



Briefing Paper

The Impact of Non-Native Species - Case Study: The Signal Crayfish

Non-native species of plants or animals can adversely affect the habitats they invade economically, environmentally and/or ecologically. Some experts believe the movement of exotic species is one of the greatest threats facing global biodiversity and ecosystem function (Mack *et al.*, 2000; Sala *et al.*, 2000; Pimentel *et al.*, 2001). There are many examples of significant plant, animal and microbial problems in the ecosystems of the UK and across the world, costing us millions of pounds to manage annually. In 2007, the Minister for Biodiversity stated that non-native invasive species cost Britain £2 billion every single year (Natural England, 2009).

In freshwater habitats, hundreds of species have been moved outside their native ranges both intentionally and inadvertently, by discharge of ballast waters and releases from aquaria, the horticultural and agricultural trades, in bait buckets and netting, and so forth. Fish and invertebrate species introduced either from overseas or beyond their natural distribution within the UK often pose significant threats to native populations of plants and animals. They predate, outcompete and displace native species from their preferred habitats. They can also spread parasites and introduce novel diseases, to which native populations have no natural immunity. Some invasive non-native species can also have indirect impacts on our native fisheries by influencing the ecosystems they invade. For example, invading primary consumers, such as molluscs, disrupt food-webs from the base, and aquatic plants affect the water quality and quantity of primary production, leading to changes in dissolved oxygen levels and thus impacting fish distributions. Introduced fish such as the topmouth gudgeon have devastating effects through not only rapid reproduction with multiple broods per year, but also by consuming the eggs and fry of native fish effectively eliminating recruitment to their populations.

Since, non-native species can cause diverse and generally far-reaching ecological imbalances within watercourses, controlling their spread and averting introductions of further new species is vital if we are to protect our native ecosystems and the many benefits they confer upon society.

It is widely believed that a stressed system is more susceptible to non-native species invasions, because the disturbance caused by other environmental stresses provides them with an opportunity to invade. The ecological implications of alien species in already stressed systems are not well understood, partly due to extensive lag times between the cause and effect and also magnitude of different variables which could be affected. Currently, under the Water Framework Directive, alien species cannot, on their own, be a reason for a water body to fail 'good ecological status'. This is not acceptable, as the presence of dominant alien species may indicate an already stressed ecosystem or one in which damage is consequently underway and, if dominant, automatically reflect a far from 'natural' condition.

The top ten 'high impact' non-native species, according to the Water Framework Directive Risk Assessment (Environment Agency, 2008), affecting water bodies have been identified as;

- Australian swamp stonecrop (*Crassula helmsii*)
- Floating pennywort (*Hydrocotyle ranunculoides*)
- Water Fern (*Azolla filiculoides*)

- Parrot's feather (*Myriophyllum aquaticum*)
- Common cord-grass (*Spartina anglica*)
- Japanese weed (*Sarassum muticum*)
- North American signal crayfish (*Pacifastacus leniusculus*)
- Zebra mussel (*Dreissena polymorpha*)
- Chinese mitten crab (*Eriocheir sinensis*)
- Slipper limpet (*Crepidula fornicata*)

However, the same report listed over 50 other non-native species, including freshwater molluscs, copepods and oligochaetes, although the probability of them becoming invasive was unknown. Further data are urgently required.

Case study: Signal crayfish

The signal crayfish (*Pacifastacus leniusculus*) is a North American species, which was introduced into southern Britain for cultivation in 1976 (Lowery and Holdich, 1988; Holdich and Reeve, 1991). The signal crayfish is an omnivorous species, feeding on both plant and animal foods (Guan and Wiles, 1998). Crayfish are ecosystem engineers, organism that create and/or modify habitats. Crayfish do this through clipping macrophytes with their chela, and burrowing through sediments (Lodge *et al.*, 1994; Angeler *et al.*, 2001).

