Information about GB Non-native Species Risk Assessments

The Convention on Biological Diversity (CBD) emphasises the need for a precautionary approach towards non-native species where there is often a lack of firm scientific evidence. It also strongly promotes the use of good quality risk assessment to help underpin this approach. The GB risk analysis mechanism has been developed to help facilitate such an approach in Great Britain. It complies with the CBD and reflects standards used by other schemes such as the Intergovernmental Panel on Climate Change, European Plant Protection Organisation and European Food Safety Authority to ensure good practice.

Risk assessments, along with other information, are used to help support decision making in Great Britain. They do not in themselves determine government policy.

The Non-native Species Secretariat (NNSS) manages the risk analysis process on behalf of the GB Programme Board for Non-native Species. Risk assessments are carried out by independent experts from a range of organisations. As part of the risk analysis process risk assessments are:

- Completed using a consistent risk assessment template to ensure that the full range of issues recognised in international standards are addressed.
- Drafted by an independent expert on the species and peer reviewed by a different expert.
- Approved by an independent risk analysis panel (known as the Non-native Species Risk Analysis Panel or NNRAP) only when they are satisfied the assessment is fit-for-purpose.
- Approved for publication by the GB Programme Board for Non-native Species.
- Placed on the GB Non-native Species Secretariat (NNSS) website for a three month period of public comment.
- Finalised by the risk assessor to the satisfaction of the NNRAP.

To find out more about the risk analysis mechanism go to: www.nonnativespecies.org

Common misconceptions about risk assessments

To address a number of common misconceptions about non-native species risk assessments, the following points should be noted:

- Risk assessments consider only the risks posed by a species. They do not consider the practicalities, impacts or other issues relating to the management of the species. They therefore cannot on their own be used to determine what, if any, management response should be undertaken.
- Risk assessments are about negative impacts and are not meant to consider positive impacts that may also occur. The positive impacts would be considered as part of an overall policy decision.
- Risk assessments are advisory and therefore part of the suite of information on which policy decisions are based.
- Completed risk assessments are not final and absolute. Substantive new scientific evidence may prompt a re-evaluation of the risks and/or a change of policy.

Period for comment

Draft risk assessments are available for a period of three months from the date of posting on the NNSS website*. During this time stakeholders are invited to comment on the scientific evidence which underpins the assessments or provide information on other relevant evidence or research that may be available. Relevant comments are collated by the NNSS and sent to the risk assessor. The assessor reviews the comments and, if necessary, amends the risk assessment. The final risk assessment is then checked and approved by the NNRAP.

*risk assessments are posted online at: https://secure.fera.defra.gov.uk/nonnativespecies/index.cfm?sectionid=51

comments should be emailed to nnss@fera.gsi.gov.uk

GB NON-NATIVE ORGANISM RISK ASSESSMENT SCHEME
For more information visit: www.nonnativespecies.org

Name of Organism:	***Orconectes virilis*, Virile Crayfish**
Objectives:	Assess the risks associated with this species in GB.
Version:	First published on the NNSS website: 03/09/13
Author:	David Rogers and Elizabeth Watson
Suggested citation:	Rogers, D. and Watson, E. (2013). GB Non-native Organism Risk Assessment for *Orconectes virilis*. www.nonnativespecies.org

Stage 1: Initiation

1 - What is the principal reason for performing the Risk Assessment? (Include any other reasons as comments)

An established infestation has been discovered in the RA area

Comments:

Orconectes virilis has been shown to be an invasive species that could spread in the Risk Assessment Area. It was found in the River Lee catchment in 2004 and has since successfully colonized the River Lee Navigation between Ramney Marsh Lock and Tottenham Lock. It is also present in the Small River Lee, Turkey Brook, still waters and in a number of connecting ditches (Ellis 2009).

2 - What is the Risk Assessment Area?

GB

Comments:

O. virilis is currently only known to be present in the River Lee catchment near London, England.

3 - What is the name of the organism? **This will appear as a heading** (Other names used for the organism can be entered in the comments box)

Orconectes virilis (Hagen, 1870)

Comments:

Virile crayfish

Northern crayfish

4 - What is the status of any earlier Risk Assessment?

