GB NON-NATIVE ORGANISM RISK ASSESSMENT SCHEME

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N	QUESTION	RESPONSE	COMMENT
	Name of Organism:	***Potamopyrgus antipodarum*** **- New Zealand Mudsnail**	
	Objectives:	Assess the risks associated with this species in GB	
	Version:	FINAL 05/04/11	
1	What is the reason for performing the Risk Assessment?		Requested by the GB Non-native Species Programme Board
2	What is the Risk Assessment area?	Great Britain (GB)	As the email specified Great Britain we haven't included Northern Island. If we need to do so then please advise, although it is unlikely to change the assessment results.
3	Does a relevant earlier Risk Assessment exist?	NO OR UNKNOWN (Go to 5)	
4	If there is an earlier Risk Assessment is it still entirely valid, or only partly valid?		
A	**Stage 2: Organism Risk Assessment SECTION A: Organism Screening**		
5	Identify the Organism. Is the organism clearly a single taxonomic entity and can it be adequately distinguished from other entities of the same rank?	YES (Give the full name & Go to 7)	New Zealand Mudsnail - *Potamopyrgus antipodarum* (Gray, 1843). It is easy to identify and there are no taxonomic issues in GB.
6	If not a single taxonomic entity, can it be redefined?		
7	Is the organism in its present range known to be invasive, i.e. to threaten species, habitats or ecosystems?	NO or Uncertain (Go to 8)	The NZ Mudsnail is a known invader; native to New Zealand it has spread to Australia, North America and Europe over the last two centuries (GISD (2005)). However, its impact on other species, habitats and ecosystems is variable and uncertain.
8	Does the organism have intrinsic attributes that indicate that it could be invasive, i.e. threaten species, habitats or ecosystems?	YES or UNCERTAIN (Go to 9)	This species is a parthenogenetic livebearer (ovovivparous) with high reproductive potential (Winterbourn, 1970), therefore only needing one female to start a new population. It lives in a wide range of aquatic ecosystems, from brackish to freshwater, including rivers, reservoirs, lakes, ditches and estuaries (Richards et al, 2002) and is commonly found in or by disturbed habitats (Ponder, 1988; Schreiber et al, 2003). It is also resistant to turbidity, sewerage and mild pollution (Crosier et al (undated); Kerney, 1999).
9	Does the organism occur outside effective containment in the Risk Assessment area?	YES (Go to 10)	
10	Is the organism widely distributed in the Risk Assessment area?	YES & Future conditions/management procedures/policies are being considered (Go to 19)	It is now one of the most common freshwater gastropods in Britain and is still extending its range in parts of northern England, Wales and Scotland (Kerney, 1999). The upland areas are least dense which may reflect under recording and colder temperatures for longer periods.
11	Does at least one species (for herbivores, predators and parasites) or suitable habitat vital for the survival, development and multiplication of the organism occur in the Risk Assessment area, in the open, in protected conditions or both?		
12	Does the organism require another species for critical stages in its life cycle such as growth (e.g. root symbionts), reproduction (e.g. pollinators; egg incubators), spread (e.g. seed dispersers) and transmission, (e.g. vectors)?		
13	Is the other critical species identified in question 12 (or a similar species that may provide a similar function) present in the Risk Assessment area or likely to be introduced? If in doubt, then a separate assessment of the probability of introduction of this species may be needed.		
14	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?		
15	Could the organism establish under protected conditions (e.g. glasshouses, aquaculture facilities, terraria, zoological gardens) in the Risk Assessment area?		
16	Has the organism entered and established viable (reproducing) populations in new areas outside its original range, either as a direct or indirect result of man's activities?		
17	Can the organism spread rapidly by natural means or by human assistance?		
18	Could the organism as such, or acting as a vector, cause economic, environmental or social harm in the Risk Assessment area?		
19	This organism could present a risk to the Risk Assessment area and a detailed risk assessment is appropriate.	Detailed Risk Assessment Appropriate GO TO SECTION B	
20	This organism is not likely to be a harmful non-native organism in the Risk Assessment area and the assessment can stop.		
