Garra rufa (Doctor Fish)

- Small freshwater fish from the Middle East
- Not yet recorded in the wild in Britain, but widely distributed in captivity
- Found in stony / rocky streams in native range
- Potential impacts on GB native species through competition

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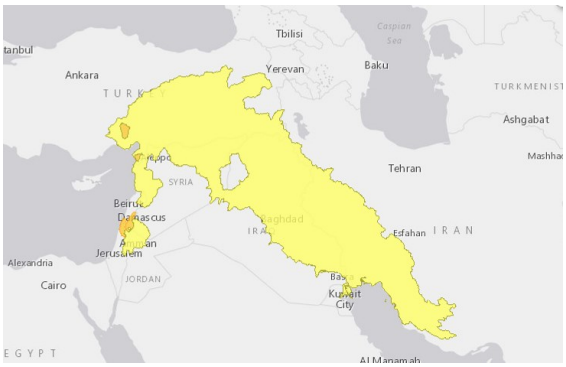
History in GB

Imported into GB since 2005 for use in fish spa industry, which is now in decline (imports have dropped from a peak of 30,000 animals per week in early 2011 to around 1000 animals per week in early 2012). Widely distributed across GB in captive situations, but there are as yet no reports of it having been introduced into natural waters.

Native distribution

Native to Israel, Jordan, Syria, parts of Iraq and Iran, and Eastern Turkey.



Source: IUCN 2015

Distribution GB

Not yet present, however risk of establishment is moderately likely in southern parts of Britain.

Impacts

Environmental (minor)

- May compete for food and space with smaller riverine species
- Potential impact on dynamics of algal and invertebrate production, possible indirect impacts on species at higher trophic levels
- Could introduce a range of pathogens and parasites but unlikely to pose a significant threat to native species.

Economic (minor)

- None recorded

Social (minor)

- None recorded

Introduction pathways

Deliberate release — from fish spas where these have ceased trading

Spread pathways

Natural — relatively slow spread within river systems due to low fecundity and environmental conditions

Human — accidental movement with consignments of other fish

Summary

	Risk	Confidence
Entry	LIKELY	HIGH
Establishment	MODERATELY LIKELY	LOW
Spread	VERY SLOW	MEDIUM
Impacts	MINOR	HIGH
Conclusion	MINOR	MEDIUM

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

Rapid Assessment of: ***Garra rufa*** **(Doctor Fish)**
Author: Alasdair Scott, Cefas
Version: Final (April 2016) – Draft 1 (April 2012), Draft 2 (September 2012), signed off by NNRAP (February 2013), approved by GB Programme Board (March 2015), published on NNSS website (September 2015)

GB Non-native species Rapid Risk Assessment (RRA)

Introduction:

The rapid risk assessment is used to assess invasive non-native species more rapidly than the larger GB Non-native Risk Assessment. The principles remain the same, relying on scientific knowledge of the species, expert judgement and peer review. For some species the rapid assessment alone will be sufficient, others may go on to be assessed under the larger scheme if requested by the Non-native Species Programme Board.

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

Response: The sudden interest in the use of *Garra rufa* as a health and beauty treatment in spas has resulted in a large increase in the rate of import of this species, with a consequent increase in the risk that it may be released into natural waters within GB.

2 - What is the Risk Assessment Area?

Response: *GB*

3 - What is the name of the organism (scientific and accepted common; include common synonyms and notes on taxonomic complexity if relevant)?

Response: *Garra rufa*, known as the Doctor fish or Nibble fish. We note that the trade in fish for the spa industry, which are usually sold as *Garra rufa*, includes other species of *Garra* (*G hughi* has been identified in trade by Cefas), and the species *Cyprinion macrostomus*. This RA concentrates solely on *G rufa*, which is the dominant species in trade

4 - Is the organism known to be invasive anywhere in the world?

Response: There are no reports of the species being invasive.

5 - What is the current distribution status of the organism with respect to the Risk Assessment Area?

Response: The species is widely distributed across GB in captive situations, the result of a very significant and rapid increase in the use of these animals in fish spas, as a therapy for dealing with a range of skin conditions. There are as yet no reports of the species having been introduced into natural waters within GB. The species is also found in very small numbers in the ornamental fish trade.

6 - Are there conditions present in the Risk Assessment Area that would enable the organism to survive and reproduce? Comment on any special conditions required by the species?

Response: The species naturally inhabits sub-tropical environments which experience seasonal temperature

highs and lows greater than those experienced by aquatic environments in GB, therefore it is likely that the species could survive if released in GB. The species inhabits stony or rocky streams which provide the substrate on which its major food resource grows. It is not currently known whether the species could breed in GB environmental conditions.