Partial

5 - Give details of any earlier Risk Assessment(s)

Tricarico E, Vilizzi L, Gherardi F, Copp GH. (2010) Calibration of FI-ISK, an Invasiveness Screening Tool for Nonnative Freshwater Invertebrates. Risk Analysis, Vol 30, No 2, 285-292.

Stage 2a: Organism Risk Assessment

6 - If you are sure that the organism clearly presents a risk, or that in any case a full Risk Assessment is required, you can omit this section and proceed directly to the Section B.

Go to the main Risk Assessment, SECTION 2B

Stage 2b: Pathways

20 - How many pathways are relevant to the potential entry of this organism?
Very few

21 - Please list the broad pathways through which the organism could be carried (one per line).
Aquarium trade
Comments:
There are two pathways by which *O. virilis* could have entered GB, 1. Via the aquarium trade, 2. Via the food market, however it is locally reported that the only population in GB was the result of disposal from an aquarium collection (Ellis 2009).
There are no known records of *O. virilis* being sold as food or eaten in GB and although they are considered to have table market potential, they are not marketed in North America at present; test marketing in Europe did not meet with any success because of their small size (Souty-Grosset et al. 2006). Although *O. virilis* is commonly used as bait and sold in bait shops in North America (ISSG 2010), this is not a likely route for entry to GB.

22 - Please select the pathway:
Aquarium trade
Comments:

PATHWAY – AQUARIUM TRADE

23 - How likely is it that the organism is strongly associated with the pathway at the point(s) of origin?
likely
Level of confidence: very high
Comments:
It is locally reported that the populations in the River Lee catchment is the result of a local resident disposing of his aquarium stock, although under the Prohibition of Keeping Live Fish (Crayfish) Order 1996, it is illegal to keep this species.

24 - How likely is it that large numbers of the organism will travel along this pathway from the point(s) of origin?
unlikely
Level of confidence: very high
Comments:
At present it is unlikely that large numbers of crayfish will be moved by this pathway as it is illegal, however, if one berried female (which can produce up to 707 eggs (ANSIS 2007)) is introduced a breeding population could quickly become established.

25 - How likely is the organism to survive during transport or storage within the pathway?
very likely
Level of confidence: very high
Comments:
It is likely that if an aquarist goes to the trouble of disposing of his stock in the wild it is likely that he will ensure their survival during transport. *O virilis* is tolerant of a wide range of physio-chemical parameters (Souty-Grosset *et al.* 2006)and therefore likely to survive conditions during transport.

26 - How likely is the organism to enter the Risk Assessment Area undetected?
very likely
Level of confidence: very high

27 - How likely is the organism to multiply/increase in prevalence during transport /storage?
very unlikely
Level of confidence: very high
Comments:
O. virilis is unlikely to complete its life cycle during transport/storage but if a female is being transported it may lose some of its juveniles thus increasing the number of independent crayfish.

28 - How likely is the organism to survive existing management practices within the pathway?

very unlikely

Level of confidence: high

Comments:

Existing legislation should prevent illegal keeping (Prohibition of Keeping of live fish (crayfish) order 1996) but the situation regarding introduction to the wild is anomalous at present. It is illegal to introduce non-native crayfish to the wild under the Wildlife and Countryside Act 1981 (WCA) except if they are "normally resident". At first in the 1980s, *O. virilis* was not "normally resident" hence the introductions would have been illegal but at present, *O. virilis* could be considered "normally resident" hence it would not be illegal to introduce it to the wild. If *O virilis* was included on Schedule 9 of the WCA (prevents the release of species already "normally resident") the situation would be reversed and it would be illegal again to release it.

29 - How likely is the organism to arrive during the months of the year most appropriate for establishment?

likely

Level of confidence: high

Comments:

This pathway can lead to an introduction at any time of the year and the crayfish will very likely survive allowing the population to breed (in season) and become established.

30 - How likely is the organism to be able to transfer from the pathway to a suitable habitat or host?

moderately likley

Level of confidence: high

Comments:

When disposing of *O. virilis* in this way, the aquarist is likely to select a suitable habitat of which there are many within the Risk Assessment Area.

31 - Do other pathways need to be considered?

