Rhodothamniella floridula on sand-scoured lower eulittoral rock

MarLIN – Marine Life Information Network
Marine Evidence–based Sensitivity Assessment (MarESA) Review

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Sand tolerant red algae on lower shore.
Photographer: Kate Northen
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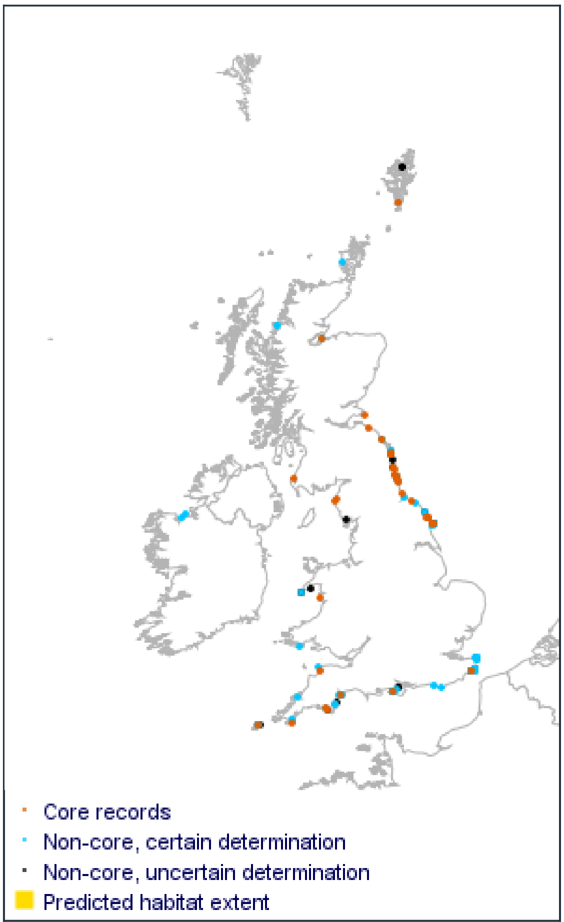

17-09-2018
Biotope distribution data provided by EMODnet Seabed Habitats (www.emodnet-seabedhabitats.eu)

Researched by Dr Heidi Tillin & Karen Riley **Refereed by** This information is not refereed.

Summary

UK and Ireland classification

EUNIS 2008	A1.215	*Rhodothamniella floridula* on sand-scoured lower eulittoral rock
JNCC 2015	LR.MLR.BF.Rho	*Rhodothamniella floridula* on sand-scoured lower eulittoral rock
JNCC 2004	LR.MLR.BF.Rho	*Rhodothamniella floridula* on sand-scoured lower eulittoral rock
1997 Biotope	LR.MLR.Eph.Rho	*Rhodothamniella floridula* on sand-scoured lower eulittoral rock

Description

Lower eulittoral and sublittoral fringe bedrock and boulders subject to mild sand-scouring characterized by a canopy of the wracks *Fucus serratus* or *Fucus vesiculosus*, beneath which a mat of the sand-binding red seaweed *Rhodothamniella floridula* occurs. These mats can form distinct areas without Fucus serratus. The small hummocks of *Rhodothamniella floridula* also contain a diversity of other red seaweeds tolerant of sand scour, e.g. *Palmaria palmata*, *Chondrus crispus*, coralline crusts and *Mastocarpus stellatus*. The brown seaweed *Cladostephus spongiosus* or the ephemeral green seaweed *Ulva intestinalis*, *Ulva lactuca* or *Cladophora rupestris* may occur. The hydroid *Dynamena pumila* can form colonies on the *Fucus serratus* fronds. The barnacle *Semibalanus balanoides*, the limpet *Patella vulgata*, the anemone *Actinia equina* and the polychaete *Spirobranchus triqueter* may be present where bedrock are available along with a few winkles such as *Littorina littorea*. In addition, polychaetes and amphipods may burrow into the *Rhodothamniella floridula* mat, while the mussel Mytilus edulis is restricted to small crevices in the bedrock. The species diversity of this biotope is normally low and there can be much variation in the species composition from site to site. (Information from Connor *et al*., 2004).

Depth range

Lower shore

Additional information

As the dominance of species varies from one to another so the colour of these populations may range from bright or dark green to various sandy, brownish-red shades, the whole contrasting sharply with adjacent areas of *Fucus* spp. (Lewis, 1964).

Listed By

- none -

Further information sources

Search on:

G G G JNCC

Habitat review

Ecology

Ecological and functional relationships

This biotope is predominantly of algae which dominate the rock surface and canopy. Macroalgae provide habitats for many species of invertebrates and fish and also provide shade under their canopy.

Rock type and sand scour effects are of critical importance to the development of this biotope. Sand-binding algal species are able to colonize soft or crumbly rock more successfully than fucoids (Lewis, 1964). Where sand scour is severe, fucoids and *Rhodothamniella floridula* tend to be absent while ephemeral green algae dominate the substratum and a different biotope will be present (Connor *et al*., 1997b).

Seasonal and longer term change

No information was found specifically on this biotope. However, some general observations from rocky shore communities are relevant.

