Prasiola stipitata on nitrate-enriched supralittoral or littoral fringe rock

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

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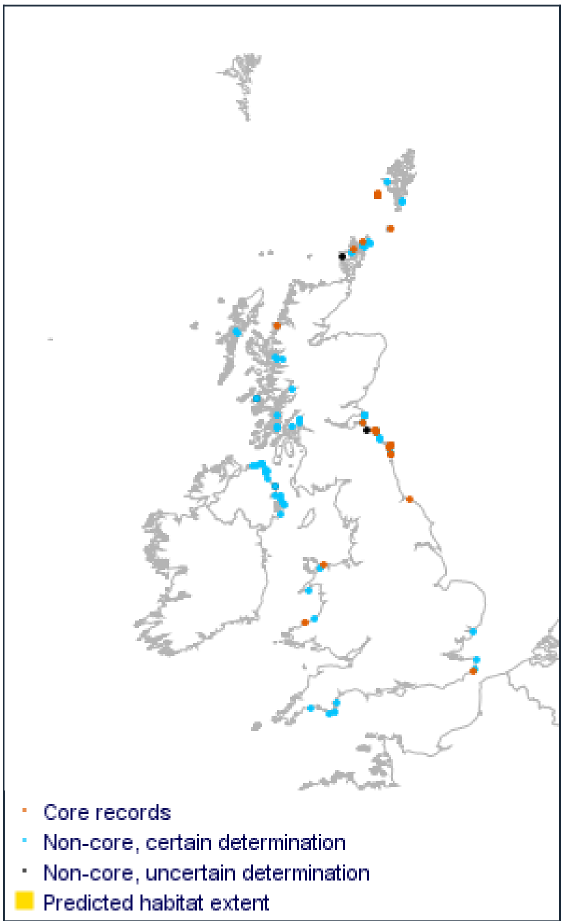
Prasiola stipitata on nitrate-enriched supralittoral or littoral fringe rock
Photographer: Judy Foster-Smith



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

Researched by Dr Harvey Tyler-Walters **Refereed by** Admin

Summary

UK and Ireland classification

EUNIS 2008	B3.112	*Prasiola stipitata* on nitrate-enriched supralittoral or littoral fringe rock
JNCC 2015	LR.FLR.Lic.Pra	*Prasiola stipitata* on nitrate-enriched supralittoral or littoral fringe rock
JNCC 2004	LR.FLR.Lic.Pra	*Prasiola stipitata* on nitrate-enriched supralittoral or littoral fringe rock
1997 Biotope	LR._.L.Pra	*Prasiola stipitata* on nitrate-enriched supralittoral or littoral fringe rock

Description

Exposed to moderately exposed bedrock and large boulders in the supralittoral and littoral fringe that receives nitrate enrichment from nearby roosting sea birds and is characterized by a band or patches of the transient tufty green seaweed *Prasiola stipitata* or *Prasiola* spp. This typically grows over the black lichen *Verrucaria maura* in the littoral fringe or yellow and grey lichens in the supralittoral zone. In damp pits and crevices, species such as the winkle *Littorina saxatilis*, amphipods and halacarid mites are occasionally found. LR.FLR.Lic.Pra often covers a smaller area than 5m x 5m and care and may be under-recorded. LR.FLR.Lic.Pra can be associated with artificial substrata such as septic tanks, and in supralittoral areas influenced by sewage seeps or agricultural run-off. It may also be found at the entrances to and on the ceilings of littoral caves or in patches on large boulders, where birds may be roosting. *Prasiola stipitata* reaches its maximum abundance during the winter months. It generally dies out during the summer in southern Britain, when the biotope reverts to either YG or Ver.Ver. In the cooler northern areas it may be present all year round. (Information taken from Connor *et al*., 2004).

