

***Argulus* in the Tay District, 2006**

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(photo courtesy of Fisheries Research Services)

Summary

In August 2006 some specimens of the species *Argulus coregoni* were found on wild fish in the lower River Earn (Dupplin), the lower Tay (Islamouth) and the lower River Isla (Links Farm). This species was previously reported by Fisheries Research Services to occur in the lower Earn and lower Tay.

Another species, *Argulus foliaceus*, was found in Fingask Loch, Blairgowrie. This species was found in the 1990s in Sandyknowes Fishery, Bridge of Earn, and has more recently been reported in Lindores Loch, Fife.

Despite initial concerns, the *Argulus* in Fingask Loch will, therefore, not have come from those now endemic in the Isla system, since they are different species. Likewise, Fingask Loch will not be a source of infection of the River Isla or the Tay.

The effects of the now endemic *Argulus coregoni* on river fish locally are unknown, but will be worse in long dry summers. *Argulus foliaceus* pose a significant threat to small stillwater fisheries.

Rigorous controls are required to ensure that *Argulus foliaceus* does not spread further through either stocked fish, plants, anglers tackle etc.

Introduction

This paper describes the results of a survey of the distribution of the freshwater louse, *Argulus*, within the Tay District during the summer of 2006. It was conducted by Tay District Salmon Fisheries Board staff under contract to the Tay Foundation.

Biology

Argulus, the freshwater louse, is a genus of freshwater lice found throughout the world. Contrary to its nick-name it is not a louse but a freshwater crustacean parasite found on a wide range of freshwater fish species.

Adult *Argulus* lay their eggs on some surface like a stone or plant leaves. Their incubation is temperature dependent and they may hatch quickly in warm summer weather. After hatching the tiny *Argulus* are little bigger than a full stop on this page but they seek fish on whose skins they cling to and feed on. Their level of activity and growth is again dependent on temperature and, in Scotland, temperatures are only really high enough in summer. The young *Argulus*, especially, are poorly able to withstand currents, therefore they probably only survive in stillwaters, in marginal or backwater areas of rivers, slow flowing pools or among submerged vegetation. In Britain, *Argulus* seem to first appear in the late spring when young hatch out from eggs laid the previous autumn which have lain dormant over winter. However, with increasing temperature in early summer the first generation of *Argulus* may themselves reach breeding age within a few weeks and then give rise to a subsequent generation and so on.

Argulus feed by puncturing the skin of fish and sucking out blood. Low levels of infestation might only result in discomfort but heavy infestation can ultimately result in the death of a fish. *Argulus* can cause severe infestation in places where host fish are abundant and easily found and high temperatures prevail for a long enough period to allow the summer population to mushroom. More detailed information on their biology can be found in Taylor, Sommerville and Wootten (2005).

Distribution

Of the 143 *Argulus* species described so far only three are found in the UK. Two of these, *Argulus foliaceus* and *Argulus coregoni* are regarded as native to the UK, though non-native to northern Scotland at least. The non-native *Argulus japonicus* most likely was introduced to Britain from the Far East through the ornamental fish trade. There is as yet no record of this latter species from Scotland (Taylor *et al.* 2005).

A. coregoni have been present in the River Clyde since at least the beginning of the twentieth century (although they were initially misidentified as *A. foliaceus*) and *A. foliaceus* had been reported in several stillwaters in central and southern Scotland and also the Union and the Forth Clyde canals by the 1960s (Campbell 1971). In 1971 the Clyde was still the only place in Scotland known to have of *A. Coregoni*, although Campbell noted that perhaps they might been overlooked elsewhere.

It is not known exactly how long *Argulus* have been present in the Tay District, but *A. coregoni* have apparently been present in the lower Earn for several decades (A. Walker pers. comm.). It is not known whether it may just have gone overlooked or introduced by some means. On occasions some significant infestation of fish may have occurred on the Earn. One angler we spoke to recalled seeing approximately 200 *Argulus* on a brown trout he caught in that river in 1989. By the mid 1990s *Argulus* were also known to be present in Glenfarg Reservoir, which is fed by water pumped up from the lower reaches of the River Earn (Northcott and Walker no date).

In the summer of 1994 stocked rainbow trout at Sandyknowes Fishery at Bridge of Earn started behaving oddly, swimming in circles near the surface of the loch. Some specimens removed from the loch were covered in *Argulus*, later identified as *A. foliaceus*. The fish suffered severe scale loss, fin damage and lesions due to the lice feeding activity, many were moribund. Large numbers of dead sticklebacks were also seen. The outbreak was associated with a prolonged period of dry and warm weather, when the temperature in the loch reached more than 20°C. A similar outbreak on trout and sticklebacks also occurred at Sandyknowes in summer of 1995, leading to a temporary closure of the fishery (Northcott, Lyndon and Campbell 1997, Northcott and Walker no date).