- Ephemeral green algae may show a peak in abundance during the spring.
- Winter storms will reduce or damage fucoids and macroalgal cover.
- Crab and fish tend to move to deeper water in the winter months, so that predation is probably reduced.
- *Corallina officinalis* may be overgrown by epiphytes, especially during summer. This overgrowth regularly leads to high mortality of fronds due to light reduction (Wiedemann pers comm. to Tyler-Walters, 2000).
- At least in northern Britain, *Littorina littorea* migrates down shore as temperatures fall in autumn (to reduce exposure to sub-zero temperatures) and up shore as temperatures rise in spring; migration depends on local winter temperatures.
- The upper limit of distribution of *Patella vulgata* on a shore is increased by shade and exposure. In some situations seasonal variations in sunshine causes a downward migration in spring/summer and an upward migration in autumn/winter (Lewis, 1954).

Habitat structure and complexity

Bedrock and boulders form the substratum in this biotope; the pits, crevices and inclination of which create microhabitats exploitable by both mobile and sessile epilithic species. In addition, the macroalgal species of the community add considerable structural complexity to the biotope in the form of additional substratum for settlement by epiphytic species. The sand scour tolerant species, *Rhodothamniella floridula*, enhances the structural complexity by binding sand within a mat over the rocky substratum into which polychaetes and amphipods can burrow. There is likely to be considerable structural heterogeneity over a small scale within the biotope. For instance, although barnacles may form a dense layer over the substratum that largely excludes other species, the gaps created by dead barnacles may be exploited by small invertebrates.

Productivity

Rocky shore communities are highly productive and are an important source of food and nutrients for members of neighbouring terrestrial and marine ecosystems (Hill *et al.*, 1998). Macroalgae exude considerable amounts of dissolved organic carbon which is taken up readily by bacteria and may even be taken up directly by some larger invertebrates. Dissolved organic carbon, algal fragments and microbial film organisms are continually removed by the sea. This may enter the food chain of local, subtidal ecosystems, or be exported further offshore. Rocky shores make a contribution to the food of many marine species through the production of planktonic larvae and propagules which contribute to pelagic food chains.

Recruitment processes

Many rocky shore species, plant and animal, possess a planktonic stage: gamete, spore or larva which float in the plankton before settling and metamorphosing into adult form. This strategy allows species to rapidly colonize new areas that become available such as in the gaps often created by storms. For these organisms it has long been evident that recruitment from the pelagic phase is important in governing the density of populations on the shore (Little & Kitching, 1996). Both the demographic structure of populations and the composition of assemblages may be profoundly affected by variation in recruitment rates.

- Community structure and dynamics are strongly influenced by larval supply. Annual variation in recruitment success, of algae, limpets and barnacles can have a significant impact on the patchiness of the shore.

2. The propagules of most macroalgae tend to settle near the parent plant (Schiel & Foster, 1986; Norton, 1992; Holt *et al.*, 1997). For example, red algal spores and gametes are immotile and the propagules of Fucales are large and sink readily. Norton (1992) noted that algal spore dispersal is probably determined by currents and turbulent deposition (zygotes or spores being thrown against the substratum). For example, spores of *Ulva* spp. have been reported to travel 35km. The reach of the furthest propagule and useful dispersal range are not the same thing and recruitment usually occurs on a local scale, typically within 10m of the parent plant (Norton, 1992). Vadas *et al.* (1992) noted that post-settlement mortality of algal propagules and early germlings was high, primarily due to grazing, canopy and turf effects, water movement and desiccation (in the intertidal) and concluded that algal recruitment was highly variable and sporadic. However, macroalgae are highly fecund and widespread in the coastal zone so that recruitment may be still be rapid, especially in the rapid growing ephemeral species such as *Ulva* spp. and *Ulva lactuca*, which reproduce throughout the year with a peak in summer. Similarly, *Ceramium* species produce reproductive propagules throughout the year (Dixon & Irvine, 1977; Burrows, 1991; Maggs & Hommersand, 1993).
3. Gastropods exhibit a variety of reproductive life cycles. The common limpet *Patella vulgata* and the periwinkle *Littorina littorea* have pelagic larvae with a high dispersal potential, although recruitment and settlement is probably variable.
4. Barnacles such as *Semibalanus balanoides* have a planktonic nauplius larva, which spends about 2 months in the plankton, with high dispersal potential. Peak settlement in *Semibalanus balanoides* occurs in April-May in the west and May-June in the east and north of the British Isles, However, settlement intensity is variable, subsequent recruitment is inhibited by the sweeping action of macroalgal canopies (e.g. fucoids) or the bulldozing of

limpets and other gastropods (see *MarLIN* review for details).
5. Many species of mobile epifauna, such as polychaetes that may be associated with patches of mussels or rock crevices, have long lived pelagic larvae and/or are highly motile as adults.

Time for community to reach maturity

The MLR.Rho biotope consists mainly of algal species, with high spore production and dispersal potential, enabling rapid colonization and recolonization. The development of the community from bare or denuded rock is likely to be similar to that occurring after an oil spill. Recovery of rocky shore populations was intensively studied after the *Torrey Canyon* oil spill in March 1967. Areas affected by oil alone recovered rapidly, within 3 years. If rocks or boulders are present with sand in suspension, it is likely that recovery of the MLR.Rho biotope would take approximately the same amount of time.