Depth range

Upper shore

Additional information

-

Listed By

- none -

Further information sources

Search on:

G G G JNCC

Sensitivity review

Sensitivity characteristics of the habitat and relevant characteristic species

This biotope (LR.FLR.Lic.Pra) is characterized by dense patches or cover of the tufts of dark green *Prasiola stipitata*. Each individual plant (or tuft) is 1-5 mm in height. *Prasiola stipitata* can occur in the eulittoral but only forms dense mats in the littoral fringe and supralittoral. It is most usually associated with areas that receive some form of nutrient enrichment, e.g. areas subject to agricultural runoff, sewage seeps, bird colonies or upper shore rocks used as a roost by seabirds or wildfowl (Lewin, 1955; Rindi *et al.*, 1999; Connor *et al.*, 2004; Kang *et al.*, 2013; Guiry, 2016) but can occur in oligotrophic conditions (Lewis, 1964 cited in Russell, 1991). It is most abundant in winter, dying back in the summer months on southern shores, although it remains all year round in northern shores subject to lower temperatures and higher rainfall or in areas of runoff (Rindi *et al.*, 1999; Connor *et al.*, 2004). It grows on littoral fringe rock and artificial substrata (Rindi *et al.*, 1999) but also grows over other littoral fringe communities (e.g. *Verrucaria maura*, LR.FL:R.Lic.Ver) or supralittoral yellow and grey lichen communities (LR.FLR.Lic.YG) in winter, wet crevices or areas of runoff, although it also grows over Lic.Ver in the vicinity of bird colonies,where wave action provides adequate spray to keep the *Prasiola stipitata* mat moist (Wootton, 1991). *Littorina saxatilis*, littoral fringe isopods and halacarid mites probably graze the *Prasiola* together with other macroalgae, and surface microalgae but are mobile not limited to this biotope alone. Therefore, the sensitivity of this biotope is determined by the important characterizing species *Prasiola stipitata*.

Resilience and recovery rates of habitat

Prasiola stipitata has a unique life cyle (Van den Hoek *et al.*, 1995; Lee, 2008). The diploid thallus can form diploid spores or haploid gametes at the apex of the frond. Diploid spores (aplanospores) are non-motile (aflagellate), settle, germinate and forms plants. Haploid gametes form at the apex of the frond, which undergoes meiosis to form male and female cells. This results in a patchwork pattern of male and female cells, as the female cells have larger, darker, chloroplasts. On release, the males gametes are biflagellate while the female gametes are non-motile (aflagellate). On contact, one of the male gametes flagella fuses with the female gamete, followed by fertilization. The resultant zygote swims vigorously by means of the remaining flagellum. At 5°C, it can swim for several hours before settlement. Spore-forming plants occur higher on the shore than gamete forming plants (Freidmann, 1959 and Freidmann & Manton, 1959 cited in Lee, 2008). Therefore, *Prasiola stipitata* can releases numerous asexual spores and sexual gametes into the water column. The non-motile asexual spores probably allow it to colonize the substratum quickly while numerous spores mean that recruitment to suitable substratum is also probably rapid. In addition, Bingham & Schiff (1979) observed that fragmentation of the thallus resulted in the release of most of its cells and that these cells could attach to the substratum and develop into new plants in culture. Also, Guiry (2016b) noted that *Prasiola stipitata* plants that died back in summer apparently survived as basal fragments to regrow in winter.

Friedmann (1959, 1969 cited in Rindi *et al.*, 1999) noted that *Prasiola stipitata* was seasonal from its southern limit to about 55° N (latitude) and disappeared in summer but that is was perennial further north. However, in some areas, e.g. the west coast of Ireland, where rainfall is substantially higher and consistent than other places in north west Europe, *Prasiola stipitata* persisted for the entire year, as long as summer was not too hot or dry (Rindi et al., 1999). In Galway Ireland, the abundance and height of the *Prasiola stipitata* belt on the shore were lower in summer. Plant length was greatest in October to March with a peak in January, spore production was greatest in March, May and June but recorded every month, although sterile plants were seen in April and gametogenesis was recorded in November to March only (Rindi *et al.*, 1999). In the Bay of Fundy, Canada it is also seasonal, dying back in summer month (Kang *et al.*, 2013). Kang *et al.* (2013) noted that, in November, during its normal period of expansion, and area without an obvious cover of *Prasiola stipitata* had extensive cover one week later.

Resilience assessment. *Prasiola stipitata* is seasonal in much of its range, dying back in summer months and increasing in abundance and extent in winter; produces numerous asexual and motile sexual spores, so that local recruitment and dispersal are probably good and can colonize the substratum quickly under suitable conditions. Therefore, resilience is likely to be **High**, even where the biotope is removed.