B	**SECTION B: Detailed assessment of an organism's probability of entry, establishment and spread and the magnitude of the economic, environmental and social consequences**		

	Probability of Entry	RESPONSE	UNCERTAINTY	COMMENT
1.1	List the pathways that the organism could be carried on. How many relevant pathways can the organism be carried on?	many - 3	MEDIUM -1	Main pathways: 1) Unintentional human transportation via contaminated equipment and clothing of recreational water users e.g. boaters, anglers, hikers, swimmers, dog walkers, horse riders etc. 2) Ballast waters. 3) With the transfer of fish eggs and live game from hatcheries. 4) Transfer of bottom materials through dredging, mining etc. 5) Transport on or in wildlife (fish, wildfowl, domestic livestock etc). 6) Water flow. 7) Floating plants. 8) Crawling.
1.2	Choose one pathway from the list of pathways selected in 1.1 to begin the pathway assessments.	Unintentional human transportation via contaminated equipment and clothing of recreational water users eg. boaters,		Other research shows that this is the most likely cause for local scale movement (Crosier et al, undated; Richard et al, 2004; GISD, 2005).
1.3	How likely is the organism to be associated with the pathway at origin?	likely - 3	LOW - 0	There are already very high populations of this species across the UK and in mainland Europe. It is therefore likely that it will be associated with the pathway at origin.
1.4	Is the concentration of the organism on the pathway at origin likely to be high?	likely - 3	MEDIUM -1	Where populations are present numbers are often very high (Richards, 2001), particularly in newly established colonies (Kerney, 1999).
1.5	How likely is the organism to survive existing cultivation or commercial practices?	likely - 3	MEDIUM -1	
1.6	How likely is the organism to survive or remain undetected by existing measures?	likely - 3	MEDIUM -1	This is a small species (adults = 4-6mm) and so it is likely to go undetected. It can also survive long periods outside of water if the environment is moist (Dwyer et al, 2003). They can also tolerate mild pollution (Crosier et al, undated; Kerney, 1999).
1.7	How likely is the organism to survive during transport /storage?	very likely - 4	LOW - 0	This is a hardy species that can survive both brackish and freshwater environments (can tolerate 17-24% salinity (Bondesen & Kaiser, 1949 in Richards et al, 2002)) and is able to withstand desiccation. It is also tolerant to turbidity, sewerage and mild pollution (Crosier et al, undated; Kerney, 1999).
1.8	How likely is the organism to multiply/increase in prevalence during transport /storage?	N/A	LOW - 0	Survival and reproduction would be dependent on the timescale, environment and medium of transport.
1.9	What is the volume of movement along the pathway?	moderate - 2	HIGH -2	
1.10	How frequent is movement along the pathway?	very often - 4	MEDIUM -1	Recreational activity takes place constantly in freshwater and estuarine environments so movement along this pathway will be high.
1.11	How widely could the organism be distributed throughout the Risk Assessment area?	very widely - 4	LOW - 0	This species is already widely distributed across GB, its greatest range being across England (Kerney, 1999). It has the potential to cover the whole of the RA in freshwater and brackish habitats and is only likely to be limited by very cold upland northerly regions as it does not survive near freezing temperatures (Richards et al, 2004). Climate change may lead to warmer winter temperatures in these areas, and therefore less frost days, which in turn could increase the spread of this species further.
1.12	How likely is the organism to arrive during the months of the year most appropriate for establishment ?	very likely - 4	LOW - 0	Recreational activities usually increase during the spring-autumn months (including the fishing season), which is the most reproductive period for the NZ Mudsnail (Richards et al 2002). They can however reproduce at any time of year if the environment is not too extreme (Winterbourn, 1970).
1.13	How likely is the intended use of the commodity (e.g. processing, consumption, planting, disposal of waste, by-products) or other material with which the organism is associated to aid transfer to a suitable habitat?	very likely - 4	LOW - 0	Boats, equipment, shoes and outdoor clothing are likely to be taken to different sites, some of which may not already be contaminated with this snail.
