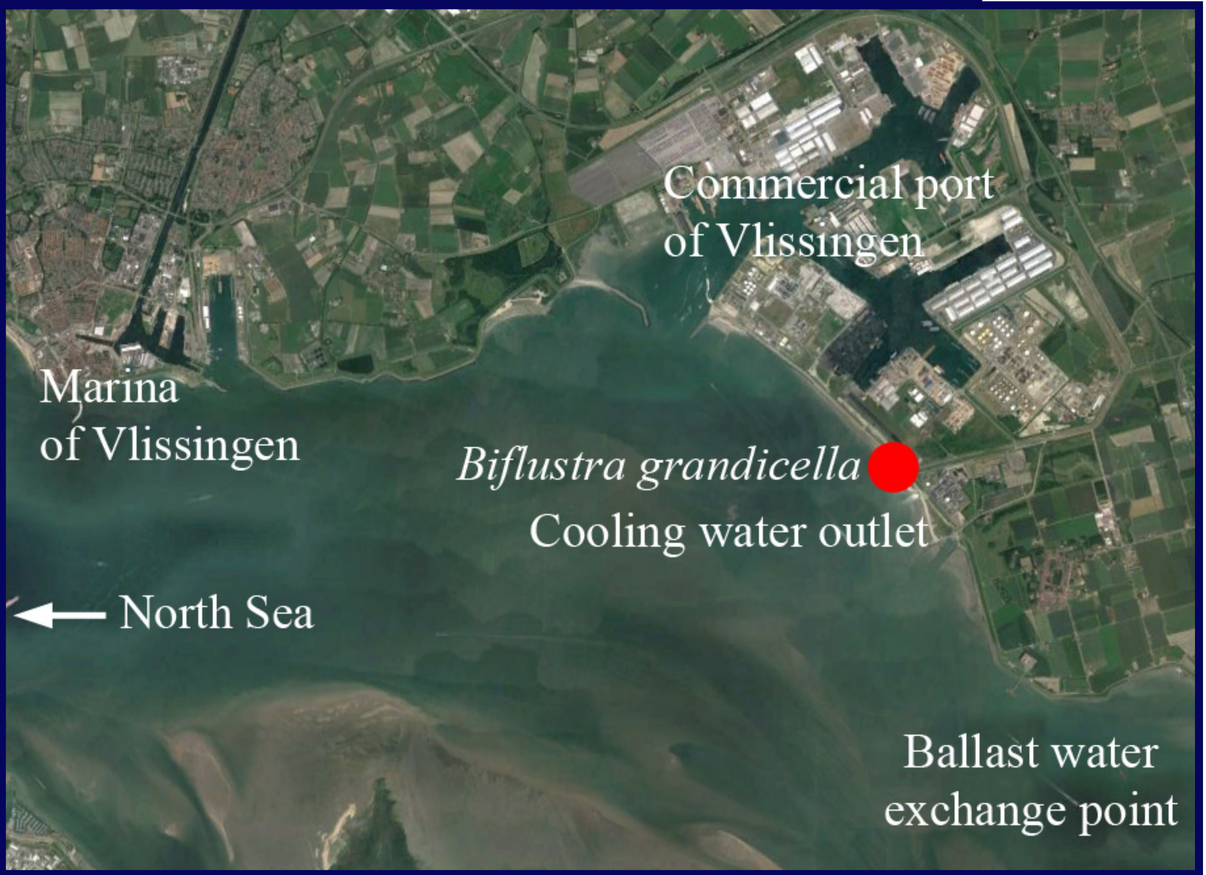
Risk Assessment of the bryozoan *Biflustra grandicella*

Issued by the Office for Risk Assessment and Research of the Netherlands Food and Consumer Product Safety Authority



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Risk Assessment of the bryozoan *Biflustra grandicella*

Cover:
Site where colonies of the bryozoan *Biflustra grandicella i*n the Netherlands were recorded, nearby various potential transport vector.