Hydrological Pressures

	Resistance	Resilience	Sensitivity
Temperature increase (local)	Medium Q: Low A: NR C: NR	High Q: Medium A: Medium C: Medium	Low Q: Low A: Low C: Low

Friedmann (1959, 1969 cited in Rindi *et al.*, 1999) noted that *Prasiola stipitata* was seasonal from its southern limit to about 55° N (latitude) and disappeared in summer but that is was perennial further north. It is recorded throughout the North Atlantic, from the Massachusetts to south west Greenland on the eastern seaboard and from north Spain to Iceland in the west and into the Baltic (Russell, 1991). The littoral fringe and supralittoral experiences the extremes of hot summers and cold frosty winters, so that *Prasiola stipitata* is probably adapted to extreme variation in temperature. However, an increase in temperature is likely to affect desiccation experienced by the biotope, in combination with wave splash, spray, rainfall and wind. An increase in temperature may affect the seasonality so that perennial populations in northern waters may become seasonal while die back in southern waters may be more prolonged. Therefore, a resistance of **Medium** is suggested with Low confidence. Resilience is probably **High** so that sensitivity is assessed as **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

Friedmann (1959, 1969 cited in Rindi *et al.*, 1999) noted that *Prasiola stipitata* was seasonal from its southern limit to about 55° N (latitude) and disappeared in summer but that is was perennial further north. It is recorded throughout the North Atlantic, from the Massachusetts to south west Greenland on the eastern seaboard and from north Spain to Iceland in the west and into the Baltic (Russell, 1991). The littoral fringe and supralittoral experiences the extremes of hot summers and cold frosty winters, so that *Prasiola stipitata* is probably adapted to extreme variation in temperature. However, a decrease in temperature is likely to affect desiccation experienced by the biotope, in combination with wave splash, spray, rainfall and wind. A decrease in temperature may affect the seasonality so that seasonal populations in southern waters may become perennial. In addition, winter is the main growth period for *Prasiola stipitata*. Therefore, a resistance of **High** is suggested with Low confidence. Resilience is, therefore, **High** (by default) so that the biotope is assessed as **Not sensitive**.

Salinity increase (local)	High Q: High A: High C: Medium	High Q: High A: High C: High	Not sensitive Q: High A: High C: Medium

The littoral fringe is likely to experience localised evaporation and resultant increased surface salinity during neap and low tides in hot summers and/or warm windy conditions, together with reduced salinity due to rainfall or runoff. Russell (1991) reported that salinity tolerance in *Prasiola stipitata* showed local adaptation, depending on origin. Specimens from Norway, where summers were cool and wet, were less exposed to hypersaline events that more southern specimens (from north west England) that died back in summer while specimens from the Baltic were more exposed to hyposaline events. Specimens from Norway and NW England had the highest density of plantlets at 34‰ and markedly reduced density at 6‰ while Baltic specimens had a maximum density at 34‰ but a smaller reduction in density at 6‰, after three weeks. All specimens had lower densities after three weeks at 68‰ and greatly reduced densities at 102‰. Nevertheless, all specimens were very halotolerant (Russell, 1991). *Prasiola stipitata* is probably adapted to extremes of salinity greater than expressed by the benchmark. Therefore, a resistance of **High** is suggested. Resilience is, therefore, **High** and the biotope has been assessed as **Not sensitive** at the benchmark level.

Salinity decrease (local)	High	High	Not sensitive
	Q: High A: High C: Medium	Q: High A: High C: High	Q: High A: High C: Medium

The littoral fringe is likely to experience localised evaporation and resultant increased surface salinity during neap and low tides in hot summers and/or warm windy conditions, together with reduced salinity due to rainfall or runoff. Russell (1991) reported that salinity tolerance in *Prasiola stipitata* showed local adaptation, depending on origin. Specimens from Norway, where summers were cool and wet, were less exposed to hypersaline events that more southern specimens (from north west England) that died back in summer while specimens from the Baltic were more exposed to hyposaline events. Specimens from Norway and NW England had the highest density of plantlets at 34‰ and markedly reduced density at 6‰ while Baltic specimens had a maximum density at 34‰ but a smaller reduction in density at 6‰, after three weeks. All specimens had lower densities after three weeks at 68‰ and greatly reduced densities at 102‰. Nevertheless, all specimens were very halotolerant (Russell, 1991). *Prasiola stipitata* is probably adapted to extremes of salinity greater than expressed by the benchmark. Therefore, a resistance of **High** is suggested. Resilience is, therefore, **High** and the biotope has been assessed as **Not sensitive** at the benchmark level.