7 - Does the known geographical distribution of the organism include ecoclimatic zones comparable with those of the Risk Assessment Area or sufficiently similar for the organism to survive and thrive?

Response: There is some evidence that parts of its native range may experience climatic conditions not dissimilar to those in the South of England. There is therefore a risk that the species could survive and thrive in some parts of GB.

8 - Has the organism established viable (reproducing) populations anywhere outside of its native range (do not answer this question if you have answered 'yes' to question 4)?

Response: We found no reports of the species being established outside its native range

9 - Can the organism spread rapidly by natural means or by human assistance?

Response: the wide availability of this species in a trade that requires substantial number of animals in each facility poses a risk that the species could be introduced to waters in significant numbers. There is no threat to GB from the natural spread of the species, though there would be a risk of further spread through human activity, such as movements of fish for re-stocking.

10 - Could the organism itself, or acting as a vector, cause economic, environmental or social harm in the Risk Assessment Area?

Response: As a grazer of algae, this species occupies an ecological niche not greatly exploited by native fish species. The species would however influence food supply to other small native fish species and other parts of the food chain. It is therefore possible that an established population of *G rufa* could impact on a range of invertebrate and fish species.

Entry Summary

Estimate the overall likelihood of entry into the Risk Assessment Area for this organism (comment on key issues that lead to this conclusion).

Response: ***likely***

Confidence: ***high***

Comments (include list of entry pathways in your comments):

The fish spa industry in GB, which started around 2005, and comprised only a handful of sites until 2009 has undergone an extremely rapid increase over the last two years, with many spa owners having very little, or no, knowledge of the difficulties of maintaining a population of live fish in what are typically modest aquarium facilities. It is inevitable that a number of these people will not pursue the use of these animals for an extended period. It is evident in early 2012 that the fad for such spas has already peaked and the industry is declining. Imports of *G rufa* have dropped from a peak of 30, 000 animals a week in early 2011 to around 1000 animals per week.

It is therefore likely that where spas ceasing trading, the owners will face the problem of disposing of their fish. It is likely that some owners will dispose of their stock to nearby waters rather than kill them. Any releases into suitable environments could result in the establishment of the species given the significant numbers likely to be released through this route. The species is also present in very small numbers in the ornamental fish trade but it is unlikely to be released in significant numbers from this industry.

Establishment Summary

Estimate the overall likelihood of establishment (comment on key issues that lead to this conclusion).

Response: ***moderately likely***

Confidence: ***low***

Comments (state where in GB this species could establish in your comments, include map if possible):

There is a lack of detailed information on the breeding biology of *G rufa* (see synopsis by Jarvis 2011), so we are forced to assess the risk of establishment based principally on whether it naturally occurs in environments with a seasonal temperature profile similar to that of parts of Great Britain. Much of the available data on *G rufa* relates to populations in the sub-tropical environments that exist across much of its range (Israel, Jordan, Syria, parts of Iraq and Iran, and Eastern Turkey), where the species will experience temperature extremes in excess of those which be encountered in GB. It is therefore evident that the species could survive the range of environmental temperatures likely to be encountered in GB. Breeding of *G rufa* in these sub tropical environments typically starts in May, with batches of eggs spawned until the end of June (Yazdanpanah 2005, Patimar et al 2010), but the species shows a degree of spawning flexibility producing batches of eggs from May to September in a Central Iranian stream (Abedi et al 2011). These studies do not document water temperatures at spawning but local climate data suggest that spawning first occurs in these environments when water temperatures have risen above 20^{o} C and continues when water temperatures exceed 30^{o} C. We would not expect fish which require such environmental conditions to breed successfully in GB. However, Okur and Yalcin-Ozdilek (2008), who document the extensive distribution of *G rufa* in streams in the Amanos mountains of South East Turkey, at water temperatures in the range 5.8 to 31.2^{o} C and Kara et al (2010) who document a natural population of *G rufa* living in the Ceyhan river catchment in the same region of Turkey, both provide some evidence that the species may thrive in much cooler climates. In the Ceyhan system, *G rufa* are reported to

populate a large proportion of the catchment, particularly hillstream areas. Their distribution appears to encompass habitats immediately downstream of the colder headwaters which support a population of the salmonid *Salmo trutta macrostigma*. There is no direct water temperature data available for the various parts of the Ceyhan river, but a comparison of available seasonal air temperature profiles of the upper parts of the Ceyhan catchment with that of south east England (London), shows significant overlap between the monthly high and low temperatures of these regions. The monthly temperature minima and maxima are 2 to 5^0 C higher during the likely *G rufa* breeding season in this region of Turkey (worldweatheronline.com) but it appears that it would be possible for Garra to breed in southern GB between June and August. We believe therefore that *G rufa* shows sufficient flexibility in its environmental tolerances to allow it to breed in southern parts of Great Britain. It is not clear whether the geographic range of *G rufa* in the Ceyhan system is temperature limited or whether the salmonid dominated population in the upper catchment prevents its further spread, however if either of these factors serves to limit *G rufa* distribution then it is unlikely that they would establish populations in the more upland salmonid dominated watercourses in GB.

