Rusty Crayfish *(Orconectes rusticus)*

- Medium sized crayfish from North America.
- Not yet present in GB, one population in Europe.
- Impacts likely to be greater than other crayfish species.
- Potential impacts on native crayfish, other invertebrates and aquatic plants if becomes established.
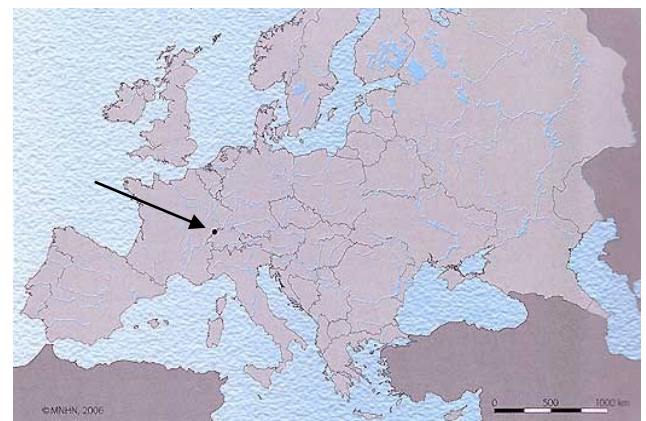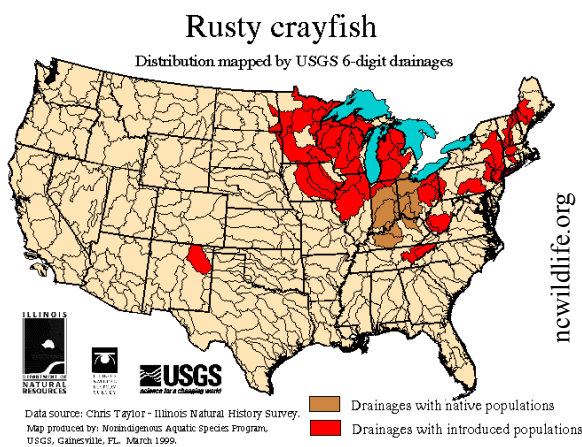
History in GB

Not yet present in GB (possession of this species as an ornamental is illegal). Could occupy most freshwater habitats across England, Scotland and Wales.

Native distribution

North America – Ohio river basin in eastern US.

Rusty crayfish
Distribution mapped by USGS 6-digit drainages

ncwildlife.org

Data source: Chris Taylor - Illinois Natural History Survey.
Map produced by: Nonindigenous Aquatic Species Program,
USGS, Gainesville, FL. March 1999.

Drainages with native populations
Drainages with introduced populations

Distribution in Europe

One location in France.

©MNHN, 2006

Source: Atlas of Crayfish in Europe 2006

Impacts

One of the most invasive crayfish known. Out-competes other crayfish, though not tested against Signal.

Environmental (major)
- Outcompetes other crayfish of similar size, probable vector of crayfish plague.
- Reduction in invertebrate and aquatic plant abundance.

Economic (minor)
- Potentially would impact game fisheries but effect likely to be limited compared to other crayfish (mainly signal).

Social (minimal)
- Potential impact on angling (see economic impact).

Introduction pathway

Aquarists trade (unlikely) - possession of this species is illegal although it has been introduced by this pathway in Europe

Spread pathways

Natural (rapid) - up to 3.7km per year.

Human (intermediate) - could be spread by anglers/ members of the general public; spread in America by anglers who use it for bait.

Summary

	Risk	Confidence
Entry	LIKELY	HIGH
Establishment	VERY LIKELY	HIGH
Spread	RAPID	HIGH
Impacts	MAJOR	HIGH
Conclusion	MEDIUM	HIGH

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@apha.gsi.gov.uk

GB NON-NATIVE ORGANISM RISK ASSESSMENT SCHEME

For more information visit: www.nonnativespecies.org

Name of Organism:	***Orconectes rusticus,* Rusty Crayfish**
Objectives:	Assess the risks associated with this species in GB.
Version:	Final (April 2016) – Draft 5 (24/07/13), Draft 3 (28/02/2011), Original draft 26/09/11; signed off by NNRAP June 2011; approved by GB Programme Board March 2015; published on NNSS website September 2015.
Author:	David Rogers and Elizabeth Watson

Stage 1: Initiation

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

The organism has been identified as a risk by scientific research

Comments: *Orconectes rusticus* is one of the most invasive crayfish species known (Souty-Grosset 2009). It is not present in GB but if it became established,it is very likely to impact heavily on all crayfish species (native and non-native) present and the aquatic ecosystems

2 - What is the Risk Assessment Area?