Additional information

No text entered

Preferences & Distribution

Habitat preferences

Depth Range	Lower shore
Water clarity preferences	Oceanic water
Limiting Nutrients	Nitrogen (nitrates)
Salinity preferences	Full (30-40 psu)
Physiographic preferences	Open coast
Biological zone preferences	Eulittoral, Lower eulittoral
Substratum/habitat preferences	Bedrock, Large to very large boulders, Small boulders
Tidal strength preferences	Moderately Strong 1 to 3 knots (0.5-1.5 m/sec.), Weak < 1 knot (<0.5 m/sec.)
Wave exposure preferences	Exposed, Moderately exposed
Other preferences	

Additional Information

No text entered

Species composition

Species found especially in this biotope

Rare or scarce species associated with this biotope

-

Additional information

No text entered

Sensitivity review

Sensitivity characteristics of the habitat and relevant characteristic species

The biotope description and characterizing species is taken from Connor *et al*., (2004). This biotope is characterized by mats of the small red seaweed *Rhodothamniella floridula*, which is present on rock surfaces, with or without a canopy of *Fucus serratus* or *Fucus vesiculosus*. Mats of *Rhodothamniella floridula* are considered the key characterizing feature of this biotope and the sensitivity assessments are therefore focussed on this species.

The biotope occurs in the lower eulittoral and sublittoral fringe on bedrock and boulders that are subject to mild sand-scouring and has quite specific habitat requirements, *Rhodothamniella floridula* only occurs in areas of rock with a sand supply: sediment availability and transport processes are therefore significant. The environmental factors are considered within the sensitivity assessments where they may be altered by the pressure.

Species that are common on a range of rocky shores also occur in this biotope. The small hummocks of *Rhodothamniella floridula* also contain a diversity of other red seaweeds tolerant of sand scour, e.g. *Palmaria palmata*, *Chondrus crispus*, coralline crusts and *Mastocarpus stellatus*. The brown seaweed *Cladostephus spongiosus* or the ephemeral green seaweed *Ulva intestinalis*, *Ulva lactuca* or *Cladophora rupestris* may occur. The hydroid *Dynamena pumila* can form colonies on the *Fucus serratus* fronds. The barnacle *Semibalanus balanoides*, the limpet *Patella vulgata*, the anemone *Actinia equina* and the polychaete *Spirobranchus triqueter* may be present where bedrock are available along with a few winkles such as *Littorina littorea*. In addition, polychaetes and amphipods may burrow into the *Rhodothamniella floridula* mat, while the mussel *Mytilus edulis* is restricted to small crevices in the bedrock. The species diversity of this biotope is normally low and there can be much variation in the species composition from site to site. These species are not considered key characterizing species or to provide key structures or functions and the assessments largely avoid discussion of the associated biological assemblage except in the most general terms.

Resilience and recovery rates of habitat

The key characterizing species, the red algae *Rhodothamniella floridula* is attached to the substratum and is considered unable to re-attach following removal. Recovery of the biotope will therefore depend on the supply or propagules to repopulate surfaces where the population is removed or partly removed. No information was found relating to colonization or recolonization rates of *Rhodothamniella floridula* and some inferences have been made from the distribution of this species and from the life-history traits of similar species.

Rhodothamniella floridula is widely distributed around the UK, so that potentially suitable shores can be recolonized from adjacent populations. The species appears to have an annual life-cycle, the sandy turfs produced by this algae are thickest in the winter and become bleached in summer. Where they die back they lose sand. Red algae are typically high fecund, but their spores are non-motile (Norton, 1992) and therefore highly reliant on the hydrodynamic regime for dispersal. Kain (1975) reported that after displacement some Rhodophyceae were present after 11 weeks, and after 41 weeks, in June, Rhodophyceae species predominated. However, Stegenga (1978) noted that tetrasporangia of *Rhodothamniella floridula* (as *Rhodochorton floridulum*) germinated in 'rather low numbers'.

Resilience assessment. Where resistance to an impact from a pressure is 'High', resilience is assessed as 'High' by default (no impact to recover from). The presence of adult plants locally will aid recovery of small areas by providing spores and, recovery is, therefore, also assessed as 'High', where resistance is 'Medium'. Based on non-motile spores and the low germination rates reported by Stegenga (1978) , recovery from more significant impacts (where resistance is 'Low' or 'Medium') is assessed as 'Medium', (2-10 years). Due to a lack of evidence, confidence in recovery is low.

NB: The resilience and the ability to recover from human induced pressures is a combination of the environmental conditions of the site, the frequency (repeated disturbances versus a one-off event) and the intensity of the disturbance. Recovery of impacted populations will always be mediated by stochastic events and processes acting over different scales including, but not limited to, local habitat conditions, further impacts and processes such as larval-supply and recruitment between populations. Full recovery is defined as the return to the state of the habitat that existed prior to impact. This does not necessarily mean that every component species has returned to its prior condition, abundance or extent but that the relevant functional components are present and the habitat is structurally and functionally recognisable as the initial habitat of interest. It should be noted that the recovery rates are only indicative of the recovery potential.

Hydrological Pressures

	Resistance	Resilience	Sensitivity
Temperature increase (local)	High Q: Low A: NR C: NR	High Q: Low A: High C: High	Not sensitive Q: Low A: Low C: Low

Species found in the intertidal are exposed to extremes of high and low air temperatures during periods of emersion. They must also be able to cope with sharp temperature fluctuations over a short period of time during the tidal cycle. In winter air temperatures are colder than the sea, conversely in summer air temperatures are much warmer than the sea The rocky shore species associated with this biotope are therefore likely to have a degree of resistance to temperature changes.

Maximum sea surface temperatures around the British Isles rarely exceed 20 °C (Hiscock, 1998) and, as *Rhodothamniella floridula* has a global distribution (Guiry & Guiry, 2015, and references therein) it is, over the whole of its range, subject to a wider range of temperatures than experienced in the British Isles. It is therefore expected that increases in temperature, at the pressure benchmarks, will not result in mortality of the species.