There is no available data on the breeding ecology of *G rufa* in the cooler parts of its natural range, but we would anticipate that if the species behaves like UK native cyprinids then it would exhibit a longer life span, slower rate of maturity and lower annual reproductive output than it does in warmer climates.
Patimar et al, Yazdanpanah, 2005 and Aedi et al 2011, demonstrate that the fecundity of *G rufa* varies with environmental conditions, but is generally low for a cyprinid species. We believe that this low fecundity is likely to reduce the risk that the species could become invasive and damaging to other fish species in GB waters. Goren and Galil (2005) suggested that *G rufa* populations in Israel may have been lost due to predation on juvenile stages, by the introduced mosquito fish (*Gambusia affinis*). While there is some evidence that the level of predation may have been exacerbated by other habitat changes, there remains the possibility that introduced *G rufa* in GB would be equally vulnerable to predation by native species, both fish and aquatic invertebrates. We found no published data on the larval and early juvenile stage ecology of *G rufa* against we could assess any particular vulnerabilities of strengths of the species in dealing with likely predation threats.

We would expect G rufa to be able to establish populations in both lotic and lentic environments, with it being most suited to survive in southern groundwater fed streams, with high Winter temperature minima and temperatures near to ambient air temperature in Summer.

The species could also thrive in stillwaters, particularly those with impoverished predatory fish fauna, with the caveat that many such waters in GB are now carp dominated and highly turbid, which could significantly restrict food availability for this species, thereby reducing its potential to reach large population sizes.

Spread Summary

Estimate overall potential for spread (comment on key issues that lead to this conclusion).

Response: ***very slow***

Confidence: | ***medium***

Comments (include list of spread pathways in your comments):

Other than as a consequence of the release mechanism described earlier, the spread of *Garra rufa* is only likely to occur as a result of its accidental movement with consignments of other fish for re-stocking, as it has no direct commercial value as either a food or sport fish. As with other small species such as the topmouth gudgeon, there is a risk that *G rufa* would be undetected during fish transfers, but unlike the topmouth, which was introduced for farming as a potential ornamental species, and which became established in one of England's largest fish farms supplying coarse fish, *G. rufa* is unlikely to be introduced into such a farm environment, from which its spread would be more likely.

The risk of transfer of *G rufa* from open waters could be mitigated by the imposition of appropriate screening of other commercially valuable species prior to their movement from catchments containing *G rufa.*

We estimate that spread within river systems will be relatively slow due to the species' low fecundity and its existence at the likely lower end of its environmental tolerances for reproduction.

Impact Summary

Estimate overall severity of impact (comment on key issues that lead to this conclusion)

Response: ***minor***

Confidence: ***high***

Comments (include list of impacts in your comments):

There is no published evidence to suggest that *G rufa* is an invasive species within or outside its typical environmental range. It occupies a low trophic level, feeding on the algal and associated invertebrate fauna of rocky/stony substrates, so is unlikely to have a significant direct impact on other fish species in GB, though there may be some competition for food and space with smaller riverine species such as stone loach, bullheads and gudgeon. There is likely to be some impact on the dynamics of algal and invertebrate production, which could have indirect impacts on species at higher trophic levels, but it is likely that the scale of any such impacts would be regulated by the direct control of G *rufa* population size through predation by other fish and invertebrate species.

There is some data available on the pathogens and parasites of *G rufa*. We believe that it is unlikely that the species will introduce any of the listed notifiable diseases controlled within GB. The Fish health Inspectorate (FHI) sampled 8 imported consignments, reportedly of *Garra rufa* for disease screening in 2011(at levels capable of detecting with 95% confidence an infection level of 10% in the sampled population). These have demonstrated both that a range of pathogens are associated with such imported consignments and that some of the *Garra* were in fact *G hughi* rather than *G rufa*. A number of bacterial pathogens were isolated, including the potentially zoonotic *Vibrio cholerae, V vulnificus, Streptococcus agalactiae* and mycobacteria. These bacteria may pose a low risk for users of fish spas, but are unlikely to pose a significant threat to fish populations in natural waters in GB due to their temperature requirements. The FHI also isolated an aquabirnavirus from *G rufa* and an uncharacterised herpesvirus closely related to goldfish herpesvirus, from *G hugh* . It is unclear whether these viruses would affect any native fish species.