GB

Comments: All water bodies in GB

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 rusticus (Girard, 1852)

Comments: Rusty 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.

Tricarico et al. 2010 based their assessment on published information. *Procambarus clarkii* and *Pacifastacus leniusculus* were the species with the highest risk score because they are the most imported crayfish species into Europe for aquaculture purposes and their life cycle and impacts are the most studies and they are known to be particularly invasive. The third highest scorer, *Orconectes limosus*, is widely distributed in central Europe and is also known to have caused high impacts (but there is slightly less known about this species that Pc or Pl) but as Or is not established in Europe, there are no reports on its impact in Europe hence the lower score. This does not mean that if *O. rusticus* becomes established in GB that their impact will be less than P. leniusculus or the other species mentioned above.

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

Comments: As *O. rusticus* is not present in GB or Europe there is only one likely pathway for entry to GB from afar, the aquarist trade (although a similar species *Orconectes juvenilis* appears to have been introduced into France on one occasion for the Food market)

21 - Please list the broad pathways through which the organism could be carried (one per line).

Aquarist trade

Comments: There are more pathways for other Orconectes species which are present in Europe (including 2 Orconectes species in GB), e.g. Food trade and the public especially anglers, but as *O.rusticus* is not present in Europe (except in the aquaria) or GB the possible pathways are very limited. However one has to consider imports from its distribution in North America and that it is present in the aquarist trade (Souty-Grosset 2006).

22 - Please select the pathway:

Aquarist trade

Comments: This is the only likely pathway for entry to GB (although a similar species, *Orconectes juvenilis,* appears to have been introduced pre 2005 to France for the food trade (Chucholl and Daudy 2008) on one occasion).

PATHWAY – AQUARIST TRADE

23 - How likely is it that the organism is strongly associated with the pathway at the point(s) of origin?

very unlikely

Level of confidence: very high

Comments: Under the Keeping of Live Fish (Crayfish) Order 1996, it is illegal for an aquarist to keep any freshwater crayfish species except *Cherax quadricarinatus* (Red claw originating in Australia) therefore this should be the only species selected for entry to GB at the origin. However illegal or inadvertent selections may occur.

24 - How likely is it that large numbers of the organism will travel along this pathway from the point(s) of origin?

very unlikely

Level of confidence: very high

Comments: Due to the illegality of keeping *O. rusticus* in GB there should be no organisms traveling along the pathway.

25 - How likely is the organism to survive during transport or storage within the pathway?

very likely

Level of confidence: very high

Comments: *O. rusticus* is as robust as many other organisms transported by the aquarist trade and should easily survive transport.

26 - How likely is the organism to enter the Risk Assessment Area undetected?

unlikely

Level of confidence: medium

Comments: *O. rusticus* should be picked up at border entry to GB by the Border Inspection Post (BIP). If however it entered the aquarist market/community in GB, detection of aquarist disposing of their unwanted stock to the wild becomes less likely.

27 - How likely is the organism to multiply/increase in prevalence during transport /storage?

very unlikely

Level of confidence: high

Comments: The transport and storage period is not normally long enough for complete reproduction although juveniles may become detached from females increasing the number of independent individuals.

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

very unlikely

Level of confidence: high

Comments: If the organism is detected by BIP it will be sent to Cefas for identification and destroyed. If it is

not detected, it may pass to the aquarist trade in GB hence eventually could be releases to the Risk Assessment area..

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

moderately likely

Level of confidence: high

Comments: The month of year for establishment is not so important because even if *O. rusticus* enters when it is not the month appropriate for establishment, it is likely to survive in the Risk Assessment area until it can establish and only one crayfish may be required to start the population because female *O. rusticus* store sperm, mating in the winter (between late summer and early spring) and holding the sperm until the eggs are released in late spring (Gunderson 2008).

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

very likely

Level of confidence: very high

Comments: There appear to be few constraints on the ultimate range of *O. rusticus* (Hamr 2002). *O. rusticus* could survive in most areas of most lowland rivers and other water bodies in GB and would seek out its niche. Only one crayfish may be required to start a new population because female *O. rusticus* can store sperm (Gunderson 2008).

