An information paper on piscivorous bird predation and wild trout

Summary

Fish populations are regulated by 'top-down' and 'bottom-up' influences. Bottom-up influences arise from environmental conditions; for example, they may limit primary production (e.g. photosynthesis) and therefore population abundance. Another example of a bottom-up influence might be habitat availability whereby a fish population is limited by the amount or quality of habitat for spawning, juvenile or adult stages of the lifecycle. Top-down influences regulate a population slightly differently; predation or competition between species may keep a population below a size that would otherwise be observed in the absence of either or both of these two factors.

Fish-eating (piscivorous) birds in the UK include the great cormorant (*Phalacrocorax carbo* & subspecies *P.c. sinensis*), the sawbill ducks (the red-breasted merganser, *Mergus merganser* and the goosander, *Mergus serrator*) and the grey heron (*Ardea cinerea*). These birds are all protected by law. All are opportunistic predators that will take advantage of high prey densities, especially where densities are artificially high (e.g. through stocking) though some (such as the grey heron) can impact profitability of fish farms and are **generally** not considered a problem in naturally functioning wild fisheries.

The impact of avian (bird) predation on fish populations and angler catches is perceived as significant by the recreational angling community across much of the British Isles. There is a belief in that community that bird conservation is being prioritised over that of some fish species with equal conservation designation, such as Atlantic salmon. Whilst acknowledging the importance of balanced predation, this document focuses on levels of avian predation that may cause concern during the management of biodiversity and fisheries.

Are the numbers of avian piscivorous predators increasing in the UK?

Great cormorant: The number and size of inland breeding colonies of *P. carbo* in the UK has increased since the early 1980s. Various reasons are postulated for this increase; the creation of inland waters stocked for angling, coastal overfishing, a reduction of pollution levels in inland waters and increased levels of legal protection being some of the most common. It is difficult to identify which reasons are chiefly responsible for the increase. In recent years (2005 – 2010), surveys suggest a stabilisation or slight decline of the UK population.

Sawbill ducks: Since the 19th century, goosanders have undergone rapid growth in both range and population size in the UK, though in recent years (1995 – 2010) this growth has tailed off. The population of red-breasted mergansers also increased in the early 20th century (1900 – 1950), though recent indications (e.g. 2010-2011 BTO national survey) are that merganser numbers are in decline. Both birds prefer upland areas with the red-breasted merganser over-wintering on coasts. In contrast to perceptions in North America where their merganser species is perceived to impact on recreational fisheries, the red-breasted merganser is not generally considered to be a problem in the UK.

How do avian piscivorous predators impact on fisheries?

Cormorants

Cormorants in inland waters, in high numbers, have the potential to impact on fisheries. Individual adult cormorants consume large amounts of fish (around 350–585g each daily) and the *potential* for significant impacts on fish abundance in individual waters exists due to large flocks that have been reported to contain well over one hundred birds. These impacts can be economic (loss of fishery income), ecological (affecting fish community composition and abundance) or behavioural (fish behaviour and hence catch rates).

In some scientific studies, these potential impacts have been indicated (Case study Box 1), while in others, no discernible effects from piscivorous bird predation were detected (Case study box 2).

Case Study Box 1 – Cormorant impacts on fisheries

Study: Winfield et al (2002). **Where?** Freshwater Lake, England. **Summary:** In the most intensively studied example of a fish and cormorant system in the UK, the authors hypothesized that the growing cormorant population may have accounted for almost half the standing stock of adult whitefish that year.

Study: Vetemaa et al (2010). **Where?** Kaina Bay, estuary, Estonia. **Summary:** Despite the decline of a local net fishery, perch abundance declined over ten years. The study concluded that an increasingly large cormorant colony might be responsible for the decline.

Study: Stewart et al (2005). **Where?** Stocked freshwater loch, Scotland. **Summary**: Cormorants will take advantage of artificially high fish populations. Significant levels of predation on stocked brown trout by cormorants were detected.

The great cormorant has been studied extensively in Europe. However, it is difficult to make general assumptions about its overall impact on prey populations as few studies are able to use the necessary controls and replication to make conclusive, unequivocal assessments. These constraints mean a high degree of uncertainty when trying to ascribe the existence and magnitude of impacts due solely to cormorant predation. With a lack of robust information on fish population levels, numbers of feeding birds and calculations of fish consumption, it is very hard for studies to detect observable reductions in fish productivity or direct economic loss to fisheries. This conclusion was echoed by the EE REDCAFE study which concluded that ''demonstrating the impact of cormorants in large rivers and other waterbodies is difficult, because of ecological complexities".

Case Study Box 2 – cormorant impacts on fisheries

i. **Study:** Engstrom (2001). **Where?** Sweden, Lake. **Summary:** Despite the establishment of the biggest cormorant colony in Sweden and considerable fish consumption by cormorants, no discernible change in fish biomass could be detected.
ii. **Study:** Boström et al (2009). **Where?** Sweden, estuary. **Summary:** An extensive fish tagging and cormorant diet analysis exercise could not prove that an adjacent cormorant colony was responsible for a declining migratory salmonid run on the River Dalälven.
iii. **Study:** Carpentier et al (2009). **Where?** France, shallow lake. **Summary:** Study could not link cormorant predation to the perceived decline of a European eel fishery in the Lake Grand-Lieu fishery.