Water flow (tidal current) changes (local)	Not relevant (NR)	Not relevant (NR)	Not relevant (NR)
	Q: NR A: NR C: NR	Q: NR A: NR C: NR	Q: NR A: NR C: NR

The littoral fringe and supralittoral are unlikely to be affected by changes in water flow as described in the pressure benchmark. Runoff due to heavy rainfall is possible but is outside the scope of the pressure. Therefore, the pressure is **Not relevant**.

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

This biotope is characteristic of littoral fringe and supralittoral habitats that are rarely inundated and depend on wave action to provide splash or spray, or rainfall to moisten the habitat. Wooton (1991) noted that *Prasiola stipitata* grew over the Verrucaria belt in the presence of bird guano, only where wave action was sufficient to wet the habitat. In a tidal simulator experiment, Hruby & Norton (1979; Fig 2) reported that 60-100% of *Prasiola stipitata* propagules survived one to three weeks in culture at >7 hrs of immersion per tidal cycle, but 20-59% survived 4-6 hrs, and only 1-19% survived 0-4 hrs immersion per tidal cycle. Kang *et al.* (2013) examined photosynthesis in *Prasiola stipitata* under desiccation stress. They noted that photosynthesis recovered totally within one hour of immersion after two days of desiccation but after 15 days of desiccation recovery took 24 hrs. However, after 30 days the photosynthetic apparatus shows signs of damage and only partial recovery occurred. They noted that complete desiccation for 15 of more days in the field was unlikely and that the dense crowding of individual thalli within the algal mat, granted some protection from desiccation (Kang *et al.*, 2013).

While *Prasiola stipitata* is desiccation tolerant, it is only abundant in the littoral fringe or supralittoral in areas that received some wetting, and dies back in the summer months (presumably due to reduced wetting, and increased desiccation) except in areas of consistent rainfall runoff or low temperatures (Rindi *et al.*, 1999). Therefore, a change in emergence regime will alter the degree of wetting. An increase in emergence could reduce the height of the *Prasiola stipitata* band on the shore or shift it from a perennial to a seasonal biotope. A decrease in emergence may allow it to colonize further up the shore where suitable substratum exists or cause it to be out-competed by upper shore algae. Therefore, a resistance of **Low** is suggested. Resilience is probably **High** so that sensitivity is assessed as **Low**.

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

This biotope is recorded on wave exposed to moderately wave exposed shores. Although the littoral fringe or supralittoral are rarely inundated, wave action (via splash and spray) are an important source of wetting within the biotope. A change in wave action could alter the degree of wetting received by the *Prasiola stipitata* algal mat and alter its abundance and height on the shore, especially in summer months. However, a change of 3-5% of significant wave height is probably not significant on moderately to wave exposed shores. Therefore, the biotope is **Not sensitive** (resistance and resilience are High) at the benchmark level.

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.

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.

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.

Radionuclide contamination	No evidence (NEv) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR	No evidence (NEv) Q: NR A: NR C: NR

No evidence was found.

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	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 littoral fringe is is rarely inundated and is often exposed to the air. For example, Fletcher (1980) noted that *Lichina confinis*, a species that occurs at the top of the littoral fringe, spent a maximum of 1% of time submerged each year while *Verrucaria striatula*, a species that occurs in the lower littoral fringe below the *Verrucaria maura*, spent a maximum of 44% of time submerged each year. Therefore, this biotope (LR.FLR.Lic.Pra) is exposed to the air for the majority of the time. Even if the water lapping over the littoral fringe was deoxygenated, wave action and turbulent flow over the rock surface would probably aerate the water column. Hence, the biotope is unlikely to be exposed to deoxygenated conditions.

Nutrient enrichment	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR	Not sensitive Q: NR A: NR C: NR

The abundance of *Prasiola stipitata* that characterizes this biotope is associated with nutrient enrichment and the biotope occurs in areas affected by bird dropping and guano, eg. near bird colonies or roosts, or with sewage seeps and agricultural runoff. Lewin (1955) demonstrated that organic nitrogen increased the growth of *Prasiola stipitata* in culture. Wooton (1991) demonstrated that *Prasiola meridionalis* became the dominant alga in the presence of guano and wave action, and out-competed *Verrucaria maura* in the splash zone. Therefore, an increase in nutrients may benefit the biotope. Nevertheless, this biotope is considered to be **'Not sensitive'** at the pressure benchmark that assumes compliance with good status as defined by the WFD.