1.14	How likely is the organism to be able to transfer from the pathway to a suitable habitat?	very likely - 4	LOW - 0	When it is immersed in water or reaches a moist environment it can easily drop from the vector it has travelled on.

	Probability of Establishment	RESPONSE	UNCERTAINTY	COMMENT
1.15	How similar are the climatic conditions that would effect establishment in the Risk Assessment area and in the area of current distribution?	very similar - 4	LOW - 0	The species is already well established in England, much of Wales and the more coastal areas of Scotland (Kerney, 1999). There are no climatic differences in Wales which would prohibit its distribution further but the colder upland climates in Scotland may reduce the likelihood of a full distribution there due to greater frost periods.
1.16	How similar are other abiotic factors that would effect establishment in the Risk Assessment area and in the area of present distribution?	very similar - 4	LOW - 0	Temperature is an abiotic factor which could limit the snail distribution as it cannot withstand prolonged freezing conditions (Richards et al, 2004), therefore effecting its establishment in some Scottish regions. This species is tolerant of mild pollution (Kerney, 1999) so this does not limit its establishment. Current information available on the snail resistance to high velocity environments is inconclusive (Alonso & Castro-Diez, 2008). Some studies have shown that the snail establishment may be limited by high water velocity environments as it is easily displaced (Richards et al, 2001). Other authors suggest that it has a preference for moving water (Fretter & Graham, 1978) and studies have shown that it has a positive rheotactic response encouraging active dispersal upstream (Adam, 1942; Haynes et al., 1985). Although this may not be conclusive we know that the NZ Mudsnail is abundant in rivers in the RA area.
1.17	How many species (for herbivores, predators and parasites) or suitable habitats vital for the survival, development and multiplication of the organism species are present in the Risk Assessment area? Specify the species or habitats and indicate the number.	very many - 4	LOW - 0	This species can inhabit most freshwater and brackish habitats and is not species specific in its eating habits. Nor does it require other species for reproduction.
1.18	How widespread are the species (for herbivores, predators and parasites) or suitable habitats vital for the survival, development and multiplication of the organism in the Risk Assessment area?	widespread - 4	LOW - 0	This species can inhabit most freshwater and brackish habitats and is not species specific in its eating habits. Nor does it require other species for reproduction.
1.19	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	LOW - 0	No other species is required for reproduction. Its reproductive mode in GB is parthenogenesis.
1.20	How likely is it that establishment will not be prevented by competition from existing species in the Risk Assessment area?	very likely - 4	LOW - 0	There is no data to suggest that other British species will out compete this snail. Meier-Brook (2002) comments that other than *Marstoniopsis scholtzi* (Schmidt), which is rare, there are no other lake-dwelling hydrobiids in Europe; therefore almost no competition from similar species. A study based in North America (Kerans et al, 2005) suggests there is a negative correlation between the density of *P. antipodarum* and other macro-invertebrates. The fact that it has already spread so far across the RA also suggests there are no notable competitors here.
1.21	How likely is it that establishment will not be prevented by natural enemies already present in the Risk Assessment area?	very likely - 4	LOW - 0	There is no evidence of natural enemies impeding the establishment of this species.
1.22	If there are differences in man's management of the environment/habitat in the Risk Assessment area from that in the area of present distribution, are they likely to aid establishment? (specify)	N/A	MEDIUM -1	
1.23	How likely is it that existing control or husbandry measures will fail to prevent establishment of the organism?	very likely - 4	LOW - 0	In the UK there is currently no existing control programme.
1.24	How often has the organism been recorded in protected conditions, e.g. glasshouses, elsewhere?	N/A	MEDIUM -1	
1.25	How likely is the reproductive strategy of the organism and duration of its life cycle to aid establishment?	very likely - 4	LOW - 0	This species is a parthenogenetic livebearer (ovovivparous) with high reproductive potential (Winterbourn, 1970), therefore only needing one female to start a new population. The species can also reproduce sexually but parthenogenesis produces twice as many daughters (Crosier et al, undated) and exotic populations (i.e. those outside of New Zealand) are entirely clonal (Zaranko et al, 1997 in Proctor et al 2007). Females reach maturity at 3-6 months and begin to reproduce embryos at 3mm (shell length). The larger the shell size the more embryos they can produce; a single female may brood between 10-90 embryos (Crosier et al, undated). This short generation time and moderately large brood size aid establishment of this species.