However, increases in temperature above the pressure benchmark, may cause photosynthesis and growth to be impaired. For instance, Dixon & Irvine (1977) observed that the growth of *Rhodothamniella floridula* (as *Audouinella floridula*) is much faster in winter, whilst in the summer the spongy cushion can become bleached or disrupted. Stegenga (1978) found that tetraspores of cultured *Rhodothamniella floridula* (as *Rhodochorton floridulum*) were formed under all combinations of temperatures from 4 °C to 16 °C at any length of daylight, although they were most abundant at high temperatures and long days.

Sensitivity assessment. Based on the global distribution resistance to both acute and chronic increases in temperature at the pressure benchmark are assessed as 'High', and resilience is also assessed as 'High' by default, so that this biotope is considered to be 'Not sensitive'. Species may be acclimated to prevailing environmental conditions, so that distribution is only a proxy indicator of sensitivity and confidence in this assessment is Low.

Temperature decrease (local)	High Q: Low A: NR C: NR	High Q: High A: High C: High	Not sensitive Q: Low A: Low C: Low

Species found in the intertidal are exposed to extremes of high and low air temperatures during periods of emersion. They must also be able to cope with sharp temperature fluctuations over a short period of time during the tidal cycle. In winter air temperatures are colder than the sea, conversely in summer air temperatures are much warmer than the sea. The rocky shore species associated with this biotope are therefore likely to have a degree of resistance to temperature changes.

Dixon & Irvine (1977) observed that the growth of *Rhodothamniella floridula* (as *Audouinella floridula*) is much faster in winter, whilst in the summer the spongy cushion can become bleached or disrupted. It is therefore likely that a reduction in temperature will increase the growth rate of the species.

Minimum surface seawater temperatures rarely fall below 5°C around the British Isles (Hiscock, 1998) and, as *Rhodothamniella floridula* has a global distribution (Guiry & Guiry, 2015, and references therein) it is, over the whole of its range, subject to a wider range of temperatures than experienced in the British Isles. It is therefore expected that a decrease in temperature will not result in mortality of the species.

However, low temperatures may delay or slow reproduction. Stegenga (1978) found that spores of cultured *Rhodothamniella floridula* (as *Rhodochorton floridulum*) were formed under all combinations of temperatures from 4°C to 16°C at any length of daylight, although they were most abundant at high temperatures and long days.

Sensitivity assessment. Based on the global distribution resistance to both acute and chronic decreases in temperature at the pressure benchmark are assessed as 'High', and resilience is also assessed as 'High' by default, so that this biotope is considered to be 'Not sensitive'. Species may be acclimated to prevailing environmental conditions, so that distribution is only a proxy indicator of sensitivity and confidence in this assessment is Low.

Salinity increase (local)	No evidence (NEv) Q: NR A: NR C: NR	No evidence (NEv) Q: NR A: NR C: NR	No evidence (NEv) Q: NR A: NR C: NR

The *Rhodothamniella floridula* dominated biotope occurs in full salinity conditions. Although no information has been found on survival in hypersaline conditions, the species occurs in rockpools where evaporation may occasionally lead to higher than normal salinities suggesting the species may have at least a short-term tolerance.

Salinity decrease (local)	Low Q: Low A: NR C: NR	Medium Q: Low A: NR C: NR	Medium Q: Low A: Low C: Low

Biotopes found in the intertidal will naturally experience fluctuations in salinity where evaporation increases salinity and inputs of rainwater expose individuals to freshwater. Species found in the intertidal are therefore likely to have some form of behavioural or physiological adaptations to changes in salinity. As this biotope is present in full salinity, the assessed change at the pressure benchmark is a reduction in salinity to a variable regime (18-35 ppt). No information was found on the effects of reduced salinity on the key characterizing species *Rhodothamniella floridula*. However, as this species occurs only in full salinity conditions it is probable that a proportion of the population would die in lower salinities. Therefore, resistance has been assessed as ‘Low’ and recovery (following habitat recovery) is assessed as ‘Medium’ (2-10 years). Sensitivity is therefore assessed as ‘Medium’.

Water flow (tidal current) changes (local)	High Q: Low A: NR C: NR	High Q: High A: High C: High	Not sensitive Q: Low A: Low C: Low

The biotope with which *Rhodothamniella floridula* is associated occurs in areas where the water flow rate is either 'moderately strong' (0.5-1.5 m/s) or 'weak' (>0.5 m/s) (Connor *et al*., 2004). Moderate water movement is beneficial to seaweeds as it carries a supply of nutrients and gases to the plants and removes waste products. However, if flow becomes too strong, plants may become displaced. Additionally, an increase to stronger flows may inhibit settlement of spores and remove adults or germlings. *Rhodothamniella floridula* has a compact solid 'mat' or 'cushion' which probably makes it resistant to displacement by an increase in water flow.

Although *Rhodothamniella floridula* may not be directly sensitive to changes in water flow at the pressure benchmark, changes in flow that result in changes in sediment transport may result in negative effects. The biotope is present where sand scours and abrades the rock, preventing the establishment of fucoids. An increase or decrease in flow, that results in less, or no, sand being deposited on the rocks due to a lack of re-suspension from source sediments or velocities too high to allow sand to settle, may lead to a change in the biotope. Sediment transport processes are influenced by a range of site-specific factors including local sediment supply and topography. A generic assessment is not possible and this indirect effect is not assessed. It should be noted also that wave action may be a more important factor for sediment transport in this biotope than local tidal currents.

