



Those who explore the creeks, lakes and various waters of Britain, may, more than most, come across rafts of plants never before seen in this country. Strange Amazonian, Antipodean or Japanese plants have been smothering some of our lakes and meres in the past twenty years or more. On the other hand we

may find that a familiar fish or shrimp has been displaced by a foreigner or a relocated Britisher. Air transport and world-wide shipping bring alien plants and animals to our shores. Even native species are spread to new habitats across the country by our love for pets, fishing, travel and exploration.

Unstoppable in the final analysis, like the invasion of the Vikings or the dispersal of once local families across the land, the shifting of plant and animal species can cause difficult problems and may require adjustments in our expectations and habits.

A poster / sign now frequently seen in Lakeland. Downloadable here: <http://www.scrt.co.uk/biosecurity/biosecurity-for-boat-and-kayack-users>

It is emphatically not just foreign invaders that we have to be concerned about – habitat changes and the relocation of organisms to new habitats due to our interference with nature can also cause problems for once stable ecosystems or particular members of them. Like the contemporary human immigrations and effects of pollution worldwide, we have to cope somehow with these influxes and introductions. We small-boaters now find that our seemingly innocuous boating activities are the vehicles of change and that we are at the forefront of the battle to limit this creeping tumult and attack on our native freshwaters.

Those bastions of Englishness,

the English lakes, are not immune from assault (though what I am about to describe was an inside, all-British, job). Bassenthwaite Lake was one of the four habitats left in Britain to hold a population of the vendace or whitefish (*Coregonus albula*) which became established there at the end of the last ice age. This herring-like fish, a member of the salmon family, which has 60 fellow members of the genus worldwide, still hangs on in Derwentwater but became suddenly extinct in Bassenthwaite Lake in 2001.

It requires low temperatures and high dissolved oxygen as well as a moderately productive environment with a good supply of zooplankton on which to feed. Vendace became extinct in two Scottish lakes as early as 1911 which leaves Derwentwater as the last remaining natural habitat they inhabit. In the case of Bassenthwaite Lake the extinction was partly as a result of eutrophication ('good feeding' for phytoplankton and rooted plants) in the form of nitrates and phosphates from the Keswick sewage works as well as the agricultural run-off.

A further significant factor was the inadvertent introduction by anglers of fish species (originally as live-bait for northern pike *Esox lucius*). These species were roach (*Rutilus rutilus*), ruffe (*Gymnocephalus cernuus*) and, more recently, dace (*Leuciscus leuciscus*). Vendace require only mesotrophic conditions ('moderately good feeding' for phytoplankton and

Northern pike: *Esox lucius*



plants) which always existed at Bassenthwaite due to its catchment. Many upland lakes are 'oligotrophic' ('poor feeding' for phytoplankton and plants) and are unsuitable habitats for this specialised fish.

Vendace delicately browse on tiny zooplankton like the water flea *Daphnia* and could not withstand competition for that food with dace and roach nor predation on its eggs by ruffe. Silting was also a problem for them as it interferes with egg survival; eggs are deposited on the gravelly lake bottom often close to the shore.

Having disappeared from Bassenthwaite in 2001, the introduction from Derwentwater to establish them in two refuge Scottish lakes has been attempted with one effort being successful at Loch Skeen. Bringing vendace back to Bassenthwaite Lake will depend on reducing the phosphate influx from the sewage works (recently achieved) and removing the competitors (much more difficult).

Paradoxically, vendace are not only widespread throughout northern Europe but are an invasive species themselves in some lakes in both Norway and Russia. They have also been introduced to lakes in the USA – thousands of young fish from Germany were stocked in two water bodies in Maine during the 1880s by the U.S. Fish Commission. As a species they are not in danger and are classified as of 'Least Concern' on the IUCN Red List. The British vendace are nevertheless fully protected under the Wildlife and Countryside Act (1981).