1.26	How likely is it that the organism's capacity to spread will aid establishment?	very likely - 4	LOW - 0	The capacity for dispersal in the water body is moderately high as is the involvement of human activity aiding dispersal (GISD, 2005).
1.27	How adaptable is the organism?	very adaptable - 4	LOW - 0	This species can inhabit most freshwater and brackish habitats and is not species specific in its eating habits or substrate specific. Nor does it require other species for reproduction. It is therefore very adaptable.
1.28	How likely is it that low genetic diversity in the founder population of the organism will not prevent establishment?	very likely - 4	LOW - 0	Exotic populations (i.e. those outside of New Zealand) are entirely clonal (Zaranko et al, 1997 in Proctor et al 2007); Populations of Euro clones A, B and C are found in Britain (Hauser et al, 1992), and another previously unidentified clone (D) (Weetman et al, 2002). Populations therefore have low genetic diversity but as the species has already spread over most of the RA there is no evidence to suggest that this prevents establishment. Hauser et al (1992) does comment that the low genetic diversity may reduce its ability to adapt to rapid environmental change and competition; and also that it may restrict its ability to extend into a new ecological range (Weetman et al, 2002).
1.29	How often has the organism entered and established in new areas outside its original range as a result of man's activities?	very many - 4	LOW - 0	Its initial invasion into Australia, Europe and North America is thought to be from the ballast water of ships (Ponder, 1988; Zaranko, 1997). It is known to be dispersed by human recreational activities on equipment and clothing (GISD, 2005; Proctor et al 2007).

1.30	How likely is it that the organism could survive eradication campaigns in the Risk Assessment area?	likely - 3	HIGH -2	A species specific eradication technique has not yet been developed and the species is too widely spread for full eradication. However, *P. antipodarum* is the first intermediate host to over a dozen digenetic trematodes. When snails are infected with the larvae of these parasitic trematode worms they are sterilized (Lively (undated)) and so development of a biological control is being researched. Molluscacides are not species specific so should not be recommended unless full eradication of all species is required. Drying out of areas could be used for small scale eradications resulting in local remissions. In all cases preventative procedures would be needed to reduce likelihood of recontamination.
1.31	Even if permanent establishment of the organism is unlikely, how likely is it that transient populations will be maintained in the Risk Assessment area through natural migration or entry through man's activities (including intentional release into the outdoor environment)?	N/A		The NZ Mudsnail is already well established in the UK.

	Spread	RESPONSE	UNCERTAINTY	COMMENT
2.1	How rapidly is the organism liable to spread in the Risk Assessment area by natural means?	intermediate - 2	MEDIUM -1	The natural spread of this species is through the water course, either by dispersal on currents, attachment to floating plants or via fish and wildfowl. Human interaction is thought to have the greatest effect on the spread of this species (Richards et al, 2004) on a local scale. The NZ Mudsnail is also known to actively disperse by crawling upstream (Adam, 1942 & Haynes et al, 1985 in Alonso & Castro-Diez, 2008).
2.2	How rapidly is the organism liable to spread in the Risk Assessment area by human assistance?	rapid - 3	MEDIUM -1	Human activity is thought to be the main cause of the local spread of this species, particularly by using contaminated equipment in uncontaminated areas (Richards et al, 2004). This species has been in GB for a long time but in North America where it invaded in the 1980's it has spread rapidly through Western America (Richards et al, 2002). Meier-Brook (2002) also comments that in Lake Bodensee within 5 years of discovering them "one could step on nothing but *Potamopyrgus* shells" in some parts.