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1. Summary

Settled colonies of the "corn-flake coral" bryozoan species *Biflustra grandicella* were for the first time recorded in Europe in the winter months of 2016-2017. They were found just above the low water line on a beach next to the warm water outlet of the nuclear plant of Borssele in the Netherlands. The present report concerns the risk assessment commissioned by the Office for Risk Assessment and Research of the Netherlands Food and Consumer Product Safety Authority. Although it is unlikely that this tropical species will have a large impact in the relatively cold environment in the Netherlands, the species may cause problems clogging up cooling systems. In addition the Netherlands may act as a stepping stone for the species in its spread to warmer seas like the Mediterranean. Hull fouling and ballast water transports are identified as the main transport vectors of *B. grandicella* while the site where the settled bryozoan colonies were recorded is directly next to a pleasure craft harbour, a commercial port and an anchorage site used for ballast water exchange. Especially because the Dutch climate appears unsuitable for the establishment of *B. grandicella* in the wild, i.e. away from warm water outlets, eradication is probably possible at limited costs.

2. Introduction

In the South China Sea the "corn-flake coral" bryozoan species *Biflustra grandicella* (Canu & Bassler, 1929; Gordon, 2016), which is native to the region, is one of the commonest fouling bryzoans around (Liu, 1992). As a fouling species on ship hulls and possibly in ballast water it can be transported over vast distances. This explains how colony fragments were recorded for the first time far outside of its native range in 1997 in the southwestern Atlantic off the NE coast of Brazil (Almeida *et al*., 2017). Although there are no indications that the species managed to establish itself there since then, it did settle in large numbers in New Zealand directly after it was first found in 2002 in Golden Bay on the north end of South Island (Grange & Gordon, 2005). There at first scallop dredges full of colonies were fished up over a region of about 44 square kilometres. The population appears to have collapsed soon after however. Although colonies were still found on pleasure crafts years after the first sightings (Gordon *et al*., 2008) the species is not recorded any more in recent years (Gordon, *per comm*.). Tilbrook (2012) suggests that one of the fouled pleasure crafts described by Gordon et al. (2008) may have been responsible for the introduction of the species in Australia as it was traced back to having been in Queensland Australia in 2005. In Australia, the species was first recorded in Townsville, Queensland in 2011 where two small shells encrusted with *B. grandicella* were found amongst beach-cast debris (Tilbrook, 2012). It is still uncertain whether the species has been able to establish itself there afterwards (Tilbrook, 2012). In Europe the bryozoan *B. grandicella* (Canu & Bassler, 1929) was recorded for the first time on 11 December 2016 by Erik Speknijder who posted photos of a strange bryozoan that washed ashore in the Westerschelde, The Netherlands. On 12 February Nanda van den Berg manages to make photos of various up to basketball sized colonies growing in situ in the littoral zone of the beach "De Kaloot", just off to the cooling water outlet of the nuclear plant of Borssele in the Westerschelde. Subsequently the bryozoan specialist Hans De Blauwe that had received the photos concerned, collected some colonies and managed to identify the species as *Biflustra grandicella* (Blauwe, 2017). As this species, which is quite conspicuous in its appearance, was not found since then on any other site, the invasion may still be in its early stage. Therefore the Office for Risk Assessment and Research of the Netherlands Food and Consumer Product Safety Authority has commissioned an assessment of the potential risk that this species may form in the Netherlands and elsewhere in Europe. In addition the possibility was assessed to eradicate it in its early stages of settlement in the Netherlands.

3. Methodology

To assess the risk of the potentially invasive bryozoan *Biflustra grandicella* the Harmonia+ tool was used (D'hondt *et al*., 2014, 2015). This tool concerns a questionnaire that includes 30 core questions about the organism concerned focussing on different stages of invasion including its (potential) introduction, establishment, spread and impact. In the following paragraphs each of these stages are described for *Biflustra grandicella* after which the conclusion of this risk assessment is presented based partly on the resulting Harmonia+ risk score. Based on this conclusion it can be decided whether eradication may be feasible. A potential eradication plan including costs, is presented at the end of this report.