No

END LEVEL

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32 - Please estimate the overall likelihood of entry into the Risk Assessment Area for this organism (please comment on the key issues that lead to this conclusion).

likely

Level of confidence: high

Comments:

Orconectes virilis appears to have been introduced into the River Lee catchment by the aquarist trade and has become established and as this has occurred once, despite legislation it could happen again.

Establishment

33 - How likely is it that the climatic conditions that would affect establishment in the Risk Assessment Area are similar to those in the area of the organism's current distribution?

very likely

Level of confidence: high

Comments:

O virilis occurs naturally in many regions of the USA and Canada and has also been introduced into other regions in North America and into Chihuahua, Mexico (Hamr 2002). It is able to survive severe winters in its home range. In Europe it has become established at one site in the Netherlands and is beginning to spread (Pockl *et al* 2006)and is now established in one area of the River Lee catchment in England (Ahern 2008). *O. virilis* could colonise any suitable lowland river, pond or lake in GB without difficulty.

34 - How likely are other abiotic factors that would affect establishment in the Risk Assessment Area and in the area of current distribution to be similar?

very likely

Level of confidence: very high

Comments:

O. virilis occurs in lakes, watercourses and wetlands in both North America and Europe (Netherlands and GB).

35 - How many species or suitable habitats vital for the survival, development and multiplication of the organism species are present in the Risk Assessment Area? Please specify in the comment box the species or habitats.

very many

Level of confidence: very high

Comments:

O. virilis can be found in permanent water bodies which are deep enough not to freeze solid and do not experience low oxygen levels. It requires shelter in the form of rocks, logs or thick vegetation in which to hide from predators during daylight hours (NBII 2010). Therefore many freshwater habitat in GB could be invaded by *O. virilis.* It's survival would depend on availability of food but as they are opportunistic omnivores, consuming whatever they can catch, food is not likely to be a problem.

36 - How widespread are the species or suitable habitats necessary for the survival, development and multiplication of the organism in the Risk Assessment Area?

ubiquitous

Level of confidence: very high

Comments:

Suitable habitats are widespread throughout the Risk Assessment Area, see above.

37 - If the organism requires another species for critical stages in its life cycle then how likely is the organism to become associated with such species in the Risk Assessment Area?

N/A

Level of confidence: very high

38 - How likely is it that establishment will occur despite competition from existing species in the Risk Assessment Area?

likely

Level of confidence: medium

Comments:

There is little competition to *O. virilis* from native fauna, however other non-native species such as *Pacifastacus leniusculus* or *Eriocheir sinensis* may out-compete it. *O. virilis* is presently being displaced by introduced *Orconectes rusticus* (not present in Europe) in many areas of Ontario, Wisconsin, Illinois and Minnesota and by *Orconectes limosus* (widespread in Europe) in the St Lawrence River in Quebec (Souty-Grosset et al. 2006).

39 - How likely is it that establishment will occur despite predators, parasites or pathogens already present in

the Risk Assessment Area?

very likely

Level of confidence: high

Comments:

The main predator of *O. virilis* are reported to be fish (Souty-Grosset *et al* 2006) but birds are also likely to be predators. No major disease problems have been reported for this species and it has been shown to be highly resistant to crayfish plague although it is likely to be carrying it.

40 - How likley are management practices in the Risk Assessment Area to favour establishment?

likely

Level of confidence: high

41 - How likely is it that existing control or management measures will fail to prevent establishment of the organism?

very likely

Level of confidence: high

Comments:

Although management practices including legislation are designed to prevent spread and establishment they are difficult to enforce and have little effect (Holdich & Pockl 2005).

42 - How likely is it that the organism could survive eradication campaigns in the Risk Assessment Area?

very likely

Level of confidence: very high

Comments:

At present there is no eradication method for any species of non-native crayfish in the Risk Assessment Area. Peay *et al.* (2006) has shown that eradication of non-native crayfish may be possible using a biocide in small enclosed waters. At present and in the foreseeable future, the use of biocides is strictly limited to the use of Pyblast in isolated waters. Trials have indicated that although the use of biocides may be effective in killing nuisance populations of crayfish, the nature of the chemicals required, the high costs and the adverse effects on human health and the environment make this method of control/eradication unsuitable for virtually all sites in GB (Rogers & Watson *in prep.*).