31 - Do other pathways need to be considered?

No

END LEVEL

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: The only pathway of entry is illegally via the aquarium trade and this species should be detected and destroyed at import. It is illegal to keep *O rusticus* in GB without a licence (Keeping of Live Fish (Crayfish) Order 1996) and illegal to release it to the wild (Wildlife and Countryside Act 1981) hence the likelihood of entry is very low. However as *Orconectes virilis* and *Orconectes limosus* have reached the Risk Assessment area (GB) O rusticus could do the same. The main pathway that has led to spread in North America is its use as bait for angling but as there are no established populations in GB this potential for range expansion does not exist at present (Phillips et al. 2009)

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: very high

Comments: *Orconectes rusticus* is noted as having few constraints on its geographical range (Hamr 2002), it has a higher metabolic rate and greater appetite than other crayfish so availability of food may eventually limit the range of populations; as a temperate species it is most active in temperatures above 6-8 Centigrade and will be restricted by sub arctic and sub tropical zones. Water ranging pH 5.4-6.1 can be lethal to juveniles (Souty-Grosset 2006).

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: *Orconectes rusticus* is noted as having few constraints on its range (Hamr 2002, Souty-Grosset 2006); it also has superior streamlining and station holding capability enabling it to colonise upstream portions of even fast flowing rivers (Hamr 2002)

35 - How many species or suitable habitats vital for the survival, development and multiplication of the organism 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: *Orconectes rusticus* is noted as having few constraints on its geographical range (Hamr 2002), therefore there will be adequate habitats present throughout the Risk Assessment area. It is likely to favour lowland river catchments with higher temperature regimes and more invertebrate and macrophytes food available.

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: *Orconectes rusticus* has such a wide range of possible food species and habitats that it is likely to find species and habitats for its survival almost anywhere in GB although they do need permanent water all year round.

In North America, typically this species is transported through live bait fisheries into new watersheds and once established is able to expand its range through connecting waterways (Phillips 2010), so although there is potential for spread in GB, as keeping of the species, the use of crayfish as bait, and introduction to the wild, are all illegal activities the spread by this method will be curtailed to illegal activities.

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?

moderately likely

Level of confidence: high

Comments: *Orconectes rusticus* out competes other crayfish species (Momot 1997) that it has encountered although it has not been tested against *Pacifastacus leniusculus*, the dominant species in GB. Although it is more likely to encounter other North American species in GB (because they are more widespread and occur more densely in the South of England where *O. rusticus* is more likely to enter the risk assessment area due to the human population density), it can also carry crayfish plague which will give it competitive advantage should it encounter susceptible species, e.g. *Austropotamobius pallipes* or *Astacus leptodactylus.*

One notable distinction in the reproductive biology of *O. rusticus* is its ability to lay eggs at lower temperatures relative to competing crayfish, enabling a "head-start" in population growth for a season; it can begin laying eggs at 4oC which is a lower temperature that any other species recorded. The reproductive biology of this species help to enable its invasion characteristics (Momot 1966, Aiken 1968, Weagle and Ozburn 1972, Berrill and Arsenault 1982, Phillips 2010)

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: very high

Comments: *Orconectes rusticus* is a medium to large crayfish species (Hamr 2002) and aggressive so predatory effects, e.g. otters, mink and fish, will be no worse than for other crayfish species which have already become established in GB. Crayfish plague should not be a problem for this North American species, which may be carrying the plague and other parasites/pathogens are of minor consequence. It is also likely to displace other crayfish species (Momot 1997) which may be predators and prey.

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

moderately likely

Level of confidence: high

Comments: Once introduced to the Risk Assessment Area, management practices will have little effect on establishment.

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

very likely

Level of confidence: very high

Comments: There is no means of eradication of crayfish in GB once they become established in a river system. Control (i.e. reduction in population size) of the *O. rusticus* population may be possible by trapping or other means

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: There is no means of eradication of crayfish in GB once they become established in a river system however if they are found in an enclosed water body, biocides may be effective if permitted for use. In North America, currently no environmentally sound way to eradicate *O. rusticus* without causing harm to native crayfisf, fish and amphibians exists and it is unlikely that any will be developed in the near future (Gunderson 2008).