Initially it was thought that *Argulus* may have entered the fishery on roach which may have entered from the River Earn during large floods in 1993 (Northcott, Lyndon and Campbell 1997). In 1995 Fisheries Research Services then performed surveys at a number of locations on the Earn and found that *Argulus* seemed quite common on salmonids especially around Bridge of Earn but they seemed relatively scarce by Auchterader and FRS speculated they were probably not established in the upper Earn. However, all the *Argulus* in the Earn were of the *coregoni* species. FRS also found this to be the species present in Glenfarg Reservoir (Northcott and Walker 1996, Northcott and Walker no date). They also found *A. Coregoni* in the lower part of the mainstem of the Tay including the Perth Harbour area. However, no *Argulus* were found in an oxbow pond near Bridge of Earn which is regularly flooded by the Earn. They also found that, on considering all their sampling sites, *Argulus* infestation on roach was low compared to salmonids and they concluded roach was not a preferred species. They also seemed to avoid minnows but not sticklebacks.

It became clear, therefore, that the *Argulus* in Sandyknowes Fishery had not been introduced from the Earn by roach. It was suggested that they might have been brought in with weed or on grass carp, both of which had been brought up from England to this fishery (Northcott and Walker no date).

After the mid '90s FRS seemed to pay relatively little attention to *Argulus* within the Tay District but reports increased again in recent years with infestations on salmon parr being reported on the lower Tay in the warm dry summer of 2005, and problems being reported at Lindores Fishery in Fife and Fingask Loch, a stocked trout loch near Blairgowrie. The situation had become so bad that rainbow trout are no longer stocked into Lindores during the summer. Consequently against this background the Tay Foundation commissioned this survey in 2006 to better establish the *Argulus* distribution within the Tay District.

Methods

During July and August 2006 Tay District Salmon Fisheries Board (TDSFB) staff searched rivers within the Tay Salmon Fisheries District for the occurrence of *Argulus* on local freshwater fish species. Warm days were selected since *Argulus* are more active in warm weather.

To catch the fish and examine them for parasites, fish were either caught by flyfishing with small trout flies or electric fishing. In total 478 fish were caught from various river locations, mainly salmon parr, but brown trout (all age classes), grayling, minnows and stone loaches were also caught. After a fish was caught it was quickly transferred to a small plastic bucket as otherwise the *Argulus* could detach themselves from the fish. On one occasion an *Argulus* was seen swimming in the bucket the instant the fish was brought into the bucket, though on other occasions they seemed to be attached quite tenaciously. Whilst in the bucket the fish were examined for the presence of *Argulus* and any observed were removed from the fish and preserved in alcohol so that they could later be sexed and identified to species.

The intention was to concentrate efforts on those areas where *Argulus* were thought likely to be present; the lower Earn, the lower Tay, the lower Isla and the Lunan Burn - a tributary of the River Isla into which Fingask Loch drains. There was a particular concern that perhaps Fingask Loch might act as a reservoir of *Argulus*, infecting the Isla or the Tay.

Ghillies on the River Tay also reported the presence of *Argulus* on salmon caught on their beats and specimens of *Argulus* were obtained by anglers fishing for rainbow trout on Fingask Loch.

Results

Most of the fish caught were parasite free and only a few *Argulus* specimens were ever found on the few infested fish. *A. coregoni* were found on a brown trout in the lower Earn (Dupplin), on salmon parr in the Tay (Islamouth), on grayling in the lower Isla (Links Farm). See Table 1 for more details. It was notable however that those fish with parasites were generally caught in relatively slow flowing areas. Since it was much easier to catch small fish with the fly in faster rather than in dead water areas, the degree of infestation may appear less than it really was. It was also noted that on landing one grayling into a bucket of water the *Argulus* on it quickly detached themselves. It is possible, therefore, that anglers may not be aware of the true extent of them.

Ghillies also reported some specimens of *A. coregoni* on adult salmon on Islamouth, Glendelvine, Dunkeld House and Kinnaird, though of course they need not have acquired the parasites at these places. There is also an historic record of a coloured grilse trapped by FRS at Clunie Dam on 13th September 1983 with one *Argulus* was present between adipose and tail, although it is not known which species (D. Stewart, FRS, pers.comm).

However, the *Argulus* obtained off rainbow trout from Fingask Loch proved to be the other species, *A. foliaceus*, and are known to have been present in this loch for several years. An electrofishing survey in the Lunan Burn, into which the loch flows, failed to yield any *Argulus* at all (Table 1). While *Argulus* have never reached catastrophic levels in Fingask Loch (it is thought the depth of the loch may give the fish a cool water refuge from them) they are considered a problem for the fishery. *Argulus* are not present at Butterstone Loch, further up the Lunan system and the fishery manager there insists on rigorous biosecurity measures to prevent anglers inadvertently introducing it.