4. Risk Assessment

4.1. Means of introduction

4.1.1. Probability of introduction by natural means

As the fast growing basketball (up to ~40 cm) sized colonies of *B. grandicella* are relatively easy to spot and the species has not be recorded anywhere else in Europe water yet (Blauwe, 2017), it is unlikely that the species is already occurring wide-spread along the European coast. In addition, in the temperate waters of western Europe, at most places the water temperatures are probably too cold for colonies to settle. Exceptions may be sites close by cooling water outlets, similar as the site where it was found in the Westerschelde (Blauwe, 2017). It is therefore not impossible but unlikely that *B. grandicella* was originally introduced in the Westerschelde by natural means. Hull fouling appears to have been the most logical introduction vector as is explained in the next paragraph.

4.1.2. Probability of introduction by unintentional human actions

Just in front of the beach where *B. grandicella* was recorded in the Westerschelde lies the anchorage site Everingen A, which is known as the main location where ships leaving and going to the ports of Sloehaven and Antwerp would exchange their ballast water (Gittenberger *et al*., 2017b). As *B. grandicella* cyphonautes larvae can swim freely for at least three weeks they can be transported by ballast water (Almeida *et al*., 2007). It is uncertain however whether these larvae would survive in ballast water the much longer journey from the South China Sea to The Netherlands. Assuming that the introduction into the Netherlands concerned the primary introduction of this species out of its native range, it is more likely to assume that this happened by hull fouling. Fully grown *B. grandicella* colonies have proven to survive, for at least limited time periods, tropical water temperatures down to tempratures of only 3 degrees Celsius (Blauwe, 2017), which may enable them to survive such a journey on the hull of a ship. In addition to colonies reproducing or breaking off ships at the anchorage site Everingen A, ships docking in the Sloehaven, the commercial port of Vlissingen, could also have introduced the species in the Netherlands. This port lies directly next to the beach where the settled *B. grandicella* colonies were found. That hull fouling is a likely introduction vector is supported by the fact that the species in its native range in the South China Sea is found to be one of the commonest fouling bryozoans around (Liu, 1992). In addition both Gordon et al. (2008) and Tilbrook (2012) consider hull fouling to be the most likely vector with which this species was introduced in respectively New Zealand and Australia. This is based on repeated findings of colonies settled on hulls. Results of the fouling community study SETL, ongoing since 2006 in ports and harbours all along the Dutch coast, indicate that the Sloehaven of Vlissingen is a relatively high risk port where alien hull fouling species are concerned (Gittenberger et al. 2017). A recent study on biofouling showed that the SETL-site closest to the entrance of Sloehaven port concerns the site where the highest number of non-native species was recorded over the last eleven years within the whole SETL-project. Especially hull-fouling species are recorded within the SETL-project. It is therefore concluded that hull fouling concerns the most likely vector with which *B. grandicella* was introduced in The Netherlands and may be introduced again in the future. This hypothesis is also supported by a recent study on all alien species in the Westerschelde (Wijnhoven *et al.*, 2017). In this study it is concluded that hull fouling is the main introduction vector of aliens in the Westerschelde estuary. Hereby the port of Vlissingen region is identified as the place where most aliens were recorded for the first time in the Westerschelde. This includes alien bryozoans like *Bugula stolonifera, Smittoidea prolifica* and *Tricellaria inopinata* that were first recorded there in 2015 and 2016 on SETL-plates. The recent introduction and settlement of the individuals of these three bryozoan species in the Westerschelde and the first record of a *B. grandicella* colony in 2016 may all be linked to the relatively warm winters in those years. Both 2015 and 2016 had relatively warm winters in the Netherlands and both years were recorded as being the warmest years on record globally (https://www.nasa.gov/press-release/nasa-noaa-data-show-2016-warmest-year-on-record-globally). It remains uncertain whether the populations of these bryozoans will be able to establish themselves in the Westerschelde when winter temperatures go down.

4.1.3. Probability of introduction by intentional human actions

There is no reason to expect that *B. grandicella* will be introduced in the Netherlands by intentional human actions.