A range of other parasites have been identified in *G rufa*, Jalali and Molnar (1990), Gussev et al (1993) and Jalali et al (2005), record a number of monogenean parasites of the genera Dactylogyrus and Gyrodactylus on *G rufa*, in the wild. Rahemo (1995) reported a crustacean gill parasite and a digenean, while Yalcin-Ozdilek and Ekmekci (2006) documented nematode parasites of *G rufa*. It is unlikely that these organisms pose a threat to native species in GB, as they may be host specific or have complex life cycles requiring intermediate hosts that are unlikely to exist in GB waters.

Climate Change

What is the likelihood that the risk posed by this species will increase as a result of climate change?

Response: ***low***

Confidence: ***high***

Comments (include aspects of species biology likely to be effected by climate change (e.g. ability to establish, key impacts that might change and timescale over which significant change may occur):

Any increase in the ambient temperatures of waters within GB, or any shift to more extreme temperature ranges across the year, are likely to increase the likelihood that *G rufa* could successfully colonise GB waters . We would suggest however that there would be little increase in the impact of the species on other fish communities, beyond that expected as a direct consequence of the climate change which resulted in increased suitability of the habitat for *Garra.*

Conclusion

Estimate the overall risk (comment on the key issues that lead to this conclusion).

Response: ***low***

Confidence: ***medium***

Comments:

We do not believe that *Garra rufa* poses a very significant risk to environments within Great Britain. It would at present have to colonise environments at the lower end of its natural temperature range, which would be expected to regulate its potential rate of reproduction and spread. While there would be only limited competition for food resource with native species it is highly likely that *G rufa* would be vulnerable to predation by a number of native fish and aquatic invertebrate species. Studies have shown that *G rufa* populations are vulnerable to predation in their natural habitats, and it is likely that predation would impose a significant threat to the development of healthy populations of this species in GB.

The species could introduce a range of pathogens to GB waters but it is unlikely that these pathogens would have a significant impact on wild populations of native fish.

Given the lack of data on environmental temperatures (both high and low) that may limit the distribution or breeding of G rufa across its native range, research on this area would bring greater levels of precision to the assessment of the risks it poses to waters in GB.

Management options (brief summary):

1 - Has the species been managed elsewhere? If so, how effective has management been?

Response: There is no evidence of this species having established populations outside its native range, so no information on its management as an introduced species.

2 - List the available control / eradication options for this organism and indicate their efficacy.

Response: There are few options for the eradication of this species. The use of the piscicide rotenone could be considered in some waters (the technique has already been used to eradicate topmouth gudgeon from some stillwaters in GB), but is unlikely to be used in flowing waters. Small populations if detected at any early stage could possibly be removed from small streams by electric fishing, but this option would not be feasible for more extensively established populations or for populations in larger streams or rivers. Some smaller stillwater environments could be drained and treated with quicklime where the use of rotenone is not deemed appropriate.

3 - List the available pathway management options (to reduce spread) for this organism and indicate their efficacy.

Response: The key risk is that the species will be discarded from the fish spa industry, so education of this sector is probably the key to preventing the release of this species to the wild in GB.
Once established in a water body the spread of this species could be prevented through the imposition of appropriate screening of any consignments of fish destined for transfer from that water. This technique was successfully used to screen topmouth gudgeon from commercial consignments of fish from a fish farm on which the species had established a feral population, prior to that farm being treated with rotenone.

4 - How quickly would management need to be implemented in order to work?

Response: As we believe that the species would not cause major problems for other fauna and could be readily managed to prevent its further spread from the populated site in the short term, we would suggest that an assessment of the population dynamics and potential impact of the species could be undertaken before any forced eradication with rotenone was undertaken, in a closed stillwater habitat. We would however anticipate the eradication of such a population once the population data was available.
Management of a population in a river would require prompt action if the aim was to achieve the eradication of the species. It is likely that unless a piscicide was employed such removal actions, say by electric fishing would have to take place over an extended period to ensure the complete removal of the species. With recorded life span of 4 to 7 years in its native range, which may be extended in cooler climates, it is likely that removal of breeding adults could require several years of effort, before successful removal could be achieved. The small size of the species would be a significant drawback in achieving a successful eradication by this method.

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Provide here a list of the references cited in the course of completing assessment

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