Discussion

It seems clear, therefore, that *A. coregoni* is now endemic in the lower Tay, Earn and Isla. The latter two rivers are probably particularly suited to them being relatively slow flowing and pooly. The extent to which they are a threat to fish in the river is not known. As far as juvenile salmon are concerned, since these prefer to live in riffles where *Argulus* probably would not do well, there may not be too much cause for concern. However, though they do prefer riffles, some salmon parr can and do occupy slower flowing reaches, especially larger parr, and could be adversely affected. However, those species which have a greater affinity for pools than salmon, for example trout or grayling, are likely to be most at risk of infestation. Infestation of adult salmon or sea trout could also increase the risk of fungal infections, to which they can be prone in hot dry weather.

In this survey the numbers of *A. coregoni* found on any fish was in fact low. But, as mentioned previously, there have been reports from anglers of more serious levels of infestation with one Earn angler observing perhaps 200 specimens on a brown trout in 1989. Such a level of infestation would surely have been damaging. In 1989 there was a particularly dry spring and summer, and conditions may have been extremely good for

Argulus. Thus, increasing summer warmth perhaps if associated with drier weather, could lead to more serious problems in future.

Another unanswered question is how some adult salmon acquired *Argulus*. Some of the infested fish were described by ghillies as having been fresh run. One likely candidate area for infection may be the upper, freshwater part, of the Tay estuary. Current speeds are relatively low in this area in summer, and indeed static at high tide. Unfortunately this area was not successfully sampled. Angling was tried downstream from the Friarton Bridge, but nothing was caught. A further attempt was planned for the Tay Street / Shore Road area of Perth, but unfortunately the weather broke a few days before the planned visit and the river was high and coloured.

So, while *A. coregoni* may perhaps pose more of a threat to river fish in future if summers continue to get warmer, of more immediate concern are the effects on stillwaters.

The spread of *A. coregoni* through the Tay system as a result of warmer summers and transport by fish (for example, migrating adult salmon), may result in more stillwaters ultimately being infected by that species. However, according to the literature *A. coregoni* is considered more of a river species while *A. foliaceus* seems more of a stillwater species. The spread of *A. foliaceus* is however a seriously worrying development for stillwater fisheries.

As to how *A. foliaceus* entered the various stillwaters is still unknown. However, the initial view that it was introduced to Sandyknowes by wild roach from the Earn seems untenable, given that *A. foliaceus* has yet to be found on a wild river fish in Tayside, that this species is apparently not noted as a riverine species and that roach are a poor host anyway. Curiously it was also suggested by some members of the Blairgowrie Angling Association that *Argulus* may have been introduced to Fingask Loch by roach coming in from the Lunan Burn.

The common factor between the fisheries where *A. foliaceus* is present is that they all are or have been regularly stocked with rainbow trout. A possible reason for the spread *A. foliaceus* must surely be as a result of introductions of stocked fish. Even if it were the case that they were brought in with plants or grass carp in some instances as opposed to the rainbow trout themselves, the introduction would still be a result of the way these fisheries are managed. Therefore, tighter controls on fish transfers between fish farms and waters would be useful to restrict the spread of this parasite.

