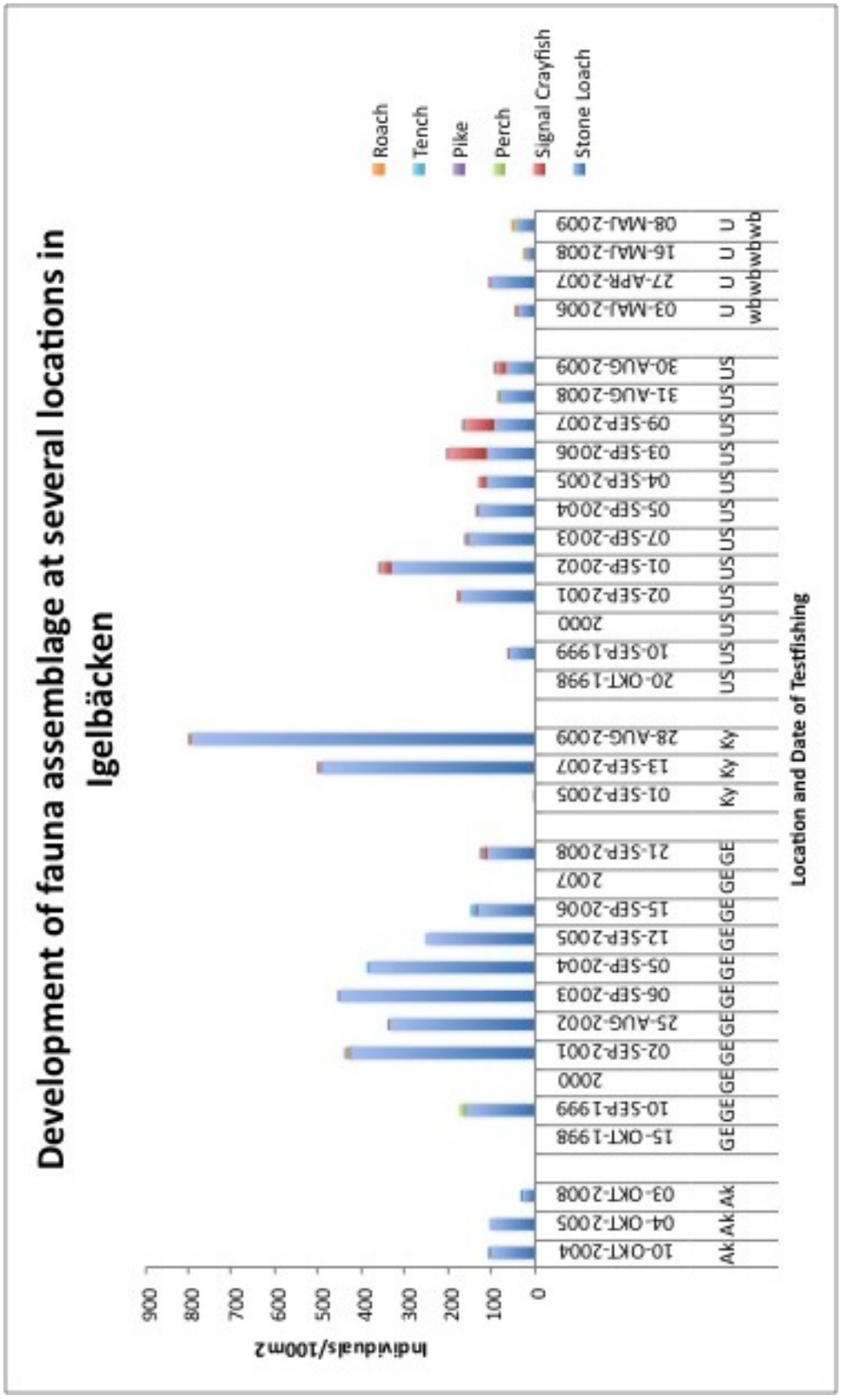

Fig. 4. Abundance of different fish and crayfish species in Igelbäcken at different sampling occasions at the five locations where stone loach has been observed.