The signal crayfish is a very widespread and invasive species in the UK, which has been shown to have many detrimental impacts on native flora and fauna (Holdich, 1988, 1999; Horwitz, 1990). The deleterious effects include;

- Displacement of the UK's only native freshwater crayfish the white-clawed crayfish (Eng and Daniels, 1982; Alderman *et al.*, 1990; Soderback, 1992; Lilley *et al.*, 1997). The distribution of the white-clawed crayfish has declined significantly since the 1980s and at current rates it is expected to face near extinction in the next 25 years (Bradley and Peay, *in press*), due to signal crayfish out-competing the white-clawed crayfish and also acting as a vector for the fungal disease 'crayfish plague' (Alderman *et al.*, 1990) that wipes out native crayfish populations.
- Shelter displacement of fish, including Atlantic salmon parr (*Salmo salar*), bullhead (*Cottus gobio*) and stone loach (*Bartatula barbatula*), thus increasing the susceptibility of excluded fish to predation, which can have deleterious effects on native fish populations (Griffiths *et al.*, 2004; Rahel and Stein, 1988; Guan and Wiles, 1997);
- Consumption of small fish (Guan and Wiles, 1998), fish fry (Rubin and Svensson, 1993) and fish eggs (Savino and Miller, 1991).
- Consumption (Axelsson *et al.*, 1997) and displacement (Nyström *et al.*, 2001) of amphibians;
- Consumption of invertebrates (Mason, 1975) and macrophytes (Mason, 1975; Nyström and Strand, 1996);
- Modification of aquatic habitats through extensive bank burrowing, resulting in greater bank erosion and stream shallowing (Guan, 1995; Holdich *et al.*, 1999) and contaminant liberation from the sediment; and
- Degradation of vegetative structure and associated habitats.

The white-clawed crayfish and the Atlantic salmon are both protected under the European Habitats Directive. The UK therefore has a responsibility and international commitment to reduce the impacts that human activities are currently having of the species, including the spread of signal crayfish.

Current management of signal crayfish and other non-native crayfish species in England and Wales

The import and trading of live crayfish currently enables the spread and release of non-native crayfish into the wild, aided by loopholes in the current legalisation. For example, it is legal to trade signal crayfish from 'go' areas (areas requiring no licensing for the keeping of signal crayfish) into 'no go' areas (areas requiring licensing for the keeping of signal crayfish); this facilitates the spread of signal crayfish into vulnerable areas.

Import

Under the Import of Live Fish Act (England and Wales) 1980 imports of live crayfish for human consumption with a licence are currently legal and the keeping of non-native crayfish is restricted. Import for aquaculture

purposes is also controlled by European legislation the EC Council Regulation 708/2007 and requires a licence for the import of live non-native species.

Trapping

A licence is needed under the Crayfish Trapping Byelaw, Environment Act 1991 (England and Wales) to trap any crayfish species. This Byelaw states that a person may place or use a trap in inland waters with a licence for the taking of non-native crayfish in the 'go areas' as stipulated under the Crayfish Order (see below). Trapping is only allowed under licence in the 'no go areas' for scientific, conservation or fisheries management purposes. This byelaw also makes it illegal to trap native crayfish from the wild without a licence. This is also illegal under Section 9 of the Wildlife and Countryside Act (WCA) 1981 and also controlled under the EU Habitats Directive.

Keeping of Non-native species

The Keeping of Live Fish (Crayfish) Order 1996, made under the Import of Live Fish Act (England and Wales) 1980 as amended, makes it an offence to keep any non-native species of crayfish in England and Wales without a licence. An exception was made for signal crayfish in certain parts of England and Wales where extensive feral populations already existed (these are termed 'go areas' and as oppose to 'no-go areas' and are listed in the Order). Parallel legislation applies in Scotland: the Import of Live Fish (Scotland) Act 1978 but without 'go' or 'no go' areas.