4.2. Establishment

4.2.1. Suitability of climate for establishment

Although the climate in the native range of *B. grandicella* in the South China Sea is tropical, i.e. with a water temperature of 18-31 degrees Celsius (Yan & Huang, 1990), settled colonies of *B. grandicella* have been found in waters with an average winter temperature of 11 degrees Celsius in New Zealand (Gordon *et al*., 2008). In the Netherlands a water temperature of 3 degrees Celsius was even measured in a settled colony that subsequently could be kept alive in an aquarium (Blauwe, 2017). Although the colonies of this tropical species apparently can survive relatively cold water temperatures for extended time periods it remains uncertain whether the species would be able to establish itself in such waters. In New Zealand for example the species did quickly spread and extend its population becoming abundant over a region of 44 km^2 within the first few years after being recorded (Gordon *et al*., 2008). Most of this population collapsed however several years later and in recent years the species not recorded anymore (Gordon, *pers. comm*.). Even in Australia and Brazil, where colonies were found in warmer waters, it seems that the species has not been able to establish itself (Almeida *et al*., 2017; Tilbrook, 2012). The warm 2015 and 2016 winters in combination with the warm water outlet of a cooling system may have given some colonies the opportunity to settle in the Westerschelde, The Netherlands, but it remains unlikely that it will be able to establish itself for the long term in The Netherlands during several colder winters in the more natural environment, i.e. away from warm water outlets. Even if the species may not be able to establish itself well in the Netherlands, the Netherlands may act as a stepping stone for *B. grandicella* in it spread to for example the Mediterranean. In the Mediterranean the average water temperatures over the year vary between 13-28 degrees Celsius (https://www.weather2travel.com/climate-guides), which is probably warm enough for *B. grandicella* to establish itself and spread widely, impacting the local environment.

4.2.2. Suitability of habitats for establishment

Although *B. grandicella* was found in the intertidal in the Netherlands, close to the low water line (Blauwe, 2017), it is known from the sublittoral at depths of 0-80 m and with salinities varying from 10 to 34 psu in its native range (Clarke *et al*., 2003; Liu, 1992). Since its discovery in The Netherlands no effort has been done to assess whether colonies are also found below the low water line. Although the colonies could also be present at much greater depths, this is doubtful here as the warm water from the cooling water outlet mainly warms up the surface water.

As *B. grandicella* colonies occur in their native range at salinities between 10.0-34.0 psu (Clark *et al*., 2003), salinity will not be a limiting factor for the establishment of this species in The Netherlands. All along the Dutch North Sea coast and in most parts of inland waters like the Wadden Sea, Oosterschelde and Westerschelde, salinities between 10.0-34.0 psu can be found.

B. grandicella colonies have been found in both muddy environments and environments with shells that were overgrown with the species (Gordon *et al*., 2008; Handley, 2006; Tilbrook, 2012), meaning that the presence of hard or soft substrata on the bottom do not restrict the possibility of this species to establish itself.

The main factor restricting the establishment of *B. grandicella* in most of the underwater habitats found in the Netherlands is expected to be the water-temperature as the survival of the colonies in the Netherlands appear to be linked to the presence of a warm water outlet. This is also discussed in the previous chapter about the suitability of the climate for its establishment.

