RISK ASSESSMENT SUMMARY SHEET

Updated: October 2020

Cephalothrix simula (a nemertean worm)

- A soft bodied marine worm, probably from the Pacific Ocean
- Found in Cornwall in 2018, no other records are known for GB
- Can contain high levels of the neurotoxin tetrodotoxin, which is used as a defence against predators
- This toxin can occur at sufficient levels in a single worm to be lethal to humans; however, there are no known reports of this causing harm anywhere in the world (worms would have to be ingested or otherwise build up in the food chain)
- Nemertean worms can be predators of molluscs as well as feeding on plant and planktonic species; however, in the case of this species these are unlikely to cause significant impacts

History in GB

Described from Japan in the 1950s, subsequently recorded from the Pacific coast of North America, the Atlantic coast of the Iberian Peninsula (from 2010), the Mediterranean Sea (from 2010) and the North Sea coast of the Netherlands (2015). In GB a single specimen was found on a dead mussel shell in Cornwall May 2018 (identification was confirmed by sequencing).

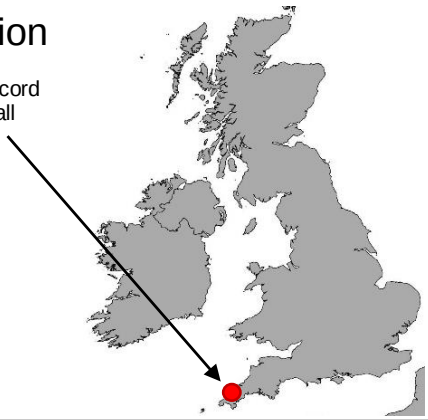
Native Distribution

Probably Pacific Ocean, recorded from waters around Japan

Source: Kajihara *et al* 2013

GB Distribution

Only one known record in GB, from Cornwall



Impacts

Environmental (minimal, medium confidence)

- While some nemertean worms can cause population declines in native species, this small species is considered unlikely to cause any significant environmental impact.

Economic (minimal, medium confidence)

- None known.

Social (minimal, medium confidence)

- Highly toxic if ingested – a single worm can exceed the human lethal dose of tetrodotoxin.
- However, the risk to humans is considered very low (as ingestion is unlikely) and there have been no known reported impacts of this species worldwide.
- The Puffer Fish, *Takifugu niphobles*, may accumulate tetrodotoxin by eating this species; however, there is no equivalent fish species in GB waters.

Introduction pathway

Potentially introduced in ballast water, hull fouling or as a contaminant of imported oyster stock

Spread pathway

Natural (moderate, low confidence) – suitable habitats for this species are found throughout GB

Human mediated (very slow, low confidence) – potential hitchhiker of hull fouling or aquaculture stock

Summary

	Response	Confidence
Entry	LIKELY	MEDIUM
Establishment	LIKELY	MEDIUM
Spread	INTERMEDIATE	LOW
Impact	MINIMAL	MEDIUM
Overall risk	LOW	MEDIUM

GB Non-native Species Rapid Risk Assessment (NRRA)

Rapid Risk Assessment of: *Cephalothrix simula* (a nermertean worm)
Author: Prof Ray Gibson, Liverpool John Moore University

Version: Draft 1 (August 2018), Peer Review (March 2019), NNRAP 1 (September 2018), Draft 2 (March 2019)
Signed off by NNRAP: March 2019
Approved by Programme Board: September 2020
Placed on NNSS website: October 2020

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

Response: *Cephalothrix simula* (Iwata, 1952) is a species of nemertean worm originally described from Japan. A single specimen, identified as a member of this species by sequencing carried out by Cefas, was found on a dead mussel shell in Cornwall, GB, in May 2018. There appear to be no other known or confirmed records of the species from British waters.

Nemertean worms are soft-bodied, largely marine, invertebrates known to occur throughout the world. However, there are little accurate data on how widely individual species are known to occur zoogeographically. With only one known exception (the entocommensal genus *Malacobdella*), nemerteans are known to be active carnivores on invertebrates (including cannibalism) and/or scavengers on dead animal remains. *Cephalothrix simula* in Japan has been recorded from intertidal to shallow sublittoral marine habitats, under stones or amongst laminarian holdfasts. Both types of habitat are widely available in GB waters. There appears to be no detailed knowledge of the species' ecology or population biology.

2 - What is the Risk Assessment Area?