Sensitivity assessment. The biotope is found across a range of flow rates, mid-range populations are considered to have 'High' resistance to a change in water flow at the pressure benchmark (although see sediment supply caveats). Resilience is assessed as 'High', by default, and the biotope is considered 'Not sensitive'.

Emergence regime changes	Low Q: Low A: NR C: NR	Medium Q: Low A: NR C: NR	Medium Q: Low A: Low C: Low

Rhodothamniella floridula occurs predominantly in the littoral and sublittoral to about 5m depth (Dickinson, 1963; Dixon & Irvine, 1997) (as *Rhodochorton floridulum* and *Audouinella floridula* respectively) and is often found in rockpools. Emergence regime is a key factor structuring this (and other) intertidal biotopes. Increased emergence may reduce habitat suitability for the characterizing species *Rhodothamniella floridula* through greater exposure to desiccation and fluctuations in temperature and salinity when emersed (above the surface) and reduced photosynthetic rates when immersed (submerged). Changes in emergence may therefore lead to physical stress followed by species replacement through competition with species more tolerant of the changed conditions. The descriptions in Connor *et al*., (2004) of the biotopes typically found above and below this biotope on the shore give some indication of potential changes. Above this biotope in sand influenced areas are a community dominated by *Mytilus edulis* and *Fucus vesiculosus* or where the sand scour is more severe, is a biotope dominated by ephemeral seaweeds such as *Ulva* spp. and the red seaweed *Porphyra* spp (Connor *et al*., 2004). Below this biotope are biotopes dominated by *Fucus serratus* and/or red seaweeds or biotopes dominated by kelp such as *Alaria esculenta* and/or *Laminaria digitata*.

Sensitivity assessment. As emergence is a key factor structuring the distribution of macroalgae on the shore, resistance to a change in emergence (increase or decrease) is assessed as 'Low'. Recovery is assessed as 'Medium' (following habitat recovery) and sensitivity is therefore assessed as 'Medium' . This sensitivity assessment is generic, but it should be noted that populations of *Rhodothamniella floridula* at the landward limit of distribution may be less sensitive to increased submergence (habitat becomes more similar to the lower shore/sublittoral fringe), whereas populations closer to the sublittoral limit may be less sensitive to increased emergence (where conditions become equivalent to the lower eulittoral). Mobile species associated with this biotope, *Littorina* spp. and *Patella vulgata*, would be able to relocate to preferred shore levels. Attached species, such as *Mytilus edulis*, and *Spirobranchus triqueter*, are found at a range of shore levels but may experience greater predation levels following increased submergence.

Wave exposure changes (local)	High Q: Low A: NR C: NR	High Q: High A: High C: High	Not sensitive Q: Low A: Low C: Low

The biotope with which *Rhodothamniella floridula* is mostly associated occurs in wave exposed or moderately exposed locations (Connor *et al*., 2004). The degree of wave exposure influences significant wave height, as in more exposed areas with a longer fetch, waves would be predicted to be higher. The occurrence of this biotope across two wave exposure categories, was considered to indicate, by proxy, that biotopes in the middle of the wave exposure range would tolerate either an increase or decrease in significant wave height at the pressure benchmark.

Stronger wave action is likely to cause damage to filaments, resulting in reduced photosynthesis and compromised growth, but more likely dislodgement by the force of wave action and by scouring from sand and gravel mobilised by increased wave action (Hiscock, 1983). The deepest living individuals are likely to avoid the worst impact of wave exposure, but some mortality in the total population is likely.

Changes in wave action that result in changes in sediment transport may result in negative effects. The biotope is present where sand scours and abrades the rock, preventing the establishment of fucoids. An increase or decrease in wave action, that results in less, or no, sand being deposited on the rocks due to a lack of re-suspension from source sediments may lead to a change in the biotope. Conversely reduced wave action that results in permanent deposition of sediments may lead in the short-term to removal of this biotope due to smothering.Sediment transport processes are influenced by a range of site-specific factors including local sediment supply and topograghy. A generic assessment is not possible and this indirect effect is not assessed.

Sensitivity assessment. Based on reported distribution, resistance to changes in wave height, at the pressure benchmark, is assessed as 'High', and resilience is also assessed as 'High' by default. The biotope is therefore considered to be 'Not sensitive'.

Chemical Pressures

	Resistance	Resilience	Sensitivity
Transition elements & organo-metal contamination	Not Assessed (NA) Q: NR A: NR C: NR	Not assessed (NA) Q: NR A: NR C: NR	Not assessed (NA) Q: NR A: NR C: NR

This pressure is **Not assessed** but evidence is presented where available.

Contamination at levels greater than the benchmark may impact this biotope. Bryan (1984) suggested that the general order for heavy metal toxicity in seaweeds is: Organic Hg > inorganic Hg > Cu > Ag > Zn > Cd > Pb. Cole *et al.* (1999) reported that Hg was very toxic to macrophytes. The sub-lethal effects of Hg (organic and inorganic) on the sporelings of an intertidal red algae, *Plumaria elegans*, were reported by Boney (1971). 100% growth inhibition was caused by 1 ppm Hg. No information was found concerning the effects of heavy metals on *Rhodothamniella floridula* specifically.

	Resistance	Resilience	Sensitivity
Hydrocarbon & PAH contamination	Not Assessed (NA) Q: NR A: NR C: NR	Not assessed (NA) Q: NR A: NR C: NR	Not assessed (NA) Q: NR A: NR C: NR

This pressure is **Not assessed** but evidence is presented where available.