2.3	How difficult would it be to contain the organism within the Risk Assessment area?	very difficult - 4	MEDIUM -1	The characteristics of this species (parthenogenetic reproduction, resistance to desiccation, small size, ability to adapt to many freshwater habitats and substrates) mean that it would be very difficult to contain it in the RA area. It has already spread to mainland Europe. However, studies suggest that having hot water cleaning stations for equipment along infested areas would kill off most of the snails and greatly reduce further contamination (Dwyer et al, 2003) if consistently used.
2.4	Based on the answers to questions on the potential for establishment and spread define the area endangered by the organism.		MEDIUM -1	Nearly all fresh- and brackish-water habitats throughout the RA area are endangered, with the possible exception of those in northern highlands.

	Impacts	RESPONSE	UNCERTAINTY	COMMENT
2.5	How important is economic loss caused by the organism within its existing geographic range?	minor - 1	HIGH -2	Possible economic effects are: contamination of drinking water (Weeks et al, 2007); biofouling; threatening the recreational fishing industry; increase vulnerability of native threatened or endangered fauna (resulting in costs for protection, research etc); monitoring, control, containment and education costs (Proctor et al, 2007). Currently there is no evidence that these effects have taken place in the UK. A potential for contamination of drinking water was suggested by Weeks et al. (2007).
2.6	Considering the ecological conditions in the Risk Assessment area, how serious is the direct negative economic effect of the organism, e.g. on crop yield and/or quality, livestock health and production, likely to be? (describe) in the Risk Assessment area, how serious is the direct negative economic effect of the organism, e.g. on crop yield and/or quality, likely to be?	minor - 1	MEDIUM -1	See above.
2.7	How great a loss in producer profits is the organism likely to cause due to changes in production costs, yields, etc., in the Risk Assessment area?	minor - 1	MEDIUM -1	See above.
2.8	How great a reduction in consumer demand is the organism likely to cause in the Risk Assessment area?	minor - 1	MEDIUM -1	See above.
2.9	How likely is the presence of the organism in the Risk Assessment area to cause losses in export markets?	very unlikely - 0	MEDIUM -1	See above.
2.10	How important would other economic costs resulting from introduction be? (specify)	moderate - 2	MEDIUM -1	If the implementation of cleaning stations at contaminated sites (high numbers), education and monitoring programmes and further research were to be set up then a moderate governmental cost would be involved.
2.11	How important is environmental harm caused by the organism within its existing geographic range?	moderate - 2	MEDIUM -1	The impact of the NZ Mudsnail on British environments is currently unknown (JNCC, 2002) and further research is certainly required before a realistic assessment can be made. Alonso et al (2008) considers that the success of the NZ Mudsnail is greatly dependent on the conservation state of the invaded habitat; it is more successful in disturbed habitats at the beginning stages of succession and less successful colonizing an already established community. This species can comprise over 95% of the invertebrate biomass in a river (Richards et al, 2002) and quickly establishes large populations due to its parthenogenetic reproductive mode. Although its environmental effects in Britain are unknown (JNCC, 2002) there has been much concern in western USA about the following:- crowding and displacement of other species (NPS (2006)); drastic alteration of primary production in some streams (Richards et al, 2002); a decrease in the colonisation and productivity of other macro-invertebrates [limited research] (Richards et al, 2002; Kerans et al 2005; Hall et al, 2006); there are concerns it will effect the food chains for native trout (Richards et al, 2002); they are a poor food substitute as little or no energy is yielded from them when eaten by fish and they can in fact pass through the digestive tract unscathed (Haynes et al, 1985). However, Meier-Brook (2002) states that the explosive expansion of the NZ Mudsnail in the European lakes has not had an adverse effect on the original mollusc fauna. The only other lake dwelling hydrobiid in Europe is the rare *Marstoniopsis scholtzi* (Schmidt) which is thought to have declined due to pollution rather than colonization of the NZ Mudsnail. He goes on to suggest that their success is mainly due to the lack of other hydrobiid snails in European freshwaters competing against them in this environment. Much more research is needed before conclusions can be made on the impact this snail has in Britain as effects appear to be varied depending on the environment being invaded.
2.12	How important is environmental harm likely to be in the Risk Assessment area?	moderate - 2	HIGH -2	See response for 2.11.
