

The Effects of Pike Predation on Lake Use and Reproductive Success of Ducks: An Experimental Study in Boreal Lakes

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Extended Abstract: The pike (*Esox lucius*) is a common and widespread fish in the boreal region of the northern hemisphere. It is known to depredate ducklings of both dabbling and diving duck, but the evidence is largely anecdotal observations by fishermen, hunters and birdwatchers. In other words, the rate of predation is largely unknown, and it is uncertain to what extent total reproduction is affected by pike predation. Solman (1945) estimated the effects of duck reproductive output through examining the stomach contents of pike and estimated that pike predation may account for the loss of 9.7% of the young waterfowl produced in his study area (Saskatchewan River delta). Paasivaara & Pöysä (2004) studied lake choice in breeding females and survival of young goldeneye in boreal lakes with a range of different pike densities. The mortality of young ducklings was higher in the high pike density lakes, but the female did not actively avoid these lakes.

Several studies in different biomes have illustrated a general negative effect of fish on duckling survival, weight gain and lake choice by breeding females (eg. Eriksson, 1983). These effects have been largely explained by the impact fish have on the aquatic invertebrates that form a large part of the diet of ducklings, i.e. competition for common prey. Fish are efficient predators and can reduce invertebrate numbers significantly after introduction to a wetland. In the Fennoscandian boreal region, where pike are among the most common fish species, the presence of fish may reduce the survival of

ducklings through both competition (mainly young pike) and predation (large pike).

The purpose of the study was to study the hypothesized predation effect without confounding effects of competition. In a natural system there is normally a variety of species and fish sizes. You therefore get competition from other species or from young pike as well as predation by the larger individuals. By selecting a treatment with only large pike, we removed the competition effects.

Our study was carried out in the north of Sweden in oligotrophic lakes, typical of the region and much of boreal in general. Eleven naturally fishless lakes were surveyed in 2005, pair counts were noted in the early spring, and brood counts later in the season. In 2008, pike were caught in a nearby bay as they were coming in to spawn in early spring. 20 pike were introduced to one of the lakes from the 2005 survey, and 25 were added to another of these lakes. The additional 9 lakes surveyed in 2005 were left fishless, to control for year effects in our study area. The ducks present in the study system were mallard (*Anas platyrhynchos*), common goldeneye (*Bucephala clangula*) and teal (*Anas crecca*).

In 2008 brood and pair counts were carried out the same way as in 2005 and we found that pairs of all duck species did not avoid the lakes with introduced pike (fig. 1). There was no significant difference between the lake use of pike lakes and fishless lakes by pairs of any of the three species. The number of utilization days during

brood counts, on the other hand, were strongly affected by the experimental treatment for two of the species (goldeneye; $p < 0.001$, teal; $p < 0.05$), but the effect on mallards was not significant. The latter result may be due to type II statistical error, as mallard occurred in much fewer lakes. Only one teal and one mallard brood was observed during the first brood observation in the pike lakes, after which they had all disappeared. However, some goldeneye broods survived throughout the study period (fig 2).

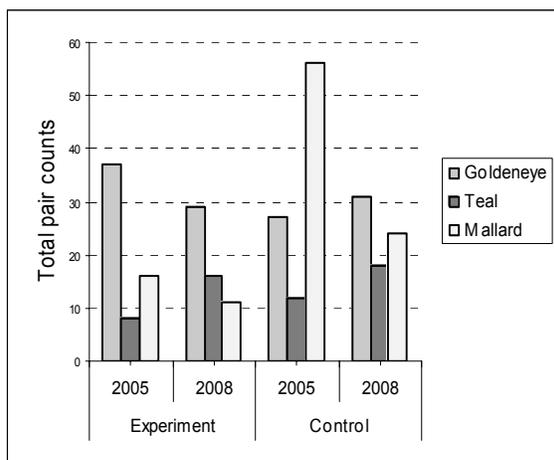


Figure 1. Pair counts were carried out three times in early spring.

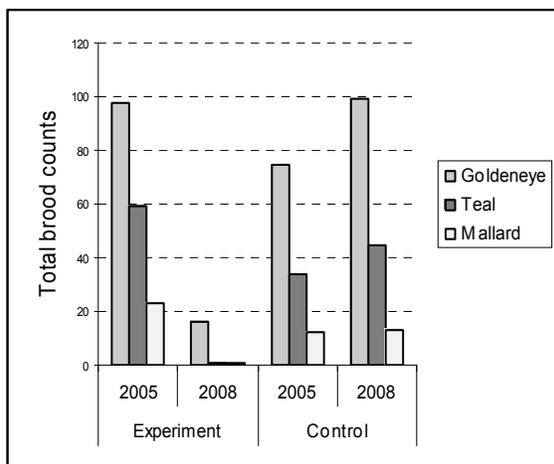


Figure 2. Brood counts were carried out four times in late spring. The results clearly illustrate a negative effect of pike on brood utilization. It is not possible,

however, to determine whether the broods were decimated by pike predation or whether the females and broods left the study lake with time or after the first pike encounter. If pike have a strong negative impact on duckling survival, then we would expect an evolutionary adaptation in females to avoid lakes with large pike. Our lakes were fairly shallow and it was possible to see pike when surveying the lakes. During the early nesting phase, females do not avoid pike lakes in our lakes.

Fish have been historically introduced by humans to fishless lakes in Sweden and in Fennoscandia to increase the potential for fishing, but the rate of introductions have increased and few fishless lakes remain. For this reason, the pressure on breeding ducks through competition and predation by fish is higher than it has been in the past. In order to have good duck breeding areas it is therefore important to have some fish-free lakes, and particularly lakes free of pike. The main management implication of this study is that a more restrictive attitude is called for towards introduction of pike to good duck breeding sites.

Eriksson, M.O.G. 1983. The role of fish in the selection of lakes by nonpiscivorous ducks: Mallard, Teal and Goldeneye. *Wildfowl* 34:27-32

Paasivaara, A. & Pöysä, H. 2004. Mortality of common goldeneye (*Bucephala clangula*) broods in relation to predation risk by northern pike (*Esox lucius*). *Ann. Zool. Fennici*. 41:513-523.

Solman, V.E.F. 1945. Ecologic relations of pike, *Esox lucius* L., and waterfowl. *Ecology*. 26 (2): 157-170.