Overview

Short description of *Gracilaria vermiculophylla*, Worm Wart Weed

*Gracilaria vermiculophylla* is a type of red seaweed. Plants are dark-red to almost black, elongated with slender branched fronds growing to a length of 2 m. Attachment is by a small discoid holdfast. Branches are circular to slightly compressed in cross-section. Branching is irregular and dense with fronds tending to be widest in their central region, tapering towards the apices. Branches tend to be wrinkled and can show longitudinal grooves. The plants are cartilaginous but branches can feel elastic due to the lower parts being hollow. The growth form can vary from bushy to long and straggly. Female plants are long, poorly branched, strongly wrinkled and very thick towards the base; small hemispherical warts (conceptacles) adorn the frond surface. Male and tetrasporophyte plants are densely branched; male plants appear pale due to microscopic conceptacles on the surface. DNA analysis is required to confirm this species’ identity due to physical similarities shared with a number of closely related species.

Description of *Gracilaria vermiculophylla*, Worm Wart Weed status in GB

Large established populations have been confirmed in Dorset from Brownsea Island in Poole Harbour (from around 2009) and from Christchurch Harbour (2015), a single plant was discovered in Devon in the Salcombe-Kingsbridge estuary (2015). There is also a putative record from Porthmadog in Wales (2017).

Habitat summary: *Gracilaria vermiculophylla*, Worm Wart Weed

In its native range plants are predominantly attached to hard substrates such as rocks, whereas in its non-native range, including GB, this species is often found as loose-lying or entangled plants and favours sheltered estuaries and bays with muddy sediments which are rich in nutrients. It has broad environmental tolerances, surviving at salinities from 2–45 psu and temperatures from below 5 to 35 degrees C. It has been recorded from both cold and warm temperate waters.

Overview table

<table>
<thead>
<tr>
<th>Environment:</th>
<th>Marine</th>
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<tbody>
<tr>
<td>Species status:</td>
<td>Non-Native</td>
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<tr>
<td>Native range:</td>
<td>Northwestern Pacific</td>
</tr>
<tr>
<td>Functional type:</td>
<td>Algae (macroalgae)</td>
</tr>
<tr>
<td>Status in England:</td>
<td>Non-Native</td>
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<tr>
<td>Status in Scotland:</td>
<td>New arrival</td>
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<td>Status in Wales:</td>
<td>New arrival</td>
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<tr>
<td>Location of first record:</td>
<td>Poole Harbour</td>
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<td>Date of first record:</td>
<td>2010</td>
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Invasion history: *Gracilaria vermiculophylla*, Worm Wart Weed

Origin

Native to the NW Pacific (Japan, Korea, China and Vietnam). Introduced European populations appear to originate from NE Japan (Krueger-Hadfield et al., 2017b).

First Record
The first record from the wild in GB is thought to be from Brownsea Island, Poole Harbour, Dorset in 2009. Originally recorded as Gracilariaopsis longissima, it is now considered to have been Gracilaria vermiculophylla (Herbert et al., 2010; Krueger-Hadfield et al., 2017a)

Pathway and Method
Aquaculture is the most likely vector for its arrival in Britain as known locations also host Pacific oyster (Magallana gigas) aquaculture sites. Further introductions may take place by this route or through transport of fragments via shipping or leisure craft. Secondary spread around GB is likely via dispersal of vegetative fragments by currents, via fishing and leisure craft, entanglement in fishing gear, migrating birds, or shellfish movements. In Sweden, spread was very rapid (150km in 2 years) (Nyberg et al., 2009; Maggs & Magill, 2014; Krueger-Hadfield et al., 2017b)

Species Status
A widespread macroalgal invader in temperate estuaries of the N Hemisphere including Western and Eastern North America, NW Africa and Europe. The first record from the NE Atlantic was from western Germany (the Wadden Sea) in 2002 (Thomsen et al., 2007), and it has been present in NE Ireland since 2008 (Carlingford Lough (2008), Dundrum Bay (2012) and Strangford Lough (2013)). Large populations have recently been confirmed (using molecular analysis) in Dorset from Brownsea Island in Poole Harbour (2016, but see First Record below) and Christchurch Harbour (2015), and a single plant was discovered in Devon in the Salcombe-Kingsbridge estuary (2015). There is also a putative record from Porthmadog in Wales (2017) which was not DNA tested (Maggs & Magill, 2014; Krueger-Hadfield et al., 2017a)