4.3. Spread

4.3.1. Dispersal by natural means

If the population of *B. grandicella* in the Westerschelde would be able to establish itself, the species can extend its range within the Netherlands to other similar sites by natural means. This can be concluded based on the water currents along the coastline and the fact that the *B. grandicella* larvae can swim freely in the water column for at least three weeks (Grange & Gordon, 2005). Cooling water outlets into marine waters can be found all along the European coastline, often used by coal energy and nuclear energy plants. Such coal energy plants in the Netherlands are found on the Maasvlakte on the North Sea border of the port of Rotterdam and in the eastern Wadden Sea in the north of the Netherlands next to the Eemshaven. In between these two sites a cooling water outlet is situated on the Dutch North Sea coast off the nuclear plant close to Petten. The approximate distances from these three cooling water outlets to the one in the Westerschelde concern respectively 95 km (to Rotterdam), 190 km (to Petten) and 370 km (to Eemshaven). All these sites lie to the north of the Westerschelde. Therefore the bryozoan larvae could in principal reach these sites along with the residual sea current, which runs from the south to the north along the coastline of the Netherlands (Howarth, 2001) with an average velocity of about 4 km/day. Taking into account [1] that sea water surface currents are increased by about 2% of the wind speed (Chang *et al*., 2012), [2] spawning of *B. grandicella* in the Netherlands will probably happen in the warmest time of the year, and [3] summer winds in the Netherlands are often coming from the south west, one can calculate the average residual sea current velocity during the spawning period and thereby the distances that the larvae could theoretically travel along with this sea current. Although the residual current velocity of the surface water along the Dutch North Sea coast varies, on average it concerns >0.05 m/s (Duin *et al*., 2012), i.e. >4.32 km/day. Assuming a current velocity of 4 km/day and a moderate southwestern wind (6 knots = Beaufort force 4), the current velocity would be 4 km/day + (6 knots x 0.02 x 1.852 km/hour x 24 hours/day) = 9.33 km/day. Larvae in waters with this residual current velocity can travel over a distance of about 196 km in three weeks' time. Based on this it can be assumed that *B. grandicella* larvae released in the Westerschelde should easily be able to reach the warm water outlets in Rotterdam and probably also the one off Petten by natural means. If the species manages to establish itself there, it can use these two sites as stepping stones to eventually also reach the warm water outlet next to the Eemshaven in the eastern Wadden Sea.

In addition to being able to disperse in the larval stages, bryozoans like *B. grandicella* are frequently found on floating substrata such as algae and plastic debris enabling colonies to be distributed with the seas currents (Gordon et al. 2008).

Although the species may be dispersed by natural means to sites to the north of the Westerschelde, the south to north residual current will not allow the dispersion of *B. grandicella* south along the European coastline towards the Mediterranean.

4.3.2. Dispersal by human actions

The main dispersal vectors of alien species within European marine waters concern ballast waters, hull fouling and shellfish transports (Gittenberger *et al*., 2017). As the Westerschelde is not used by the shellfish industry this vector will not aid the dispersal of *B. grandicella* from that region. If the species manages however to extend its range, e.g. in a warm summer by natural means, to the neighbouring sea-inlet the Oosterschelde, then shellfish transports may start to play a role as this bay is extensively used as a shellfish production area, even though most shellfish in the Oosterschelde are not exported to other regions.

A more likely vector of dispersal would be ballast water. *B. grandicella* cyphonautes larvae can be transported by ballast water as they can swim freely for at least three weeks (Almeida *et al*., 2007). Just in front of the beach where *B. grandicella* was recorded in the Westerschelde lies the anchorage site Everingen A, which is known as the main location where ships leaving and going to the ports of Sloehaven and Antwerp would exchange their ballast water. For that reason the bottom underneath the anchorage site was specifically searched for alien species in 2016 to assess possibilities for exemptions to the ballast water convention following the OSPAR/HELCOM protocol (Gittenberger *et al*., 2017b; HELCOM/OSPAR, 2013). No organisms were found in bottom grabs at the site in 2016, presumably because of the great depths (30-55 meter) and the strong currents (Gittenberger *et al*., 2017b). Regardless of that result it can be concluded that *B. grandicella* larvae released in the water at that site are very likely to be present in ballast water that ships at Everingen A take in. Many if not most ships docking in the commercial ports of Vlissingen, Sloehaven and Antwerp travel worldwide between continents and seas with temperate to sub-tropical (e.g. Mediterranean) and tropical climates. Ballast water can therefore play a distinct role in the dispersal of *B. grandicella* cyphonaute larvae in the Westerschelde. It should be noted however that such larvae are probably killed with ballast water cleaning systems that will become mandatory on ballast water holding ships within the coming years because of the international ballast water convention that has come into force in September 2017. This convention is therefore expected to significantly reduce the chance that *B. grandicella* larvae are transported with ballast water.