Response: *Great Britain.*

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

Response: ***Cephalothrix simula*** (Iwata, 1952) Synonyms: *Procephalothrix simulus*, *Cephalothrix linearis* (in part). No common name. The genus *Cephalothrix*, originally established by Orsted (1843), was redefined by Wijnhoff (1913). The 17 species of *Cephalothrix* named before 1913 were inadequately described and much confusion and synonymity between species was common in the literature. Wijnhoff split the original genus into two with the introduction of *Procephalothrix* Wijnhoff, 1913. The principal morphological difference between members of the two genera appears to be the presence (*Procephalothrix*) or absence (*Cephalothrix*) of a body wall inner circular muscle layer (Junoy & Gibson, 1991), a feature not mentioned for older named species. Well defined anatomical differences between many species of both genera remain problematical: Kajihara *et al*. (2013), for example, report that *Cephalothrix simula*, *Cephalothrix fasciculus* (Iwata, 1952) and *Cephalothrix hongkongiensis* Sundberg, Gibson & Olsson, 2003, cannot be distinguished on the basis of anatomical features used at the time they were originally described.

A nemertean species identified as *Cephalothrix linearis* was recorded from Japan by Yamaoka (1940). *C. linearis* has been widely reported from the Mediterranean, western coasts of northern Europe and the North Atlantic including Greenland and North America north of Cape Cod (Gibson, 1995). There are insufficient data available to positively resolve the question as to whether or not *C. simula* and *C. linearis* might actually be conspecific although they are probably not.

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

Response: Possibly; insufficient data to be certain. Originally recorded from Japan (Hokkaido and Kyushu) by Iwata (1952), nemertean specimens attributed to the species *Cephalothrix simula* have subsequently been recorded from the Pacific coast of North America, the Atlantic coast of the Iberian Peninsula, in the Mediterranean Sea and on the North Sea coast of the Netherlands (Faasse & Turbeville, 2015). The problem remains that just because the species was first recorded from Japan (Iwata, 1952) does not necessarily mean that it is originally endemic from that region. The problem is compounded by the fact that since the establishment of the phylum Nemertea in the latter part of the 19th century there have been comparatively few scientists involved in any aspect of their study and the nemertean fauna of most parts of the world is accordingly not well known.

For probably at least 75% (possibly significantly greater) of the nemertean species described from around the world a first record from a particular country does not indicate that it is endemic to that country. Any assessment of what can genuinely be considered an introduced species (of nemertean) is thus highly problematical.

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

Response: A single record of a specimen identified as *C. simula* exists from Cornwall. The specimen was found on a dead mussel shell in May 2018. The species has been reported from the North Sea shores of the Netherlands.

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: An intertidal to shallow sublittoral species recorded from under stones on rocky beaches, living among shellfish communities or in the holdfasts of laminarian algae (all types of habitat widely available in GB waters) suggests that the species would encounter no difficulties in becoming established and successfully reproducing. There are many types of marine invertebrates in GB waters which would provide a food source for this carnivorous species. So far as is known there are no special ecological conditions required for it to survive beyond suitable habitats, which are readily available.

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: Yes. There are numerous records of several marine nemertean benthic species being widely distributed in north-western European waters (Gibson, Hextall & Rogers, 2001; Gibson & Knight-Jones, 2017).

8 - Has the organism established viable (reproducing) populations anywhere outside of its native range (answer N/A if you have answered 'yes' to question 4)?

Response: If *C. simula* reported from Japan and the Netherlands are indeed conspecific then it must be presumed that the answer to this question can only be yes.

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

Response: Not known with absolute certainty but highly probable. There appear to be no specific studies on any nemertean species relating to either natural or artificial rates of dispersal. Studies on the tetrodotoxin content of *Cephalothrix simula* by Kajihara *et al.* (2013) suggest that the species could easily be introduced to

an area via ship ballast water, in ship-fouling communities or in populations of the oyster *Crassostrea gigas* (Thurnberg, 1793): the oyster species has already been introduced to many parts of southern English coasts (Gibson, Hextall & Rogers, 2001).

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

Response: Studies by Rowell & Woo (1990), Rowell (1992) and Bourque et al. (2001) show that some heteronemerteans (mostly *Cerebratulus* species) can achieve predation rates that can alter populations of soft-shell clams or even devastate them, but species of Cephalothrix are both very much smaller and are not known to actively feed on molluscs. Any economic or social impact on the human population is likely to be non-existent. Although *Cephalothrix simula* is known to be highly toxic – the species contains high levels of tetrodotoxin (Asakawa, Ito & Kajihara, 2013). The authors record that the highest toxicity they found in a single worm exceeded the human lethal dose. 80% of the individuals they studied were ranked as 'strongly toxic' (more than about 1000 MU/g), 48% yielded toxin levels exceeding 2000 MU/g and the highest toxicity level recorded per gram of whole worm was 25,590 MU. Of thirteen nemertean species from Japanese waters investigated for tetrodotoxin activity *Cephalothrix simula* proved to be the most toxic, levels of toxicity being independent of locality or habitat but varying seasonally.