Ecology & Habitat: Gracilaria vermiculophylla, Worm Wart Weed
Dispersal Mechanisms
The spores and spermatia are non-motile and can only survive for up to a few days, so natural dispersal is limited. However this species has the capacity to undergo extensive vegetative fragmentation, and these unattached fragments can grow and reproduce. As they are negatively buoyant, dispersal distance is again limited, unless facilitated by strong currents or anthropogenic means e.g. on nets and other marine equipment or shellfish movements (Weinberger et al., 2008; Krueger-Hadfield et al., 2017b)

Reproduction
G. vermiculophylla can reproduce both sexually and asexually. In its native range, where it is predominantly found on rocky shores, sexual reproduction is the norm. In GB (and over most of its non-native range) vegetative propagation of tetrasporophyte (diploid) plants dominates at the sites of introduction, possibly due to the lack of hard substratum necessary for spore recruitment (Krueger-Hadfield et al., 2017b, Bunker et al., 2017). However in Ireland all reproductive phases have been observed (Maggs & Magill, 2014)

Known Predators/Herbivores
G. vermiculophylla supports a wide range of grazers and epibiota including periwinkles, isopods and amphipods (Thomsen et al., 2007; Fofonoff et al., 2018)

Resistant Stages
G. vermiculophylla can survive several weeks of burial in sediment (Thomsen & McGlathery, 2007), ice cover (Nyberg et al., 2009) and absence of light and immersion in water for at least five months (Nyberg, 2007; Nyberg & Wallentinus, 2009).

Habitat Occupied in GB
In GB this species occurs intertidally and subtidally in shallow, low energy, soft-bottomed estuaries and bays. Plants may be loose-lying or attached to small shells or pebbles, but established populations are often found in association with habitat-building benthic invertebrates, for example using the byssal threads of mussels, or polychaete tubes for attachment (Thomsen et al., 2007; Nyberg et al. 2009.) G. vermiculophylla is tolerant of varying salinities and has a wide temperature tolerance (Maggs & Magill, 2014; GISD, 2018)

Distribution: Gracilaria vermiculophylla, Worm Wart Weed
Large populations are present in Christchurch Harbour and around Brownsea Island in Poole Harbour. A single specimen has also been confirmed from the Salcombe-Kingsbridge estuary. There is also a putative record from Porthmadog in Wales. As molecular analysis is required to confirm identification it is probable that this species is highly under-recorded in GB

Impacts: Gracilaria vermiculophylla, Worm Wart Weed
Environmental Impact
This species forms algal mats which can outcompete and even smother native seagrasses and modify intertidal saltmarshes (Thomsen et al. 2009). Once established G. vermiculophylla can attain very high biomass, and these large populations may displace native species of seaweeds such as fucoids, retard settlement of native species by making substratum unavailable, and cause mortality in larval stages by reducing light and oxygen availability. This species can dominate algal assemblages. However it may also increase biodiversity by introducing structural complexity to soft-bottomed shores, supporting grazers such as gastropods and epibiota such as red algae, and providing new refugia for mobile invertebrates (Maggs & Magill, 2014; GISD, 2018). Additionally, the movement, accumulation and decomposition of G. vermiculophylla is likely to have important implications for nutrient cycling and trophic dynamics in areas it invades (Thomsen et al., 2009)

Health and Social Impact
None known

Economic Impact
Plants can damage nets and foul propellers. In the USA power plant cooling intakes have been blocked (Maggs & Magill, 2014).

References & Links:
Gracilaria vermiculophylla, Worm Wart Weed
Identification

Biology, ecology, spread, vectors


Management and impact

(Rhodophyta, Gracilariaceae) in northern Europe, with emphasis on Danish conditions, and what to expect in the future. Aquatic Invasions, (2).


General


https://secure.fera.defra.gov.uk/nonnativespecies/downloadDocument.cfm?id=1522