In England and Wales, a general licence was granted to authorise the keeping of non-native crayfish in fish markets, restaurants, markets and hotels for direct human consumption, although these animals still have to be held in secure conditions. This general licence is relevant if an establishment falls in one of the above categories, and so the proprietor will not need a specific licence although they do have to follow the procedures below:

- In the case of fish markets or fishmongers, the crayfish are intended for human consumption and are held on a short-term or temporary basis for imminent transfer;
- In the case of hotels, restaurants and individual persons, the crayfish are held for no other purpose than direct human consumption;
- The crayfish are held in securely in escape-proof containers at all times; and
- Crayfish which are not used are dead before disposal.

A general licence was also issued under this Order for the keeping of 'tropical' species for ornamental purposes in heated indoor aquaria. At present the Australian red-claw (*Cherax quadricarinatus*) is the only species recognised to be truly 'tropical'.

Farming

There were four registered crayfish farms in England and Wales in 2007. Crayfish farming was initially thought to be an effective way of diversifying farm businesses but this industry has not met expectations due to low production levels, a short harvesting season. Consequently, low and unreliable yields led almost all of the 200 registered farms to cease trading. Crayfish farms must now be authorised by the Fish Health Inspectorate at Cefas. Any new American signal farm in a 'go' area must have biosecurity standards to prevent the release or escape of crayfish, which is an offence under the WCA 1981 (as amended). Anyone wishing to farm signal crayfish in a 'no-go' area or any other non-native crayfish anywhere in England and Wales would have to establish a secure, indoor, intensive farm facility. Farming of such species in outdoor facilities would not be authorised.

Releasing Non-native Crayfish into the wild

Section 14 of the WCA 1981 (as amended) makes it an offence to release into the wild, except under licence, any animal that is 'of a kind which is not ordinarily resident in and is not a regular visitor to Great Britain in a wild state' or is included in Schedule 9. Currently Schedule 9 lists three non-native crayfish species, the American signal (*Pacifastacus leniusculus*), Turkish (*Astacus leptodactylus*) and the Noble (*Astacus astacus*) crayfish. The Nature Conservation (Scotland) Act 2004 also restricts the release of non-native crayfish in Scotland. Recently, Defra consulted on proposals to update Schedule 9.

Therefore you need a licence to introduce non-native crayfish into the wild in Britain. This applies in any area of open water, including any non-natural water body (e.g. a pond) even if it is not connected to another water body. As a result, it remains illegal to introduce signal crayfish into waters other than those from which it would be impossible for them to escape.

Under the Salmon and Freshwater Fisheries Act 1975 the movement of crayfish in England and Wales is regulated in a number of ways. In an attempt to reduce the spread of disease and live animals to unaffected waters, it has been made an offence to use any species of crayfish (alive or dead) as bait. Under Section 30 stocking consent is required to introduce native or non-native crayfish to inland waters other than fish farms.

Regulation, of course, established statutory positions, but there is widespread evidence of illegal 'seeding' of formerly uninfested river stretches with non-native crayfish, presumably by commercial operators. Enforcement remains problematic, but the potential for serious consequences should attract severe penalties in that the event that operators were caught.

Action Required

The Salmon and Trout Association and Buglife are very concerned about the impact signal crayfish are having on our native fish and invertebrate assemblages. We feel that the current legislation in England and Wales is not effective and is not successful at controlling the import and spread of the signal crayfish and other non-native crayfish, compromised still further by weak enforcement. Therefore, urgent action is required to address the increasing distribution and abundance of the crayfish, and to close the loopholes in current legislation. We urge the Government to:

- **Ban the import of live non-native crayfish.** Currently, live non-native crayfish import for aquaculture purposes is controlled in Europe by the EC Council Regulation 708/2007 and by the Import of Live Fish Act 1980 covering all harmful non-native species, both require permits for import. Although this legislation together with the Keeping of Live Fish (Crayfish) Order 1996 adequately controls aquaculture imports, imports for food consumption and ornamental trade are not as well covered. Also an importer can immediately sell the crayfish on to anyone, regardless of whether the customer receiving them may be breaking the law if they keep them without a licence or allow them to escape into the wild. This lack of control on imports after they reach the UK is likely to have resulted in the introduction of most of the recent non-native crayfish species that have established in England and Wales. Given that aquaculture production and the ornamental trade in UK is relatively small industry and that crayfish for consumption can be imported frozen, balanced against known high risks of new and existing species introduction, we feel that importation of live non-native crayfish should be banned outright.
- **Add all non-native crayfish species established in Great Britain to Schedule 9 of the WCA.** A number of non-native crayfish species that are now established in Great Britain are not listed on Schedule 9 of the WCA (prevents the release animal species already established in the wild), these include red swamp crayfish (*Procambarus clarkii*), the virile crayfish (*Orconectes virilis*), and the spiny checked crayfish (*Orconectes limosus*).
- **Abolish the current 'go' and 'no go' areas and require full licensing plus approved holding and transportation facilities for the keeping of live crayfish.** A licence would be required for the keeping of live crayfish for human consumption and for transportation. Licences should also cover facilities for crayfish to be used for scientific, conservation or fisheries management purposes. Like those developed for regulation 708/2007 for the European aquaculture trade, UK biosecurity standards need to be developed by stakeholders, and a statutory requirement made that standards for keeping, transportation and farming of crayfish should be adhere to as part of the licensing process. Licensing and approval of holding and transportation facilities would need to be renewed on a regular basis: every five years is recommended. Under the present Crayfish Order, there are no controls on signal crayfish in areas where they are widespread and there is currently no monitoring of stock that is moved from the 'go areas' allowing unregulated movement and spread.
- **No licensing of new crayfish farms and full licensing plus approved holdings for existing farms.** The threat to the environment posed by farms is huge and difficult to police and manage. Under the precautionary principle no new crayfish farms should be established and existing farms should be heavily regulated. Licences for existing farms would need to be renewed on a regular basis: every five years is recommended.
- **Ban the sale of all live crayfish species with the exception of sale for research purposes** through section 14ZA of the WCA and so abolish the current general licensing allowing individuals to hold non-native crayfish on the proviso that they are either destined for human consumption or

(for Australian red-claw only) for sale as ornamentals. This general licence allows the trade of live signal crayfish and other non-native crayfish from areas where they are widespread to vulnerable 'no go' areas, where they can be kept and sold for human consumption close to rivers, and into Scotland, where the keeping of live crayfish for human consumption is illegal. These activities increase the risk of their release into the wild. Crayfish could be marketed as fresh dead, frozen and processed, which would still maintain the marketability of crayfish, as the market already contains a large amount of imported processed crayfish. This should include the Australian red-claw as this is a hardier species than first thought and so there is a risk it could survive in British waters if it escaped or is introduced.

- **Monitor the trapping and keeping of crayfish** for the human consumption trade as well as scientific, conservation or fisheries management purposes. Despite the removal of animals from the wild being covered by the trapping bylaw and the WCA there is currently no mechanism in place to trace subsequent use of non-native crayfish trapped legally. More details need to be collected through the trapping and keeping licences (for example information when trapped crayfish are relocated and/or holding times) to control trapping and movement as well as allowing prosecutions.
- **Further research** is needed to understand and cost the full scale of the impact that non-native species, including crayfish, are having on ecosystems. Risk assessments that have been developed by Cefas need to be undertaken for all non-native crayfish and on the basis of results mitigation and/or eradication is urgently needed to reduce impacts. Whilst direct benefits to commercial crayfish farmers and trappers are easy to monetise, no parallel assessment has been made of the costs to wider society of the consequences of ecological damage. An assessment based on ecosystem services is recommended to set these private versus public benefits in context as a basis for rational regulation and application of common law remedies.

Conclusions

Non-native crayfish and other non-native species have the potential to greatly alter native freshwater communities and habitats through predation, bioturbation, mechanical destruction, competition and a range of other routes, at great ecological and economic cost. Current legalisation is inadequate to stop the spread and import of non-species, such as non-native crayfish. Therefore, changes are urgently needed to tighten the current regulations in order to reduce the impacts of non-native species. There is a real opportunity with non-native crayfish to set a precedent on how to manage non-native species but, in order to achieve this, strategic leadership and action is required immediately.

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