Goosanders

Like cormorants, goosanders are generalist, opportunistic predators that will often aggregate in large numbers to take advantage of high prey densities. Goosander predation on fish has been less studied than cormorant predation, with attendant difficulties in defining impacts on fish populations.

Goosanders are perceived as a problem for game fisheries, especially in upland rivers and analysis of their diet has shown that juvenile salmonids (including brown trout) are an important component of that diet in parts of the bird's range. Smolt runs for example, are believed to be targeted by goosanders. On certain rivers, such as the Tweed in Scotland, goosander predation on the smolt run is cited as a key factor affecting the economic value of the salmon rod fishery. Smolt predation does have a greater effect than predation upon younger life stages (parr or fry) because of the reducing influence of **compensatory mortality** **(Fact box 3)** as fish get older.

> **Fact box 3**
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> **Compensatory mortality, migratory fish & predators:** After hatching, numbers of salmonid fry can be very high but reduce dramatically as they compete for limited resources (space and food) to support them. Therefore, predation during early life often removes fish that would not have reached adulthood; the remaining fish have higher chances of survival as competition is reduced following the reduction in number of their cohort. However, this compensatory effect is reduced as the maturing fish population reduces in numbers and resources become less limiting. Predation on more mature fish, such as salmon or sea trout smolts, is therefore more likely to affect the ultimate adult population size.

Goosanders with a brood of ducklings will remain in the same area until the chicks have matured. On small upland streams, the impact of these family groups could conceivably be quite high on stocks of juvenile fish, especially where there is a lack of refuge habitat and variation in depth.

Controlling avian predation impacts on fisheries

Some fish populations in the United Kingdom are under significant pressure, due mostly to a variety of anthropogenic factors such as poor water quality and/or quantity, channel modification, barriers to migration or habitat degradation. These populations are not as resilient to increased predation pressure as healthy populations would be and management measures to combat predation are an appropriate option in these circumstances.

In most cases, declines in catches cannot readily be attributed to predators; other factors may be involved. However, there are a suite of measures that can be employed to minimise impacts where it is reliably believed that cormorants are adversely affecting a fishery. The Moran Committee Joint Bird Group (2001) addressed various options (Table 1) for controlling cormorant predation:

1 Measures to Control Cormorant Predation

Method	Pros	Cons
Habitat management - Creating fish refuges, floating islands	- A cost effective, low maintenance method, especially in certain fishery types (e.g. small still waters) - Provides other fisheries benefits associated with increased habitat diversity & cover.	-Some problems with manmade refuges in rivers; inability of fish to exploit them & problems with spate flows*.

Method	Pros	Cons
Human disturbance - Patrols & organised walks to coincide with peak feeding times for birds.	Allows for an accurate assessment of predator numbers over time - Initially, a simple and effective method of deterring predators	- Needs to be well coordinated on rivers - Cormorants may become habituated to these kinds of activities - Implications for other wildlife - Labour intensive - Often at anti-social hours (e.g. pre-dawn)
Preventing access – i.e. Protective Netting	- Impractical on rivers and larger still waters but effective on small ponds/fish farms and used widely in Europe - Will encourage cormorants to seek alternative feeding sites	- Impractical on rivers and larger still waters, - Expensive and adversely affects other wildlife
Roost removal – i.e. Removal of nesting/resting sites	- Can be used to protect vulnerable areas e.g. shallow spawning zones.	- Adverse environmental impacts of tree removal- Often impractical on rivers
Stock management - i.e. stocking of larger fish	- Some success at still-water trout fisheries, causing cormorants to feed on resident coarse fish populations - Better catch rates for anglers	- Increased rearing costs - Narrow application, not suitable or desirable for all water body types
Automated & Noise generating scarecrows	- Initially effective; may provide a good immediate option while other methods are considered. - Effectiveness & longevity can be increased by varying their positions.	- Impractical on rivers - Expensive - Cormorants/predators may become habituated to the effects of scaring - Antisocial
Shooting to scare	-Reinforces effect(s) of culling (a certain level of culling is required to maintain efficacy)- May be the only option where the public has access to a fishery	- Impermanent - Labour intensive - Antisocial
Culling	- Effective when used in conjunction with other methods (e.g. scaring). - Can be locally effective in displacing birds	- Culling on a local/small scale simply creates a vacuum soon filled by birds from adjacent areas. - Shifts the problem elsewhere - Large nationwide/EU wide culling exercise politically unacceptable.
Compensatory stocking		- Counter-productive, attracts more predators
*In this case, general 'softer' habitat enhancement methods may be more practical		

Avian predator management – final considerations

- Employing a selection of these measures can be effective. In the 1990s, around 8% of trout caught by anglers on Anglian Water fisheries showed signs of cormorant damage. By employing different stock management tactics and a combination of scaring tactics and deterrents, management reduced this to around 1% by 2001.