43 - How likely is the establishment to be aided by the biological characteristics of the species?

likely

Level of confidence: high

Comments:

O. virilis undergoes cyclic dimorphism with sexually active F1 individuals and non-breeding F11 individuals occurring at different times of the year. Sperm from the autumn mating can be stored until spring (Souty-Grosset *et al* 2006). Up to 490 eggs can be produced and juveniles mature within the first or second year. The life span is up to 4 years.

44 - How likely is establishment to be facilitated by the organisms capacity to spread?

likely

Level of confidence: high

Comments:

Spread of *O. virilis* in the Netherlands suggest a dispersal rate of more than 2 km per year (Ahern *et al* 2008). Although it is thought to only have been there for a few years it is known from a number of waters some as far as 20 km away from the original introduction (Souty-Grosset *et al* 2006). In the River Lee catchment a dispersal rate of more than 2 km per year was recorded by Ahern in 2008

45 - How likely is the organism to adapt to a changing environment?

moderately likely

Level of confidence: medium

Comments:

O. virilis is tolerant of a wide range of physico-chemical parameters; it does not adapt to severely cold weather and only mature adults avoid the cold by migrating to deeper water if present (Aikin 1968).

46 - How likely is it that small, relatively genetically homogeneous populations could become established?
likely
Level of confidence: medium
Comments:
Tested GB and Dutch individuals did not belong to any mitochondrial lineage recorded in North America but formed a separate clade, the original distribution area of which is unknown. Sequenced *O. virilis* from Iowa (USA) also represented a new clade suggesting that undiscovered lineage variation within *O. virilis* remains high (Fillipova et al 2009).

47 - How likely is the organism to be recorded in protected conditions (such as glasshouses, aquaculture facilities, terraria, zoological gardens) in the Risk Assessment Area?
very unlikely
Level of confidence: high

48 - How likely is it that the organism has established in new areas outside its original area of distribution within the past five years? (If possible, specify the instances in the comments box)
very likely
Level of confidence: very high
Comments:
Although *O. virilis* is thought to only have been present in the Netherlands for a few years it is known from a number of waters, some as far as 20 km away from the original introduction (Souty-Grosset *et al* 2006). Similarly in GB a release to a small pond adjacent to the Small River Lee is now established in the River Lee Navigation (Ellis 2009).

49 - If the organism does not establish, then how likely is it that transient populations will continue to occur?
unlikely
Level of confidence: high

50 - Please estimate the overall likelihood of establishment (mention any key issues in the comment box)
very likely
Level of confidence: very high
Comments:
O. virilis can occupy most water quality conditions and habitats found in GB and has a high reproduction rate (females carry 28 to 707 eggs with an average of 347 (ANSIS 2007)).

Spread

51 - How rapidly is the organism liable to spread in the Risk Assessment Area by natural means? (The scoring is on a log scale below)

high

Level of confidence: medium

Comments:

Once *O. virilis* gets into a system of connected water bodies then it is likely to spread rapidly. In the River Lee catchment a dispersal rate of more than 2 km per year was recorded by Ahern in 2008. First recorded in the Netherlands in 2004 it is now known from numerous sites and had colonized several hundred kilometres of waterways by 2006 (Holdich *et al* 2009) .

52 - How rapidly is the organism liable to spread in the Risk Assessment Area by human assistance? (The scoring is on a log scale below)

moderately

Level of confidence: low

Comments:

Angling and trapping occurs at sites in the River Lee catchment where *O. virilis* is present, therefore it may come into the hands of the public or anglers but it is difficult to predict the spread because one or a few individuals could transport crayfish over several hundreds of kilometres for introduction.

53 - Within the Risk Assessment Area, how difficult would it be to contain the organism? (The scoring is on a log scale below)

very difficult

Level of confidence: high

Comments:

Containment would be impossible now as *O. virilis* has already spread to the open water system of the River Lee.

54 - Based on the answers to questions on the potential for establishment and spread in the Risk Assessment Area, define the area endangered by the organism.