Contamination at levels greater than the benchmark may impact this biotope. No evidence was found specifically relating to the intolerance of *Rhodothamniella floridula* to hydrocarbon contamination. However, inferences may be drawn from the sensitivities of red algal species generally. O'Brien & Dixon (1976) suggested that red algae were the most sensitive group of algae to oil or dispersant contamination, possibly due to the susceptibility of phycoerythrins to destruction. Laboratory studies of the effects of oil and dispersants on several red algal species concluded that they were all sensitive to oil/dispersant mixtures, with little difference between adults, sporelings, diploid or haploid life stages (Grandy, 1984, cited in Holt et al., 1995).

Synthetic compound contamination	Not Assessed (NA) Q: NR A: NR C: NR	Not assessed (NA) Q: NR A: NR C: NR	Not assessed (NA) Q: NR A: NR C: NR

This pressure is **Not assessed** but evidence is presented where available.

Contamination at levels greater than the benchmark may impact this biotope. No information was found relating to the effects of synthetic chemicals on *Rhodothamniella floridula*. However, inferences may be drawn from the sensitivities of red algal species generally. O'Brien & Dixon (1976) suggested that red algae were the most sensitive group of algae to oil or dispersant contamination, possibly due to the susceptibility of phycoerythrins to destruction. They also reported that red algae are effective indicators of detergent damage since they undergo colour changes when exposed to a relatively low concentration of detergent. Laboratory studies of the effects of oil and dispersants on several red algal species concluded that they were all sensitive to oil/dispersant mixtures, with little difference between adults, sporelings, diploid or haploid stages (Grandy, 1984, cited in Holt *et al*., 1995). Cole *et al*. (1999) suggested that herbicides, such as simazine and atrazine were very toxic to macrophytes. The evidence suggests that in general red algae are very intolerant of synthetic chemicals.

Radionuclide contamination	No evidence (NEv) Q: NR A: NR C: NR	No evidence (NEv) Q: NR A: NR C: NR	No evidence (NEv) Q: NR A: NR C: NR

No evidence.

Introduction of other substances	Not Assessed (NA) Q: NR A: NR C: NR	Not assessed (NA) Q: NR A: NR C: NR	Not assessed (NA) Q: NR A: NR C: NR

This pressure is **Not assessed**.

De-oxygenation	No evidence (NEv) Q: NR A: NR C: NR	No evidence (NEv) Q: NR A: NR C: NR	No evidence (NEv) Q: NR A: NR C: NR

The effects of reduced oxygenation on algae are not well studied. Plants require oxygen for respiration, but this may be provided by production of oxygen during periods of photosynthesis. Lack of oxygen may impair both respiration and photosynthesis (see review by Vidaver, 1972). A study of the effects of anoxia on another red alga, *Delesseria sanguinea*, revealed that specimens died after 24 hours at 15°C but that some survived at 5°C (Hammer, 1972). No evidence is available to make an intolerance assessment for the key characterizing species, *Rhodothamniella floridula*.

Nutrient enrichment	High Q: Low A: NR C: NR	High Q: High A: High C: High	Not sensitive Q: Low A: Low C: Low

A moderate increase in nutrient levels may enhance the growth of the key characterizing species *Rhodothamniella floridula*. However, excessive eutrophication would probably result in the species being out-competed by ephemeral species with rapid growth rates, such as filamentous green and brown algae. The pressure benchamrk is protective of habitat condition, resistance is therefore assessed as 'High' and resilience as 'High', so that the biotope is considered to be 'Not sensitive'.

Organic enrichment	High Q: Low A: NR C: NR	High Q: High A: High C: High	Not sensitive Q: Low A: Low C: Low

No evidence was found to assess this pressure. The *Rhodothamniella floridula* biotope is considered to be structured largely by physical factors (wave exposure, sand supply and abrasion) that mediate competition rather than food supply. Additional organic matter supplied to this biotope is likely to be removed by wave action or trapped and incorporated into the sediment mat, held in place by *Rhodothamniella floridula*. Within the mat it would enhance secondary production by the associated polychaetes and amphipods and would be likely to be rapidly consumed. Resistance to this pressure is therefore assessed as 'High' and resilience as 'Hign' and the biotope is considered to be 'Not sensitive'.

Physical Pressures

	Resistance	Resilience	Sensitivity
Physical loss (to land or freshwater habitat)	None Q: High A: High C: High	Very Low Q: High A: High C: High	High Q: High A: High C: High

All marine habitats and benthic species are considered to have a resistance of ‘None’ to this pressure and to be unable to recover from a permanent loss of habitat (resilience is ‘Very Low’). Sensitivity within the direct spatial footprint of this pressure is therefore ‘High’. Although no specific evidence is described confidence in this assessment is ‘High’, due to the incontrovertible nature of this pressure.

Physical change (to another seabed type)	None Q: High A: High C: High	Very Low Q: High A: High C: High	High Q: High A: High C: High

This biotope occurs on hard substrata where macroalgae, including the characterizing mats of *Rhodothamniells floridula*, can attach. A sedimentary habitat would be unsuitable for many of the associated attached species and lead to the development of a sedimentary biotope typical of the changed conditions. It is not clear whether artificial substrata could support this biotope.

Sensitivity assessment. A change to a sedimentary habitat would reduce habitat suitability for this biotope, resistance is assessed as ‘None’ and resilience as ‘Very Low’ as the change is considered to be permanent. Sensitivity is therefore assessed as 'High'.