Both Derwentwater and Bassenthwaite Lake are Sites of Special Scientific Interest and Special Areas of Conservation. Bassenthwaite Lake is also a National Nature Reserve managed by the National Trust. The management plan for this site takes into account the former presence of vendace. Locally therefore they are deemed important and under threat, but globally they are not.



Vendace: *Coregonus albula*



Roach : *Rutilus rutilus*

The problems affecting vendace in Bassenthwaite Lake are entirely of British origin, but the native white-clawed crayfish (*Austropotamobius pallipes*) and the noble or broad-clawed crayfish (*Astacus astacus*) have suffered throughout Britain and the rest of Europe by the introduction of the American signal crayfish (*Pacifastacus leniusculus*) and other similar species, and also from pollution. The signal crayfish is a carrier of an infectious crayfish plague to which the native species have no resistance. The offending American crustacean was introduced to Europe in Scandinavia in the 1960s to supplement a fishery for a native species (*Astacus astacus*). *Astacus* has been an important part of traditional Swedish culture since

Signal crayfish: *Pacifastacus leniusculus*



medieval times at least, in the form of the crayfish party or kräftskiva, a feast to mark the end of summer.

Being newly indigenous but non-endemic, the signal crayfish would seem fair game for exploitation and, indeed, like other incomers, cannot itself be directly protected by law in Britain. Famously, an enterprising individual set traps for the American crayfish in the Serpentine in Hyde Park and made a living out of it for a time.

But woe betide you if you now set traps in waters where the native species may or may not reside; the Environment Agency will come after you. This was the fate of Christopher Helmsley in 2010 when he was made to pay £4,000 in fines and costs by South Lakeland magistrates for capturing and eating around 40 of our native crayfish from the River Kent at Staveley near Kendal. Helmsley admitting killing the endangered native white-clawed crayfish and taking fish from inland water with an unlicensed trap. Passers-by alerted the Environment Agency who alerted the police.



white-clawed crayfish (native species)

Helmsley's claim that he thought that his catch were signal crayfish did not wash. In fact it is recognised that identification and separation of these species can even cause experts difficulties so he had a point. It was still against the local byelaw to set a crayfish trap, no matter what species was caught and against national law to kill or handle the native species even though he thought they were the non-indigenous variety.

The red swamp or Louisiana crayfish or crawfish (*Procambarus clarkii*), also known as the 'mudbag', has also come to our freshwaters

where it too is subject to crayfish fishing regulations. Three Polish men were convicted of fishing without a licence by Highbury Court magistrates in 2012 and fined £790 for taking this species from a pond on Hampstead Heath. The pond is said to contain over 5,000 of the invaders the parents of which were introduced 20 years ago.

The trapping of white-clawed crayfish is outlawed across the country, but the American varieties can be fished in some parts – but not in Cumbria. Authorisation, in the form of a licence from the Environment Agency, is always required.

Rules to follow when catching crayfish:

- Native (white-clawed) crayfish are a protected species. EA provide authorisations for people who catch them to monitor their populations. You must not trap them to eat or sell. Be aware it is illegal to handle them without a licence from Natural England or the Countryside Council for Wales.
- Catching non-native crayfish is only allowed in certain areas of the country, due to the risks to native crayfish. You are advised to speak to your local fisheries officer if you are not sure which species is in your area.
- You can fish for non-native crayfish, but only if you have written authorisation from EA and you attach the identity tags that they send you to your trap(s) or fishing instrument.
- Additional to EA's consent, you must also get permission from the landowner who owns the fishing rights for the pond or river.

This high level of protection of our native crayfish seems like a lost cause. The American species can even spread to new habitat by migrating overland on damp nights, so nowhere is safe from them. The invaders are so numerous now that a fisherman recently reported to *Shooting Times* catching over 100 of them in two traps at an undisclosed carp lake. *The Shooting Times* even urged, 'If

you can't beat 'em, eat 'em,' but omitted to flag up the regulations thereby encouraging readers to ignore the laws which, one must admit, do seem rather over-protective of the doomed native species.