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

very likely

Level of confidence: very high

Comments: O. rusticus is omnivorous and aggressive; compared with other crayfish species, it has a high metabolism enabling speedy growth, can breed early in the year and has average fecundity and egg volume which is larger than its rival crayfish species (Hamr 2002, Souty-Grosset 2006))

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

very likely

Level of confidence: high

Comments: O. rusticus has shown great capacity to spread and competitively exclude rival crayfish in the USA and Canada (Momot 1997). It is reported to spread downstream between 0.9 to 3.7 km per year and upstream between 0.45 and 1.5 km per year; obstacles, e.g. weirs, in GB would be the same as for other crayfish invasive species which have already become established and thus would delay spread in some instances but not halt it.

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

likely

Level of confidence: high

Comments: As *O. rusticus* has a wide range throughout temperate regions an there appear to be few constraints on its ultimate range (Souty-Grosset 2006), it is likely to adapt to a changing environment without detriment to its establishment and spread.

46 - How likely is it that small, relatively genetically homogeneous populations could become established?

likely

Level of confidence: medium

Comments: Only one or a few individuals are needed for population establishment therefore it is likely that a genetically homogenous population could result but this population does not necessarily have to be small due to the species fecundity and lack of constraints on spread.

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?

unlikely

Level of confidence: medium

Comments: May occur in aquaria

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: There are continual reports in there literature of the spread of this species in the USA and Canada summarized in Momot 1997, Hamr 2002, Souty-Grosset 2006. There was one instance when the species was thought to be present in France but on this occasion the crayfish turned out to be a closely related species *Orconectes juvenilis* (It could just as easily have been *O. rusticus*).

49 - If the organism does not establish, then how likely is it that transient populations will continue to occur?

very unlikely

Level of confidence: high

Comments: This is unlikely because it would be expected that introductions will lead to establishment. It is unlikely that aquarists would dispose of unwanted crayfish species on several occasions creating a transient population.

50 - Please estimate the overall likelihood of establishment (mention any key issues in the comment box)

very likely

Level of confidence: high

Comments: *Orconectes rusticus* is one of the most invasive crayfish species known, there would appear to be few constraints to its spread. It expands aggressively and displaces other crayfish species and has a major impact on the aquatic environment.

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)

rapidly

Level of confidence: high

Comments: Downstream 0.9 to 3.7 km per year and upstream 0.45 to 1.5 km per year (Momot 1997). As with other invasive crayfish species, obstacles to spread, e.g. weirs, only tend to delay spread rather than halting it.

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: medium

Comments: At first, if there are only a few *O. rusticus* populations in GB, spread with human assistance would not be a major factor (because humans would not come across then often) but if *O rusticus* spreads to angling areas and builds up to large densities, then anglers may transport them or the public may take them for food or introduce them elsewhere

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: It is only possible to contain this organism it is established in discrete areas. once the population of *O. rusticus* has established in a river system it will be virtually impossible to contain or eradicate.

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.

Any water body 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)

rapidly

Level of confidence: high

Comments: One of the most invasive crayfish species known with few constraints on spread or the range extension.

Impacts

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

minor

Level of confidence: medium

Comments: The main economic impact of *O. rusticus* in North America is their direct effect on sport fish in invaded lakes. Keller et al. 2008 showed that early management of *O. rusticus* in Vilas County Wisconsin could have prevented about $1,505.205 annually in damage to the fishery industry. One example if economic loss is that Wyoming Game and Fish Department has spent $34,424.81 to date (2.1.2008) to remove *O. rusticus* from several ponds and a portion of one stream, additional expenses will be incurred to monitor the site and any subsequent eradication efforts Wyoming Game and Fish Dept. 2008).

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)

minor

Level of confidence: medium

Comments: *O. rusticus* is likely to reach higher population/biomass densities than crayfish which it displaces, can exist for many years as mixed populations with other crayfish and hybrid populations with *Orconectes propinquus* have been found (Hamr 2002) but as the spread generally constitutes replacement of another introduced crayfish species in the Risk Assessment area, the economic effect is likely to increase slightly. Effect on fish, e.g. consumption of salmon eggs, could be substantial if it was the first crayfish invader of such sites but the first invader is more likely to be *Pacifastacus leniusculus.*

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

minor

Level of confidence: medium

Comments: If *O. rusticus* were to reach a new patch of the Risk Assessment area which had not been already invaded by another alien crayfish species, the effects may be major but although *O. rusticus* is likely to produce a more major effect than other crayfish invaders, as it is likely to follow others, the change (effect on angling or salmon recruitment) caused by the replacement is likely to be minor.