Organic enrichment	No evidence (NEv) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR	No evidence (NEv) Q: NR A: NR C: NR

Organic-rich runoff would probably promote *Prasiola* growth where wave exposure allowed. However, no direct evidence on the effects of organic enrichment in the littoral fringe was found and not sensitivity assessment was made.

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 is only found on hard substrata and dominates rocks in the littoral fringe. A change to a sedimentary substratum, however unlikely, would result in the permanent loss of the biotope. Therefore, the biotope has a resistance of **None**, with a **Very low** resilience (as the effect is permanent) and, therefore, a sensitivity of **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 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 on hard rock biotopes.

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

Not Relevant on hard rock biotopes.

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

The mat of *Prasiola stipitata* is composed of numerous individual thalli, each of which is loosely attached to the substratum. It can easily be removed by hand. It is, therefore, likely to be affected by trampling or vehicular access, although no direct evidence was found. Therefore, a resistance of **Low** is suggested but with Low confidence. Resilience is probably **High** so that sensitivity is assessed as **Low**.

Penetration or disturbance of the substratum subsurface	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

Penetration is unlikely to be relevant to hard rock substrata. Therefore, the pressure is **Not relevant**.

Changes in suspended solids (water clarity)	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

This biotope occurs in mid to littoral fringe and supralittoral and rarely inundated. Therefore, an increase in turbidity due to suspended solids (at the benchmark) is unlikely to adversely affect the biotope and **Not relevant** is recorded.

Smothering and siltation rate changes (light)	No evidence (NEv) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR	No evidence (NEv) Q: NR A: NR C: NR

No information on siltation in the littoral fringe or supralittoral was found.

Smothering and siltation rate changes (heavy)	No evidence (NEv) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR	No evidence (NEv) Q: NR A: NR C: NR

No information on siltation in the littoral fringe or supralittoral was found.

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	Not relevant (NR) Q: NR A: NR C: NR	No evidence (NEv) Q: NR A: NR C: NR

No evidence was found.

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: Medium A: Low C: Low	High Q: High A: High C: High	Not sensitive Q: Medium A: Low C: Low

The littoral fringe habitat is likely to be exposed to high levels of irradiance, direct sunlight when compared to the littoral or sublittoral that are emersed. However, Kang *et al.* (2013) noted that high irradiance (up to 1800 µmol photons/m^2/s) had no negative impact on photosynthesis in *Prasiola stipitata*. In addition, a largely shaded and moist population of *Prasiola stipitata* showed no changes in photosynthetic parameters from one hour after sunrise to sunset. Although the evidence is limited, it suggests that *Prasiola stipitata* is probably resistant of a range of light and shade conditions. Therefore, resistance is probably **High**, so that resilience is **High** and the biotope is assessed as **Not sensitive**.

Barrier to species movement	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

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

The pressure definition is not directly applicable to the littoral fringe so **Not relevant** has been recorded. Collision via ship groundings or terrestrial vehicles is possible but the effects are probably similar to those of abrasion above.

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	No evidence (NEv) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR	No evidence (NEv) Q: NR A: NR C: NR

No evidence of the translocation, breeding or species hybridization in *Prasiola stipitata* was found.

Introduction or spread of invasive non-indigenous species	No evidence (NEv) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR	No evidence (NEv) Q: NR A: NR C: NR

No evidence was found.

Introduction of microbial pathogens	No evidence (NEv) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR	No evidence (NEv) Q: NR A: NR C: NR

No evidence was found.

Removal of target 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

Prasiola stipitata is unlikely to be targetted by any commercial or recreational fishery or harvest.

Removal of non-target 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

Accidental physical disturbance due to access (e.g. trampling) or grounding is examined under abrasion above. Where present, mobile invertebrate fauna are probably not entirely dependent on the algal mat for food or habitat and would forage elsewhere. However, this biotope is unlikely to be targetted by any commercial or recreational fishery or harvest.

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