2.13	How important is social and other harm caused by the organism within its existing geographic range?	minimal - 0	MEDIUM -1	Historically (early 1900's) the snail was reported to have blocked freshwater pipes in the Thames region (Castell, 1962) due to it's large numbers but the use of filters has overcome this problem (Eno et al, 1997). If the high densities were to cause reduced fish populations this could affect the recreational fishing industry (Proctor et al, 2007) which could have a negative effect on the perception of anglers at these sites. A potential for contamination of drinking water was also suggested by Weeks et al. (2007).
2.14	How important is the social harm likely to be in the Risk Assessment area?	minimal - 0	MEDIUM -1	See above.
2.15	How likely is it that genetic traits can be carried to native species, modifying their genetic nature and making their economic, environmental or social effects more serious?	very unlikely - 0	MEDIUM -1	In the UK the other resident Hydrobiids are mainly all brackish and marine species, where as *P. antipodarum* is predominately freshwater. Ponder (1988) outlines how there is much less variation in European and Australian populations of *P. antipodarum* due to its clonal method of reproduction. In NZ populations there is greater sexual reproduction and greater variation as a result. As little sexual reproduction occurs the likelihood of interbreeding with other British species is highly unlikely.
2.16	How probable is it that natural enemies, already present in the Risk Assessment area, will have no effect on populations of the organism if introduced?	very likely - 4	LOW - 0	There is no evidence of natural enemies impeding the establishment of this species.

2.17	How easily can the organism be controlled?	very difficult - 4	MEDIUM -1	In the UK there is currently no existing control programme. However, studies suggest that having hot water cleaning stations for equipment & clothing along infested areas would kill off most of the attached snails and greatly reduce further contamination to 'clean' areas (Dwyer et al, 2003) if consistently used. This would need to be in conjunction with an education programme so that recreationists were aware of their responsibilities. Eradication from current sites is however highly unlikely (see 1.30). Molluscicides should not be used as they are not species specific and would effect other molluscs in the targeted habitat. *P. antipodarum* is a known intermediate host for many species of trematode worm in NZ and Australia (Gerard & Lannic, 2003); when snails are infected with the larvae of these parasitic trematode worms they are sterilized (Lively (undated)). In Europe, however, there is little data on the parasites of *P. antipodarum* (Gerard & Lannic, 2003) and much more research would be needed before considering this as a biological control.
2.18	How likely are control measures to disrupt existing biological or integrated systems for control of other organisms?	very unlikely - 0	HIGH -2	The use of hot water cleaning stations should not impact on other control programmes. The use of molluscacides or trematodes could potentially affect other control systems.
2.19	How likely is the organism to act as food, a host, a symbiont or a vector for other damaging organisms?	likely - 3	MEDIUM -1	Digean trematodes and molluscs are known to be specifically associated with one another (Fried et al, 1997); molluscs being the primary host for the parasitic trematodes. It is also common for molluscs to be secondary hosts for trematode metacercariae but they are less host-specific at this level of their cycle (Morley, 2008). In other countries *P. antipodarum* is a known primary and secondary host for trematode worm larvae, however, an introduced species will generally lose the parasite it hosts in its native range (Morley, 2008). *P. antipodarum* may become a primary host for native European parasites although its status has not yet stabilised as only limited research has been carried out. Many other European hydriobid species, of both brackish and freshwater environments, are frequently used as hosts and there is a risk that *P. antipodarum* may become an atypical host where populations are high or where typical hosts are absent (Morley, 2008). So far only one species of European cercariae infecting *P. antipodarum* has been reported in mainland Europe (Western France), which was a blood fluke of fish (Gerara & Lannic, 2003 and Lannic, 2003 in Morley, 2008). There is also the potential for infections from the introduction of exotic trematodes from Australasia e.g. from fish and eel imports (Morley, 2008). In the 1950's an exotic species of trematode (*Notocotylus gippyensis*) was recorded in the UK, thought to have been introduced by the ornamental bird trade from New Zealand where it uses *P. antipodarum* as its primary host. Lack of survey work means that no evidence is available to associate this trematode species with *P. antipodarum* in the UK but shells with '*Notocotylus*-type cysts' have been observed from a locality near the 1950's sighting (Driscoll, 1982 in Morley, 2008). Research has also shown that susceptibility of trematode larve infection may also be dependent on the European clonal variant found at a certain site; Euro A being more resistant than Euro C in one study (Fromme & Dybdahl, 2006 in Morley, 2008). There is no doubt that the UK needs to carry out much more survey work of 'trematode-*P. antipodarum*' associations so that more accurate risk assessments can be made about the impact they are having, or will have in the future, on other vertebrate and invertebrate populations.