Physical change (to another sediment type)	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR

Not relevant to biotopes occurring on bedrock.

Habitat structure changes - removal of substratum (extraction)	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR

The species characterizing this biotope are epifauna or epiflora occurring on rock and would be sensitive to the removal of the habitat. However, extraction of rock substratum is considered unlikely and this pressure is considered to be ‘Not relevant’ to hard substratum habitats.

Abrasion/disturbance of the surface of the substratum or seabed	Medium Q: Low A: NR C: NR	High Q: Low A: NR C: NR	Low Q: Low A: Low C: Low

No information was found concerning the effects of abrasion on *Rhodothamniella floridula*. However, this species is characteristic of sand scoured habitats and the growth form of a dense mat, consolidated by sediment is probably tolerant of low intensity and magnitude surface abrasion such as a single trampling event.

Sensitivity assessment. Resistance to abrasion at the surface only is assessed as ‘Medium’ as a small proportion of the mat is likely to be removed in the impact footprint, Recovery is assessed as ‘High’ and sensitivity is assessed as ‘Low’.

Penetration or disturbance of the substratum subsurface	Low Q: Low A: NR C: NR	Medium Q: Low A: NR C: NR	Medium Q: Low A: Low C: Low

Activities that disturb the surface of the mat and penetrate below the surface are likely to tear up and remove a significant proportion of the mat. Resistance is therefore assessed as ‘Low’ and recovery is assessed as ‘Medium’. Sensitivity is therefore assessed as ‘Medium’.

Changes in suspended solids (water clarity)	High Q: High A: Low C: NR	High Q: High A: High C: High	Not sensitive Q: High A: Low C: Low

No direct evidence was found to assess this pressure, however this species is categorised as tolerant of sediments as it is frequently found on rocky coasts with high levels of sediments, where rock surfaces are scoured and covered by sand (Airoldi, 2003). The branched thalli is tough and the mats of *Rhodothamniella floridula* trap sediment allowing species of polychaete and amphipod to become established.

Sensitivity assessment. As mats of *Rhodothamiella floridula* occurs in wave exposed environments where sand layers are moved and deposited, the biotope is considered to have ‘High; resistance and (by dafulat) ‘High’ resilience to this pressure. The biotoe is therefore considered to be ‘Not sensitive’ to this pressure. Wave movements are likely to rapidly remove sediments preventing negative effects from shading and smothering. However, sensitivity to deposits of fine sediments coupled with a decrease in wave action or water flow , where the deposit remains in place for an extended period would be higher. The species associated with this biotope are considered to have an equal tolerance for this pressure as they are exposed to the same levels of sediment and deposition..

Smothering and siltation rate changes (light)	High Q: High A: Low C: NR	High Q: High A: High C: High	Not sensitive Q: High A: Low C: Low

No direct evidence was found to assess this pressure, however the key characterizing species, *Rhodothamniella floridula*, is categorised as tolerant of sediments as it is frequently found on rocky coasts with high levels of sediments, where rock surfaces are scoured and covered by sand (Airoldi, 2003). The branched thalli is tough and the mats of *Rhodothamniella floridula* trap sediment allowing species of polychaete and amphipod to become established.

Sensitivity assessment. As mats of *Rhodothamiella floridula* occurs in wave exposed environments where sand layers are moved and deposited, the biotope is considered to have 'High; resistance and (by dafulat) 'High' resilience to this pressure. The biotoe is therefore considered to be 'Not sensitive' to this pressure. Wave movements are likely to rapidly remove sediments preventing negative effects from shading and smothering. However, sensitivity to deposits of fine sediments coupled with a decrease in wave action or water flow , where the deposit remains in place for an extended period would be higher. The species associated with this biotope are considered to have an equal tolerance for this pressure as they are exposed to the same levels of sediment and deposition.

Smothering and siltation rate changes (heavy)	Medium Q: Low A: NR C: NR	High Q: Low A: NR C: NR	Low Q: Low A: Low C: Low

No direct evidence was found to assess this pressure, however this species is categorised as tolerant of sediments as it is frequently found on rocky coasts with high levels of sediments, which are scoured and covered by sand (Airoldi, 2003). The branched thalli is tough and the mats of *Rhodothamniella floridula* trap sediment allowing species of polychaete and amphipod to become established.

Sensitivity assessment. The pressure benchmark refers to a thick deposit of fine sediment. Resistance to this pressure will be mediated by the length of time the deposit remains in place which will depend on water flow and wave action as well as the footprint of the pressure. If large areas of shore were impacted, wave action may merely move sediments around the beach rather than clearing them. Fine sediments are more cohesive than the sand deposits which the biotope is typically exposed to and less permeable. If covered entirely for an extended period the mats of *Rhodothamniella floridula* will be prevented from photosynthesising and respiring and may begin to rot. Resistance is assessed as 'Medium' as a proportion of the population may be lost. Resilience is assessed as 'High' and sensitivity is assessed as 'Low'. The evidence is considered less applicable to the 'heavy' siltation pressure than the 'low' siltation and confidence in this pressure is therefore assessed as 'Low'.

Litter	Not Assessed (NA) Q: NR A: NR C: NR	Not assessed (NA) Q: NR A: NR C: NR	Not assessed (NA) Q: NR A: NR C: NR

Not assessed.

Electromagnetic changes	No evidence (NEv) Q: NR A: NR C: NR	No evidence (NEv) Q: NR A: NR C: NR	No evidence (NEv) Q: NR A: NR C: NR

No evidence.