The killer shrimp (*Dikerogammarus villosus*) and its fellow invader the demon shrimp (*D. haemobaphes*) have spread to much of Europe from the Black and Caspian Sea areas via the Danube, breaking out when the Rhine-Main-Danube canal opened in 1992. These amphipod crustaceans are similar to our native *Gammarus pulex*, typically found swimming on its side on lake and river beds where it feeds on organic detritus. The killer shrimp, however, is a much larger animal, reaching 3cm in length as against about 1cm for *G. pulex*. It takes live prey, including fish eggs and fry as well as various freshwater invertebrates. Like the fox, it is reported to kill without eating, hence the name and the threat.



Killer shrimp: Dikerogammarus villosus

After invading Germany, Netherlands, Belgium, France and Italy, the killer shrimp moved to Britain and was first discovered in Grafham Water, Cambridgeshire in September 2010 and later that year in Cardiff Bay and Eglwys Nunydd Reservoir near Port Talbot. It was found at Acle in the Norfolk Broads earlier this year (2013) and is thought to have spread to much of the Broads system. Its relative, the demon shrimp, was found in October 2012 in the River Severn at Tewksbury and also in the Kennet and Avon canal and has similar bad form.

These two invading shrimps are thought to be spreading from catchment to catchment in Britain by clinging to boats, launching trailers and trolleys and fishing equipment. So, unlike the spread of foreign crayfish, there is perhaps something we can and must do to limit the invasion.

The Broads Authority and Environment Agency have been promoting the 'Check, Clean, Dry' campaign. This advises river users to routinely check equipment, including boats, clothing and fishing gear that has been in contact with the water. They should wash it, return any organisms to the water they came from, and dry out equipment for at least 48 hours. Anglers are also asked not to use keep nets since shrimps tend to gather in them. Incidentally, live-baiting is now universally condemned and banned in the UK both on humane and environmental grounds.

Like those annoying notices on the M25 which urge us not to drive when tired but to take a rest when there is no lay-by or service station within 40 miles, the absence of water hoses at most launching sites is not going to help. Should we equip ourselves with pressure washers (12V ones are available) or will a bucket and brush be sufficient? I suspect the answer would be yes, get a pressure washer to rinse down the boat and all your gear before re-locating to a different catchment area. The efficacy of these voluntary measures remains to be seen as the offending beasts are small and love to wriggle into cracks and crannies. It only takes two to survive the wash down (or merely just one, as these amphipod shrimps are said to be parthenogenetic as well reproducing sexually) and the bridgehead is made. Allowing the boat and gear to dry out will be the key to success.

My final example invader which, as is the case of the scorpions of Sheerness, has been here in the UK for about 200 years, is the zebra mussel (*Dreissena*

polymorpha). Like the killer shrimp, the zebra mussel came to us from the Caspian and Black Sea via the River Danube but much earlier, in the early 1800s. It was first detected in Britain in 1820 in Cambridgeshire so has been here long enough for its long-term effects to be evaluated. These have not been severe. It began to invade Ireland as late as 1993. It has a similar habit to our marine mussel (*Mytilus edulis*) having byssal threads which attach it to any substratum in lakes and rivers where it pumps water through its gills extracting microscopic plankton from the river or lake water.

In Europe many species of birds and fish are capable of feeding on these invaders (including the signal crayfish which, it is said, can consume 6,000 of them in a year) but it successfully out-competes and replaces our native freshwater mussels wherever it occurs.



Zebra mussel: *Dreissena polymorpha*



Filter feeding by the zebra mussel can be very useful in waters suffering from man-made eutrophication. Algal blooms shade light from the river or lake bed thus limiting the growth of rooted weeds and consequently the invertebrates and fish which hide and feed amongst them. In extreme cases when the blooms are prolific, the decomposition of dead algae by bacteria will reduce the dissolved oxygen to such low

levels that aquatic animals die from suffocation and the water body becomes foul with the stench of rotting plant material. The ecosystem collapses; fish and their invertebrate prey disappear and what is left is an empty and lifeless body of water.