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

minor

Level of confidence: medium

Comments: There may be a reduction in demand for angling.

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: medium

Comments: Maybe minor loss of angling interest (e.g. for salmon fishing, from abroad

61 - How important might other economic costs be resulting from introduction of the organism? (specify in the comment box)

moderate

Level of confidence: low

Comments: 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?

major

Level of confidence: high

Comments: It reduces biodiversity by out competing other crayfish species and due to its great appetite (twice that of *Orconectes virilis*) has a greater environmental impact (Souty-Grosset 2006). In its original distribution in North America, it can force indigenous crayfish species out of shelter and expose them to fish predation and has led to range reduction in indigenous species in at least 3 mid western States and from numerous lakes and waterways in Ontario (Momot 1997). The most serious impact is the destruction of aquatic plants and reduction of species diversity (Hamr, 2002)

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: medium

Comments: If *O rusticus* becomes established, it is likely to displace other non-native invasive crayfish species already present (ANSIS 2007). As it is reported to have a high metabolic rate and larger appetite than other crayfish, the environmental harm would be greater than the species it replaces (Souty-Grosset 2006) which is already substantial. *Orconectes rusticus* is omnivorous and aggressively displaces other crayfish species (Hill & Lodge 1993, 1994, Garvey et al 1994, Momot 1997, Souty-Grosset 2006). It has been shown to reduce aquatic plants and macroinvertebrates (Lodge & Lorman 1987, Olsen et al 1991, Wilson et al. 2004) and can consume twice as much as similar sized crayfish because of its higher metabolic rate (Momot 1992).

Management intervention to control crayfish species in a national context is not effective at present.

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: medium

Comments: It may affect angling interests in some cases.

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: low

Comments: It may affect angling interests in some cases. (the major effect is reduction of biodiversity)

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: The native crayfish, Austropotamobius pallipes, is family Astacidae whilst O. rusticus is family Cambaridae. There are no records of cambarid crayfish breeding with astacid crayfish although they do with other cambarid crayfish (Momot 1997, 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: medium

Comments: Natural predators, e.g otters, mink, fish, birds will have some effect but not enough to stop the spread. North American species like *O. rusticus* are known carriers of the major crayfish pathogen, *Aphanomyces astaci;* this may assist in *O. rusticus* spread by in some cases by eliminating susceptible species, e.g. *Austropotamobius pallipes* and *Astacus leptodactylus.*

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 method of control once established in river systems (Holdich 1999) although enhanced trapping may be developed (Rogers and Watson 2010). Biocides may be used if the introduction is limited to enclosed waters (Peay et al. 2006) but are not widely applicable.

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: medium

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?

very likely

Level of confidence: high

Comments: As with all North American species, *O. rusticus* would be expected to be a vector of crayfish plague which is very damaging to all susceptible species including the native crayfish in GB, *Austropotamobius pallipes.* Although it would provide a food source for predators, e.g. otter, mink, heron and upset the balance of invertebrates the main result would be detrimental because it would cause loss of biodiversity. Due to its exceptional possible range It may reach areas which other invasive crayfish species have not inhabited and thus increase the risk of spread of crayfish plague.

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

Environmental; reduction in biodiversity and possibly a detriment to angling

Comments: Throughout GB is any place currently occupied by any species of crayfish or suitable for occupation. *O. rusticus* is one of the most invasive crayfish species known and there would appear to be few constraints on its spread. It expands aggressively, displaces other crayfish species and has a detrimental effect on aquatic ecology. Angling is likely to be affected by other species, e.g. Pacifastacus leniusculus, before *O. rusticus* but the effect of *O. rusticus* displacing *P. leniusculus* may exacerbate the problem.

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

major

Level of confidence: high

Comments: Loss of biodiversity and as this species is expected to follow the invasion of other crayfish species, there is likely to be exacerbation of the problems associated with non-native crayfish invasion due to the higher metabolism, appetite and aggressiveness of this species. Hence it will affect loss of biodiversity more and possibly affect angling more.

Conclusion

73 – Conclusion of the risk assessment

medium

Level of confidence: high

References

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