References

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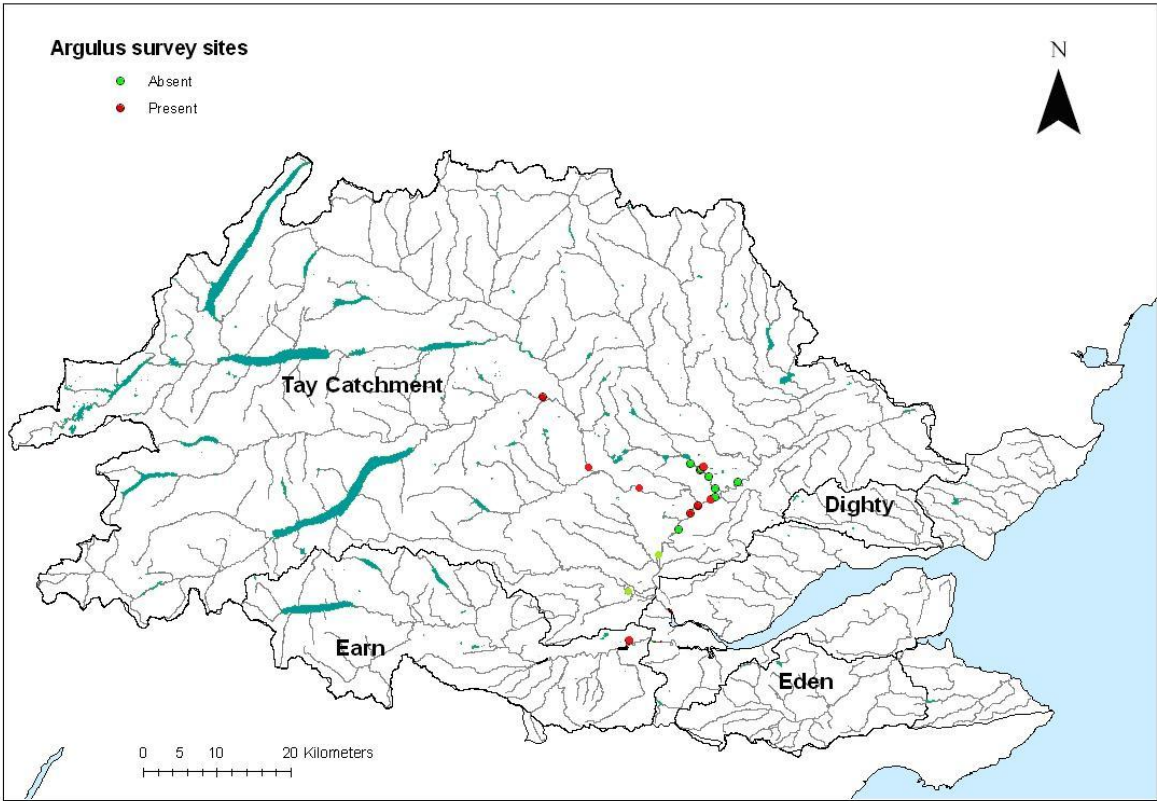


Figure 1. Locations where *Argulus* were found or reported in 2006 (red) and locations where fish were sampled but no *Argulus* were found.

Table 1: Overview of Argulus infestation on freshwater fish species within the Tay Salmon Fisheries District 2006.

Site	Grid ref	Date	Species caught	Method used	No fish caught	No fish with Argulus	Argulus species	Prevalence (%)	Abundance	Intensity	Max no lice
Tay, Upper Redgorton		13.08.06	Salmon Parr	Fly	25	0					
Tay, Taymount		13.08.06	Salmon Parr	Fly	25	0		0			
		13.08.06	Brown Trout	Fly	1	0		0			
Tay, Islamouth		13.08.06	Salmon Parr	Fly	14	2	A. coregoni	14.3		1.5	2
Tay overall					65	2	A. coregoni	3.0	0.05	1.5	1.5
Lunan, Marlee Road Bridge		02.08.06	Brown Trout, trout parr, salmon parr	E-fish	11	0					
Lunan, Coupar Angus Bridge		02.08.06	Salmon Parr	E-fish	44	0		0			
			Salmon Fry	E-fish	39	0					
			Trout Parr	E-fish	14	0					
			Trout Fry	E-fish	4	0					
			Stone loach	E-fish	16	0					
			Minnow	E-fish	1	0					
Lunan, Blairgowrie Road Bridge		02.08.06	Salmon Parr	E-fish	23	0					
			Salmon Fry	E-fish	25	0					
			Trout Parr	E-fish	6	0					
			Trout Fry	E-fish	5	0					
			Stone loach	E-fish	1	0					
Lunan, Mainstem by Fingask		02.08.06	No fish caught	E-fish		0					
Lunan	NO16234261	15.08.06	Minnows	E-fish	7	0		0			
			Eels	E-fish	1	0		0			
			Stoneloach	E-fish	1	0		0			
Lunan overall					198	0		0	0	0	0
Isla, Links Farm	NO17543862	14.08.06	Salmon Fry	E-fish	20	0					
			Minnow	E-fish	16	0					
			Stoneloach	E-fish	72	0					
			Stickleback	E-fish		0					

Isla, Links farm		15.08.06	Grayling (>12 cm)	Fly	5	2	A. coregoni	40	1	2.5	3
			Salmon Parr	Fly	6						
Isla, island upstream of Links Farm	NO180783883	15.08.09	Salmon Parr	Fly	22						
			Salmon Fry	Fly	2						
			Grayling (<12 cm)	Fly	16						
Isla, Coupar Angus		15.08.06	Salmon Parr	Fly	22						
			Grayling (<12 cm)	Fly	1						
Isla overall					182	2	A. coregoni				
Earn, Dupplin	NO05611873	16.08.06	Salmon parr	Fly	29						
			Grayling (<12cm)	Fly	2						
			Brown Trout	Fly	2	1	A. coregoni	50	1	2	2
Earn overall					33	1	A. coregoni	3	0.06	2	0

Prevalence: The percentage of fish in the sample infected by salmon lice

Abundance: The mean number of salmon lice per fish in the whole sample

Intensity: The mean number of salmon lice per infected fish

Maximum: The maximum number of salmon lice found on a single fish in the sample