Within its native range in the South China Sea, *B. grandicella*, is considered one of the commonest fouling bryozoans (Liu, 1992). This supports the hypothesis that the main vector of dispersal for *B. grandicella* from the Westerschelde will probably concern "hull" fouling, including colonies that settle within the sea-chests and on the hulls of commercial ships and on the hulls of pleasure craft. Especially the latter is also mentioned by Gordon et al. (2008) and Tilbrook (2012) as being possibly the most important vector of dispersal for *B. grandicella* to and within New Zealand and Australia. This was based on the fact that the species was repeatedly found on pleasure craft hulls. In New Zealand (Gordon *et al*., 2008). Larvae that would be released in the Westerschelde at the Kaloot beach next to the Sloehaven, the port of Vlissingen can not only settle on the hulls of the vessels in that port, but also on the ships lying still at the anchorage site Everingen A, and on the pleasure crafts in the pleasure craft harbour of Vlissingen.

Although the species can only disperse its range north along the European coastline by natural means, ballast water will enable its dispersal in all directions over much longer distances if it is not treated by a ballast water cleaning system. Hull fouling on both commercial vessels and pleasure crafts appears to be its most likely vector of dispersal (Gordon *et al*., 2008) in Europe both to the north and to the south of the Netherlands. With this vector it may reach the Mediterranean where the warmer climate appears to be ideal for the establishment of *B. grandicella*.

4.4. Impact

4.4.1. Environmental targets

B. grandicella appears to be an ecosystem engineer, being able to create hard substratum in muddy environments and more in general hard structures with holes and crevices that can be used as hiding places by a large variety of species. For example, crawling out of a single colony collected in the Westerschelde Blauwe (2017) recorded a total of 136 crabs belonging to three native species: the porcelain crabs *Porcellana platycheles* (Pennant, 1777) and *Pisidia longicornis* (Linnaeus, 1767), and the hairy crab *Pilumnus hirtellus* (Linnaeus, 1761). They used the colony as a hiding place and may therefore benefit from its presence in the Westerschelde where such ideal hiding places are scarce to find (pers. obs.). In New Zealand, according to Grange and Gordon (2005), epifauna attached to *B. grandicella* was less in abundance and diversity than that found attached to a native bryozoan species. In high densities *B. grandicella* as an ecosystem engineer is therefore expected to have a distinct impact on the local ecosystem. That such high densities can occur became clear in New Zealand where the species after being established rapidly spread over an area of approximately 255 km2, while the main distribution appeared to cover about 44 km2 (Handley, 2006). Hereby the basketball-sized colonies were so abundant that on occasion they filled complete scallop dredge nets (Tilbrook, 2012). Subsequently, the population in New Zealand appears to have collapsed and has become much more restricted (Gordon *et al*., 2008; Handley, 2006; Tilbrook, 2012). As the colonies appear to be relatively "clean", one can assume that the species probably has a chemical deterrent to epizoic settlement, and therefore probably also predation (Gordon, *pers. comm*.). It therefore does not seem likely that local predators will limit the settlement success of this species.

4.4.2. Plant targets

The species does not appear to have any impact on any specific marine plant species.

4.4.3. Animal targets

The species does not appear to have any impact on any specific marine animal species. More in general the colonies appear to form a habitat full of hiding places for small mobile invertebrates like crabs (Blauwe, 2017).

4.4.4. Human targets

The species does not appear to have any impact on human health

4.4.5. Other targets

In New Zealand the basketball-sized colonies were so abundant that on occasion they filled complete scallop dredge nets (Tilbrook, 2012). By doing so this will certainly have negatively impacted this scallop fishery. Similar dredge based shellfish fisheries are found just north to the Westerschelde in the Oosterschelde where bottom cultures can be found of mussels and oysters. If *B. grandicella* individuals would be able to settle in the Oosterschelde in similar quantities as in New Zealand, less mussels per day can be fished up as the colonies would fill up the dredges and cleaning the mussels and oysters (getting rid of the bryzoan colonies) would cost more time than usual. This would result in significant economic loss. As the calcareous colonies of the tropical bryozoan *B. grandicella* grow relatively fast up to sizes of about 40 cm, pipes within a cooling water system like the one in Borssele, just next to the beach where the bryozoan was found, may be clogged up by this species. There exists little to no experience with ways of getting rid of such colonies within cooling water systems in Europe, as similar "reef" building bryozoan species are not found in European waters. Without a properly working cooling system, the nuclear plant would in a worst case scenario have to shut down temporarily, at huge economic cost.