The zebra mussel will convert the light-blocking algae into its own flesh, effectively removing the adverse effects of agricultural run-off or sewage outfalls and cleaning the polluted water. It does this so effectively that their numbers can increase to nuisance levels and can clog the pipes and water intakes of pumping stations which provide cooling water for industry and electricity generation or drinking water. This has become an expensive problem in the Great Lakes of North America where they first appeared in 1988. They have spread to California and were detected there in 2010. It is estimated that the cost of removal from water intakes in the Great Lakes alone is between \$250 and \$500 million a year.

The zebra mussel can also swamp the spawning grounds of fish species which lay their eggs on lake or river beds such as the Arctic char (*Salvelinus alpinus*), the various Coregonus species of the UK – vendace, schelly, powan and gwyniad and also, potentially, trout (*Salmo trutta*) and Atlantic salmon (*Salmo salar*). Predation by birds in particular may be important in keeping their numbers down.

One may wonder how long a species has to have been here to be regarded as indigenous (which means 'living here', as opposed to endemic which means 'living only here') since all of our so-called native species were once invaders at some point in the distant past. One may distinguish between naturally indigenous and introduced indigenous. A good example would be the hare and the rabbit – the former came here naturally whereas the rabbit was introduced by the Romans. The rabbit is still regarded as a pest and illustrates the time it takes for

an ecosystem to become stabilised with the various species in some sort of balance.

Some species will always be pests of course – biologists distinguish between so-called ‘r-selected’ and ‘K-selected’ species (these algebraic labels refer to parameters in a simplistic formula describing population growth). The r-selected species have a life history which favours rapid reproduction and have big (pestulent) populations in the good times which are inevitably followed by dramatic crashes in population in the bad times (examples – locust and starling).

The life history of K-selected species favours slow reproduction and steady population sizes which fluctuate less dramatically and are adapted to survive through the bad times (examples – badgers and whales). The K-selected species are usually not regarded as pests unless they upset our farmers, like the European badger (*Meles meles*) has done in southwest Britain.

Our prehistoric native plants and animals in the UK were thrown into disarray by the ice ages and our presently indigenous biota became established following the most recent retreat of the ice.

This began 22,000 years ago and became stabilised in the current inter-glacial around 10,000 years BP. The newly uncovered land and bodies of fresh water became home to many invaders from the south, including ourselves (*Homo sapiens*).

The earlier invasions were natural, one supposes, and existing or earlier established species were pushed out or became adapted to their new neighbours. The most recent invasions have been largely man-induced and seem dramatic and disastrous. This is to some extent illusory and temporary. In the short term, species interaction will bring about another uneasy balance which includes the invader. In the longer term, natural selection will fine tune the balance and a stable ecosystem will prevail. Inevitably some of the existing denizens will suffer from the invasion and some will benefit.

My biological view is that we shouldn't get too hung up on the status quo or what seems to have always been. This is not to say that one doesn't regret the loss of vendace from Bassenthwaite Lake or fear the threat of the killer shrimp. We need to be equally concerned about the various plant invaders to freshwaters, which I

hope to write about in the next issue.

We should certainly attempt to control the spread of all of these aliens and to protect our most fragile and beautiful ecosystems such as the English Lakes.

When moving from catchment to catchment with your boat or fishing gear, remember to ‘Check, Clean, Dry’.

To preserve our sanity, we need to recognise that in many cases we can only limit and not absolutely prevent these invasions. *DH*

This is the first part of three articles on alien invaders of Britain – continuing in later issues with freshwater plants and then marine invaders.

It would be tedious for readers to be presented with a list of references here. This is not a scientific paper as it has not been peer-reviewed.

All of the source material can be found on the World Wide Web. The author would be pleased to hear of any errors or omissions in the text and can supply a full list of references and sources on request.

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(Below) a lurid but effective A5 flyer available from the Lakes' website