Underwater noise changes	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR

Not relevant.

Introduction of light or shading	High Q: Low A: NR C: NR	High Q: High A: High C: High	Not sensitive Q: Low A: Low C: Low

The key characterizing species *Rhodothamniella floridula* can occur as exposed mats on hard substratum or may occur beneath canopies of *Fucus* spp. which provide shade, indicating that it is tolerant of both high and low light levels. In addition, Stegenga (1978) found that tetraspores of cultured *Rhodothamniella floridula* (as *Rhodochorton floridulum*) were formed at any length of daylight, although they were most abundant at high temperatures and long days.

Sensitivity assessment. Based on occurrence in shaded and unshaded locations and the evidence from Stegenga (1978), *Rhodothamniella floridula* is considered to have ‘High’ resistance and ‘High’ resilience (by default) to this pressure and the biotope is therefore considered to be ‘Not sensitive’.

Barrier to species movement	High Q: Low A: NR C: NR	High Q: High A: High C: High	Not sensitive Q: Low A: Low C: Low

No direct evidence was found to assess this pressure. As the larvae of the key characterizing species and many of the other associated species are planktonic and are transported by water movements, barriers that reduce the degree of tidal excursion may alter larval supply to suitable habitats from source populations. However the presence of barriers may enhance local population supply by preventing the loss of larvae from enclosed habitats. As the species found within this biotope are common and widely distributed, source populations and hence larval supply is likely to be plentiful (unless unsuitable habitats provide wide discontinuities), resistance to this pressure is assessed as 'High' and resilience as 'High' by default. This biotope is therefore considered to be 'Not sensitive'.

Death or injury by collision	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR

Not relevant’ to seabed habitats. NB. Collision by grounding vessels is addressed under 'surface abrasion'.

Visual disturbance	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR

Not relevant.

Biological Pressures

	Resistance	Resilience	Sensitivity
Genetic modification & translocation of indigenous species	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR

Key characterizing species within this biotope are not cultivated or translocated. This pressure is therefore considered 'Not relevant' to this biotope group'.

Introduction or spread of invasive non-indigenous species	High Q: Low A: NR C: NR	High Q: High A: High C: High	Not sensitive Q: Low A: Low C: Low

Invasive non-indigenous macroalgae that could out-compete native macroalgae for space are the most likely species to negatively affect this biotope. The sand trapping mats of *Rhodothamniella floridula* are relatively unstable and friable and therefore unsuitable for species that require firm attachment spaces including macroalgae but especially the non-native bryozoans and tunicates such as *Didemnum vexillum* (many of which are still recorded only from marinas and artificial substratum than natural habitats).

Algal species which may have overlapping habitat requirements are the green seaweed *Codium fragile* subsp *tormentosoides*. (now renamed as *Codium fragile fragile*) and the red seaweed *Heterosiphonia japonica*, neither of these have so far been recorded in nuisance densities (Sweet, 2011j).

Sargassum muticum grows best on sheltered shores and in rockpools (Sewell, 2011c), the habitats in which the *Rhodothamniella floridula* characterised biotope occurs are probably not suitable for this species to occur in high densities.

Sensitivity assessment. No information on the effects of alien species on *Rhodothamniella floridula* were found. Overall, there is little evidence of this biotope being adversely affected by non-native species, resistance is therefore assessed as 'High', and resilience as 'High' (by default), and the biotope is considered to be 'Not sensitive'.

Introduction of microbial pathogens	No evidence (NEv) Q: NR A: NR C: NR	No evidence (NEv) Q: NR A: NR C: NR	No evidence (NEv) Q: NR A: NR C: NR

No evidence was found to assess this pressure.

Removal of target species	High Q: Low A: NR C: NR	High Q: High A: High C: High	Not sensitive Q: Low A: Low C: Low

The mussel *Mytilus edulis* is too small and patchy in this biotope to be targeted for commercial harvesting. However, some hand-gathering of this species and the edible periwinkle *Littorina littorea* or *Patella vulgata* may occur. Edible seaweeds, carrageen (*Chondrus crispus*) and dulse (*Palmaria palmata*) may also occur in low densities in the biotope and be harvested locally. As these species are present only in low densities, ecological effects such as the proliferation of algae (from removal of grazers) or other significant changes to the structure and function of the biotope are not predicted to arise from removal.

Sensitivity assessment. This biotope is considered to have 'High' resistance to removal of targeted species by hand-gatherers and 'High' resilience (by default) and is therefore considered to be 'Not sensitive' to this pressure. It should be noted that this pressure assesses the ecological effects of removal of targeted species, direct, physical impacts arising from harvesting (abrasion from trampling) are assessed through the abrasion and penetration of the seabed pressures.

Removal of non-target species	Low Q: Low A: NR C: NR	Medium Q: Low A: NR C: NR	Medium Q: Low A: Low C: Low

The sensitivity assessment for this pressure considers any biological/ecological effects resulting from the removal of non-target species on this biotope Incidental removal of the characterizing species *Rhodothamniella floridula* would alter the character of the biotope. Without the trapped sand the burrowing polychaetes and amphipods associated with this biotope would be lost and some changes in the algal mat may occur. The ecological services such as primary and secondary production and nutrient cycling associated with this biotope would also be lost.

Sensitivity assessment. Removal of a large percentage of the characterizing species would alter the character of the biotope, so that it was bare rock. Resistance is, therefore, assessed as ‘Low’, recovery as ‘Medium’, and sensitivity is, therefore, assessed as 'Medium' .

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