5. Conclusion

Based on the previous paragraphs the Harmonia+ quiestionaire was filled in the online tool (Table 1; http://ias.biodiversity.be/protocols/form). The Harmonia+ overall risk score of 0.199 (Tables 1-2) on a scale of 0-1 indicates that the alien bryozoan *Biflustra grandicella* is not expected to be a high risk species within the Netherlands. The Harmonia+ invasion and impact scores are higher, i.e. respectively 0.397 and 0.500, indicating the species could become invasive and have a distinct impact if a suitable climate would be present. The low overall risk score of 0.199 is mainly due to the fact that this is a tropical species that will probably not establish itself in the wild in the Netherlands because of the temperature climate. One should take into account however that colonies may be able to settle locally close to warm water outlets of cooling systems of coal energy and nuclear energy plants. It would not be unlikely to assume that some colonies may then also settle within the pipes of these cooling water systems. This could result in huge economical costs if the pipes in the cooling water systems would clog up and energy plants have to shut down temporarily. An additional important risk that is not taken into consideration within the Harmonia+ risk assessment tool, is the risk that larvae are transported from the Netherlands via ballast water or hull fouling to regions with sub-tropical and tropical climates, where the potential environmental impact is much larger. If the small population of settled colonies that were found in the Westerschelde does not expand itself within the Netherlands but does establish itself, it should be considered that the site is directly in front of the anchorage where ships in the Westerschelde are known to exchange their ballastwater, and directly next to both the pleasure craft harbour of Vlissingen and the commercial port of Vlissingen (see figure on the cover). It would therefore not be unlikely if this site within the Netherlands would act as an important stepping stone for *Biflustra grandicella* in its spread to warmer regions.

6. Potential eradication of *Biflustra grandicella* in Dutch waters

Most of the colonies of *Biflustra grandicella* that were found in the littoral zone in the Westerschelde were relatively large and distinctly formed. As only a maximum of 30 colonies were recorded at the site where the species was found to be settled and it was not found elsewhere since then, it may be possible to eradicate this species from the Netherlands.

Hereby we would suggest to search the littoral zone at the known site of settlement during an extreme low tide manually collecting all colonies present, using scrapers when they are attached to rocks. Some invasive species use fragmentation as a way of asexual reproduction after which the fragments get distributed with the currents and grow out again at the place where they end up on the bottom. This may also be the case for *Biflustra grandicella* as the colonies are fasting growing and extremely fragile. In addition, when parts of a colony come in contact with the substrate because of the colony's growth, they become attached to that surface. This indicates according to Blauwe (2017) that fragments may also be able to re-attach themselves. Although it remains uncertain whether this is the case, the removal of *Biflustra grandicella* colonies should be planned in winter time to minimize this risk. The colonies at that time will not be reproducing and are probably at their weakest because of the temperature, reducing the chance that fragments re-attach and survive.

Because hull fouling is one of the most likely vectors with which *Biflustra grandicella* is transported, floating docks in both the pleasure craft harbour and the port of Vlissingen, which is just next to the site where the species was found, should be searched. In addition the pleasure craft harbour of Breskens, positioned just opposite to Vlissingen, on the other side of the Westerschelde should be searched. If any specimens are found, they also have to be removed in winter time. After removing any specimens found, the sites where settled colonies of *Biflustra grandicella* were found, can be checked seasonally for at least a year to make certain that the eradication was successful. In the event that additional colonies are found during these checks, they should be removed and monitoring should be extended for a year from that moment on.

If *Biflustra grandicella* colonies are not at any additional sites, the costs that would be involved in the above described eradication and subsequent monitoring are estimated to be around 7500 Euro (Excl. BTW), assuming that the species only occurs at one site. These costs include:

- In winter time searching for colonies at four sites (three close to Vlissingen and one in Breskens) and removing them when present
  = 3760 Euro.
- Monitoring a site where *Biflustra grandicella* colonies were found settled in the past, during four seasons (March, June, September and December) after eradication
  = 3760 Euro.