These authors suggest that the Puffer Fish *Takifugu niphobles* may accumulate tetrodotoxin by eating *Cephalothrix simula*. There is no equivalent fish species in GB waters.

Other species of nemerteans, including several commonly occurring in GB waters (e.g., *Lineus longissimus* [Gunnerus, 1770] and *Lineus ruber* [Muller, 1774]) are known to be toxic to a number of carnivorous macroinvertebrates. It is widely accepted that nemerteans, which are soft-bodied invertebrates, appear to contain epidermal mucus-borne toxins used as protection against predation. Some species are believed to also rely on tetrodotoxin as their defence but in others this is not the case. Strand *et al*., 2016, for example, found that in *Lineus longissimus* toxic effects on the shore crab, *Carcinus maenas* (Linnaeus, 1758) (paralysis and death) were caused by a different mechanism of action than that of tetrodotoxin. Under laboratory conditions starved shore crabs have been observed cleaning off the body surface mucus of *Lineus ruber* before ingesting them, with no apparent detrimental effects. Homogenates of whole nemerteans directly injected into the crabs, however, do result in rapid paralysis and death. This suggests that in the wild nemerteans are not commonly used as a food source, although some references to unidentified nemertean remains occurring in the stomachs of fish are known and migrating wading birds have been observed on Canadian Atlantic shores apparently feeding on burrowing nemertean species. There are no known reports of nemertean toxins causing harm to life in natural circumstances.

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: Medium

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

A single specimen of *Cephalothrix simula* has so far been recorded from GB waters (Cornwall, May 2018). Related species, *Cephalothrix linearis* (Rathke, 1799) and *Cephalothrix rufifrons* (Johnston, 1837), have been recorded from several locations around the British Isles and Eire (Gibson, 1994). *Cephalothrix linearis* (*partim*) is reported as synonymous with *Cephalothrix simula* (Gibson, 1995). Whether or not this indicates that *Cephalothrix simula* populations could already be established in GB waters cannot at present be determined: too few appropriate studies on British nemerteans have been made to allow for any accurate assessment to be made.

Establishment Summary

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

Response: Likely
Confidence: Medium

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

Cephalothrix simula is known to occur under stones on rocky shores, in laminarian holdfasts and on oyster shells. All of these habitats are widely available around the British Isles and the species has already been recorded from the Netherlands. Establishment of the species in GB waters is considered to be probable, eventually, if indeed it is not already established (see comments under Entry Summary above). Entry could occur at many locations around the British Isles and Eire, wherever appropriate habitats are available.

Spread Summary

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

Overall response: Moderate
Confidence: Low

Sub scores:

Natural spread only:
Response: Moderate
Confidence**:** Low

Human facilitated spread only:

Response: Probably very slow but impossible to assess accurately.
Confidence**:** Low

Comments (in your comments list the spread pathways and discuss how much of the total habitat that the species could occupy has already been occupied):

There are insufficient data available on nemertean ecology or distribution to accurately assess when or where this species of nemertean may first be recorded from the GB area, if indeed it is not already here but not recorded. The number of potential habitats around British shores is almost infinite. It is impossible to make any, even remotely, accurate assessment under this category.

Impact Summary

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

Overall response: Minimal
Confidence: Medium

Sub-scores

Environmental impacts:
Response: Minimal.
Confidence**:** Medium

Economic impacts:
Response: Minimal.
Confidence: Medium

Social impacts:
Response: Minimal.
Confidence: Medium

Comments (include list of impacts in your comments):

Wherever *Cephalothrix simula* has been recorded, from Japanese, Pacific North American, Atlantic Iberian Peninsula, Mediterranean or North Sea Netherlands coasts there have been no reports of the species having any adverse environmental or biological effects. There are no reasons to suggest that its appearance in GB waters would be any different.

Climate Change

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

Response: Very low
Confidence: Medium

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):

There are no data relating possible climate change to any aspect of nemertean biology. It is thus impossible to make any assessment under this category.

Conclusion

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

Response: Low
Confidence: Medium

Comments: Wherever *Cephalothrix simula* has been recorded from, there are no reports of the species having any ecological, biological or environmental impacts. There are no known reasons to suppose that any different effects would occur if the species becomes more common in the GB area.

References

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

List:

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