2.20	Highlight those parts of the endangered area where economic, environmental and social impacts are most likely to occur		MEDIUM -1	Slower moving freshwater & brackish habitats.

Summarise Entry	very likely - 4	LOW - 0	The NZ Mudsnail is already well established in the UK. It was introduced in drinking water barrels from Australia (Ponder, 1988) and is thought to have been liberated into the Thames estuary as it can survive in a brackish environment. Although first recorded in 1889 (Smith, 1889) it is thought to have been established there as early as 1859 (Hubendick, 1950 in Ponder, 1988).
Summarise Establishment	very likely - 4	LOW - 0	The NZ Mudsnail is already well established in the freshwater and brackish habitats in the UK, its distribution in 1999 is clearly shown by Kerney (1999) and it is likely to have spread further since then. Its distribution covers the most southerly to the most northerly range, and similarly east to west. However, in Scotland its distribution is mainly coastal. It establishes new populations very successfully due to its parthenogenetic mode of reproduction. Kerney (1999) also reports that new colonies often show enormous numbers which generally decline after a few seasons.
Summarise Spread	rapid - 3	LOW - 0	This species is a parthenogenetic livebearer (ovovivparous) with high reproductive potential (Winterbourn, 1970), therefore only needing one female to start a new population. Its hardy nature has also aided its dispersal and survival. Naturally it is dispersed via water currents, fish and wildfowl but the main cause of its local spread it thought to be human interaction via recreational activities (e.g. angling, boating, picnicing etc.).
Summarise Impacts	moderate - 2	MEDIUM -1	Ecological impacts:- The NZ Mudsnail can dominate (over 95%) the invertebrate biomass in a river (Richards et al, 2002; Hall et al, 2003) which may result in: crowding and displacement of other species (NPS, 2006); drastic alteration of the primary production due to high consumption (Richards et al, 2002; Hall et al, 2003);competing with other grazing and detritivorous invertebrates (Kerans et al, 2005); low colonisation and productivity of other macro-invertebrates (Keran et al 2005; Hall et al, 2006); negatively effecting higher levels in the food chain (e.g, fish and other vertebrates) as they are a poor food substitutes to other invertebrates, yielding only 2% of their nutritional value when eaten by trout (NPS, 2006). Economic impacts:- Proctor et al (2007) outlines possible economic effects, which in summary are: biofouling; threatening the recreational fishing industry; increase vulnerability of native threatened or endangered fauna (resulting in costs for protection, research etc); monitoring, control, containment and education costs.
Conclusion of the risk assessment	MEDIUM -1	MEDIUM -1	Overall the risk associated with the NZ Mudsnail is moderate. It has already entered, established and spread in the UK's freshwater and brackish water habitats and is likely to continue expanding. Its parthenogenetic mode of reproduction has greatly aided in its establishment and spread. Recreational activities are thought to be the main cause of spread to new areas. Ecologically it may negatively change the structure of food webs, effecting organisms at all levels but in the UK there is no evidence that this is a problem..
Conclusions on Uncertainty			There is good research on the life history, ecology, genetic distribution and invasiveness of the NZ Mudsnail. However, there is a high level of uncertainly regarding the effect it has, or could have, on the environment and economy. Most papers speculate on the potential effects. Much of the survey work appears to have been done in North America and mainland Europe but more research needs to be carried out on the effects the British populations are having on the environment before management and control procedures should be investigated.

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