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Table 1. The modules and questions included in the Harmonia+ protocol, answered for the risk assessment *Biflustra grandicella.*

Module		Question	Answer	Confidence level
Context	a1	Provide the name(s) of the assessors:	dr. A. Gittenberger & drs. M. Rensing	n.a.
	a2	Provide the name of the organism under assessment:	Biflustra grandicella	n.a.
	a3	Define the area under assessment:	The Netherlands within Europe	n.a.
	a4	Describe the status of the Organism within the area	Present	Medium
	a5	This assessment is considering potential impacts within the following domains:	Environmental domain	n.a.
Introduction	a6	The probability for The Organism to be introduced into The Area's wild by natural means is:	Low	High
	a7	The probability for The Organism to be introduced into The Area's wild by unintentional human actions is:	Medium	High
	a8	The probability for The Organism to be introduced into The Area's wild by intentional human actions is:	Low	High
Establishment	a9	The Area provides a […] climate for establishment of The Organism.	Sub-optimal	Medium
	a10	The Area provides a […] habitat for establishment of The Organism.	Sub-optimal	Medium
Spread	a11	The Organism's capacity to disperse within The Area by natural means is:	Medium	Medium
	a12	The Organism's frequency of dispersal within The Area by human actions is:	High	Medium
"Impacts: environmental targets "	a13	The Organism has a(n) […] effect on native species, through predation, parasitism or herbivory:	Inapplicable	n.a.
	a14	The Organism has a […] effect on native species, through competition:	Low	Medium
	a15	The Organism has a(n) […] effect on native species, through interbreeding:	No	High
	a16	The Organism has a […] effect on native species, by hosting pathogens or parasites that are harmful to them.	Low	Medium
	a17	The Organism has a […] effect on ecosystem integrity, by affecting its abiotic properties.	Low	High
	a18	The Organism has a […] effect on ecosystem integrity, by affecting its biotic properties.	Medium	High
"Impacts: plant targets "	a19	The Organism has a(n) [...] effect on plant targets, through herbivory or parasitism.	Inapplicable	n.a.
	a20	The Organism has a(n) [...] effect on plant targets, through competition.	Inapplicable	n.a.
	a21	The Organism has a(n) [...] effect on plant targets, by interbreeding with related organisms or with the target itself.	Inapplicable	n.a.
	a22	The Organism has a [...] effect on plant targets, by affecting the cultivation system's integrity.	Very low	Low
	a23	The Organism has a(n) [...] effect on plant targets, by hosting pathogens or parasites that are harmful to them:	Very low	Medium

Module		Question	Answer	Confidence level
"Impacts: animal targets "	a24	The Organism has a(n) [...] effect on individual animal health or animal production, through predation or parasitism.	Inapplicable	n.a.
	a25	The Organism has a [...] effect on individual animal health or animal production, by having properties that are hazardous upon contact.	Very low	Medium
	a26	The Organism has a(n) [...] effect on individual animal health or animal production, by hosting pathogens or parasites that are harmful to them.	Low	Low
"Impacts: human targets	a27	The Organism has a(n) [...] effect on human health, through parasitism.	Inapplicable	n.a.
	a28	The Organism has a [...] effect on human health, by having properties that are hazardous upon contact.	Very low	High
	a29	The Organism has a(n) [...] effect on the health of human targets, by hosting pathogens or parasites that are harmful to them.	Very low	Low
"Impacts: other targets	a30	The Organism has a [...] effect on causing damage to infrastructure.	Medium	Low

Table 2. Summary of the results of the risk assessment for *Biflustra grandicella* created with the Harmonia+ tool online (http://ias.biodiversity.be/harmoniaplus).

Summary

module	score	aggregation method	weight	confidence
introduction	0.167	arithmetic	1	1.0
establishment	0.5	arithmetic	1	0.5
spread	0.75	arithmetic	1	0.5
environmental im.	0.15	arithmetic	1	0.8
plant im.	0.0	arithmetic	1	0.25
animal im.	0.125	arithmetic	1	0.25
human im.	0.0	arithmetic	1	0.5
other im.	0.5	arithmetic	1	0.0

invasion score	**0.397**	geometric
impact score	**0.500**	maximum

overall risk score: 0.199