Almost all the Risk Assessment Area

Comments:

Spread and establishment would be possible in most water bodies in GB

55 - Please estimate overall potential for spread (using the comment box to indicate any key issues). (The scoring is on a log scale below)

moderately

Level of confidence: medium

Comments:

Spread throughout the River Lee catchment is inevitable and movement to other (non-contiguous) river catchments depends on the degree of human influence, therefore there is great potential for it to spread over a wide geographical range

Impacts

56 - How great is the economic loss caused by the organism within its existing geographic range, including the cost of any current management?

low

Level of confidence: high

Comments:

There is no reported economic loss caused by *O. virilis* in N. America.

57 - Considering the ecological conditions in the Risk Assessment Area, how serious is the direct negative economic effect of the organism likely to be, for example on crop yield and/or quality, livestock or fish health and production? (describe in the comment box)

low

Level of confidence: high

Comments:

At the present time there is no economic loss in GB. It is likely that at the present time *O. virilis* occupies less than 50 ha of lentic and lotic waters in GB. As there is no recent tradition for eating crayfish in GB, and there is only a small industry based on wild and cultivated crayfish (*Pacifastacus leniusculus* and *Astacus leptodactylus* - both non-native species), then *O. virilis* is unlikely to have much of an effect on this. It could in theory compete for resources with *P. leniusculus* and *A. leptodactylus* and become the dominant crayfish if mixed populations develop (none are known at present), but unlike them it is not likely to be saleable in fish markets.

In addition, as a vector of crayfish plague it could eliminate *A. leptodactylus* in mixed populations, as the latter is susceptible to the disease. The same effect could happen if it enters water courses where the native *Austropotamobius pallipes* occurs, but this only has conservation value, as it is not harvested.

O. virilis can reach large numbers due to its high reproductive rate (Ellis 2009) so it is likely to impact on the freshwater environment. It will consume large quantities of many types of food and could have an impact on the food chain as has happened during invasions by related North American crayfish such as *Orconectes rusticus* into new areas of North America (Olsen *et al* .,1991; Olden *et al* ., 2006) and *Procambarus clarkii* in continental Europe (Geiger *et al.* , 2005; Rodriguez *et al* ., 2005).

58 - How great a loss in producer profits, production costs, yields, etc, is the organism likely to cause in the Risk Assessment Area?

minimal

Level of confidence: high

Comments:

It is likely to have only a minor impact (if any) on producer profits of other species of crayfish. It may influence the trophic structure of some water bodies, but this might not be entirely negative as it may subsidise the food web for peleagic and benthic animals, as well as some land and aerial predators. If large populations build up then they may impact on angling activities and may reduce recruitment of some species of fish by eating their eggs and reducing cover

59 - How great a reduction in consumer demand is the organism likely to cause in the Risk Assessment Area?

minimal

Level of confidence: high

Comments:

There is a growing demand for crayfish for human consumption in GB which is satisfied by imports, therefore there unlikely to be a negative impact. Nuisance from crayfish taking bait in coarse fisheries may reduce the value of some recreational fisheries, as has happened with signal crayfish. Anglers may move away from fishing waters if they are 'contaminated' with crayfish and so reduce their value to the owner (Peay & Hiley, 2004).

60 - How significant might the losses in export markets be due to the presence of the organism in the Risk Assessment Area?

minimal

Level of confidence: high

Comments:
There is virtually no crayfish export market at present.

61 - How important might other economic costs be resulting from introduction of the organism? (specify in the comment box)
May dig burrows and thus have flood defence costs but this has not been assessed.

62 - How important is environmental harm caused by the organism within its existing geographic range under any current management regime?
minimal
Level of confidence: high
Comments:
It is known to have a marked impact on the abundance and biomass of aquatic macrophytes (Chambers et al. 1990) (including rice seeds and seedlings) and macro invertebrates thereby altering the river ecosystem; its burrowing activities may cause disruption to irrigation networks in the US. It is thought also thought to be having a negative effect on the freshwater environment in the Netherlands (Holdich 2009). At present there is no recorded environmental harm in the river Lee system (Ellis 2009) although as populations expand adverse effects are likely to be found.