- DEFRA research projects found that artificial refuges in small ponds reduce the foraging efficiency of cormorants. In other words, provision of habitat makes it harder for cormorants to fish leading to a reduction in cormorants visiting the fishery and a reduction in the amount of fish consumed by cormorants. Although this study was carried out in small still waters, the principles are universal. Complex habitat makes it harder for cormorants to hunt, easier for fish to hide. There are a number of artificial designs that can be used by fisheries managers (Figure 1).

Figure 1: Artificial refuges (top), Floating islands (middle) and hedgehogs (bottom). Courtesy of Ian Russel, CEFAS and www.fishkit.com

- Many of the constraints described above also apply to goosanders and it should be borne in mind that goosanders are primarily river dwellers. In winter, when goosanders move onto still waters, the same tactics can be employed as for cormorants.

- Harsh winters that freeze still-waters could, of course, increase the over-winter predation pressure of goosander on flowing water systems that do not completely ice-over. Methods for increasing the proportions of river fish surviving over the winter are especially important in such cases (see advice section below).

- While no study has conclusively shown a link between culling of predatory birds and increased fish production[1], culling undoubtedly reinforces the effects of other deterrents (Table 1) but needs to be employed consistently and effectively to underpin its effectiveness.

- Culling is a recognized management technique when dealing with species that are causing locally high levels of damage (e.g. deer in forestry situations). However, culling on a regional scale is unlikely to be politically acceptable and will not necessarily achieve its objectives; 6000 birds were shot in Bavaria during the winters of 1996/7 but an influx of new birds meant that the winter population was not reduced. An estimated 30,000 to 60,000 cormorants across Europe would have to be killed every year to make a difference.

- Managing wild populations always involves a certain degree of uncertainty. In the Great Lakes region USA, wildlife managers destroyed the breeding attempts of a double-crested cormorant colony on an island. This invited predation in the newly-vacated fishing grounds from birds nesting on another island a considerable distance (35km) away. The net result of this **was increased predation on fish** by these cormorants to compensate for the greater distances they were travelling in order to forage.

Avian predation & wild brown trout: WTT advice:

No single method will reliably and continually protect fish against avian predation; however a combination of approaches can reduce predation to more acceptable levels and can prevent potentially damaging declines.

[1] Partly due to the difficulty of reaching solid conclusions through fieldwork

Increased habitat complexity & predation: On occasion, the WTT has been asked during its advisory visit programme how best to protect WBT populations from avian predation. Good quality, accessible habitat is a profound bottom-up influence that can greatly improve the structure & overall abundance of a fish population. Preserving and increasing habitat complexity is very much within the WTT's approach. Optimal foraging theory, backed by practical research, suggests that increasing the search time and reducing the capture efficiency of predators by increasing habitat complexity causes predators to "give up" on a patch sooner – leaving behind a greater number of prey. We believe that sensitive habitat enhancement can mediate against the effects of top-down impacts such as predation. Angling clubs and fisheries managers can 'tip the balance in favour of the trout' by following the WTT guidance below:

Simple "Dos" and "Don'ts"

- **DO** consider how you can build lots of complex habitat into your river fishery (e.g. tree branches and roots trailing into the water, dense marginal vegetation, introduced brash 'mattresses', tree 'kickers', cover logs); this will provide cover for fish whilst reducing and bird hunting efficiency. Predators find it very hard to follow trout into a complex web of trailing branches and tree roots. Consider bankside installations – where winter refuge habitat is sparse e.g. (Figure 2).
- **DO** consider the use of large woody debris (LWD) to create localized areas of scour. These deeper parts of the channel will provide cover for fish from predators.
- **DO** maintain a good mix of 'shrubby' cover on river margins right through the year, particularly over shallow water in channel margins where juvenile trout often live.
- **DO** consider employing a combination of habitat enhancements and deterrents when protecting WBT against fish-eating birds. These birds are clever; so persistence *and* variety are vital.
- **DO** consider further deterrent measures (e.g. scaring) during vulnerable periods, e.g. spawning, drought and smolt runs.
- **DO** build a good relationship with the conservation authority in your area. Maintain a dialogue if piscivorous bird predation is deemed to be an issue with your fishery and seek advice on control methods, including the process of licensing for lethal control.
- **DO** remove bottlenecks that concentrate fish in vulnerable areas. For example, weirs have been shown to delay downstream smolt migration and increase rates of bird predation. Equally, adult fish congregating below barriers during upstream spawning migrations are an easy target.

Figure 2: Large scale brash installation; Wye & Usk Foundation – responsible for dramatic increases in juvenile trout and salmon survival that is thought to be driven by reduced avian predation efficiency

- **DON'T** automatically assume that bird predation may be limiting WBT production; carefully assess other potential 'bottlenecks' (see Paul Gaskell's **'Does Habitat Restoration Work?'** paper elsewhere on the WTT website).

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