63 - How important is environmental harm likely to be in the Risk Assessment Area taking into account any management interventions that might be implemented?
major
Level of confidence: high
Comments:
If *O. virilis* spreads either naturally or by human assistance it is likely to become established in any suitable water body. Under suitable conditions it will quickly build up its numbers and have an initial impact on the freshwater environment and its biota (Chambers et al. 1990, Hanson et al. 1990), including cover, slow-moving macro-invertebrates, fish spawning sites and benthic fish such as bullheads
The introduction of *O. virilis*, into water bodies where they do not occur could have a major effect on the structure and composition of the littoral zone (Chambers et al. 1990) due to its ability to modify aquatic macrophytes, macroinvertebrate and ultimately fish communities.
If it enters waters with the native crayfish or the introduced narrow-clawed crayfish it is likely to out compete them and may kill them through the transmission of crayfish plague because like all other North American crayfish, it has to be assumed that *O. virilis* is a carrier of crayfish plague (Souty-Grosset et al. 2006, OIE 2009).

64 - How important is social, health or other harm (not directly included in economic and environmental categories) caused by the organism within its existing geographic range under any current management regime?
minimal
Level of confidence: high
Comments:
O. virilis does not appear to have caused much social or other harm.

65 - How important is the social, health or other harm likely to be in the Risk Assessment Area taking into account any management interventions that might be implemented?
minimal
Level of confidence: high
Comments:
If it spreads then the main impact will be on other crayfish species due to competition and the spread of crayfish plague and on anglers due to the large numbers of crayfish interfering with angling, e.g. eating bait.

66 - How likely is it that genetic traits of the organism could be carried to native species, modifying their genetic nature and making their economic, environmental or social effects more serious?
very unlikely
Level of confidence: high
Comments:
Austropotamobius pallipes is in the family Astacidae whilst O. virilis is in the family Cambaridae. There are no reports

of cambarid crayfish cross mating with astacid crayfish, although they do with other cambarid crayfish (Lodge *et al* ., 2000).

67 - How likely is it that the organism will not be kept under control by other organisms, such as predators, parasites or pathogens, that may already be present in the Risk Assessment Area?

very likely

Level of confidence: high

Comments:

Although natural enemies such as fish and birds are present they will have little impact on controlling the population.

68 - How difficult is it likely to be to control the organism in the the Risk Assessment Area?

very difficult

Level of confidence: very high

Comments:

At present there is no easy way to control any non-native crayfish populations (Rogers & Watson 2010).

69 - How likely are control measures introduced for this new organism to disrupt existing biological or integrated systems used to control other organisms in the Risk Assessment Area?

very unlikely

Level of confidence: high

Comments:

At present there is no easy way to control any non-native crayfish populations (Rogers & Watson 2010) so there are no control measures anticipated.

70 - How likely is the organism to act as food, a host, a symbiont or a vector for other damaging organisms?

likely

Level of confidence: high

Comments:

An expanding population of *O. virilis* would be of benefit to some damaging species, e.g. mink and cormorants. It could also act as a host to *Aphanomyces astaci* which may cause crayfish plague to be transmitted to susceptible species.

71 - Indicate any parts of the Risk Assessment Area where economic, environmental and social impacts are particularly likely to occur.

Parts of northern England where there are strongholds of native crayfish.

Comments:

In areas where native crayfish occur, i.e. mainly central and northern parts of England and Wales (Rogers & Watson 2010). Also, any body of water used for angling in GB could be affected, as has happened with signal crayfish, but most likely in lowland areas.

72 - Overall impact rating (please comment on the main reasons for this rating)

high

Level of confidence: high

Comments:

Many of the watercourses that would potentially be colonised by *O. virilis* will already be thoroughly invaded by *Pacifastacus leniusculus*. The type of direct and indirect impacts on the aquatic ecosystems will be similar if *O. virilis* displaces *Pacifastacus leniusculus* in parts of the range. It can occur in deep water, down to 10m (Souty-Grosset et al.2006), and may construct extensive burrow networks in the banks of rivers (Hamr 2002). It has been shown to have a significantly high impact on the abundance and biomass of aquatic macrophytes and macro invertebrates (Chambers et al. 1990, Hanson et al. 1990)

Conclusion

73 – Conclusion of the risk assessment
medium
Level of confidence: high

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