Cordylophora caspia and *Einhornia crustulenta* on reduced salinity infralittoral rock

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***Cordylophora caspia* and *Electra crustulenta* on reduced salinity infralittoral rock.**
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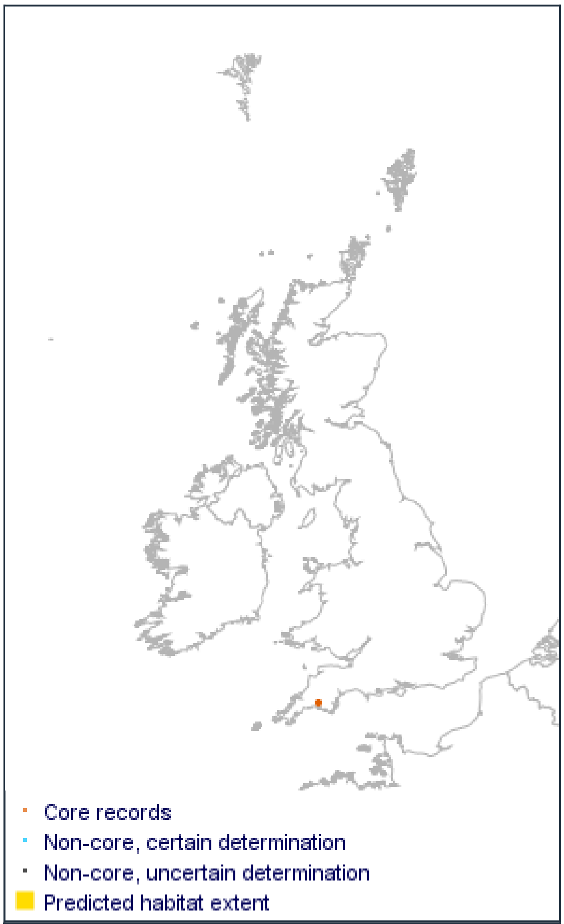

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Biotope distribution data provided by EMODnet Seabed Habitats (www.emodnet-seabedhabitats.eu)

Researched by Dr Harvey Tyler-Walters **Refereed by** This information is not refereed.

Summary

UK and Ireland classification

EUNIS 2008	A3.362	*Cordylophora caspia* and *Electra crustulenta* on reduced salinity infralittoral rock
JNCC 2015	IR.LIR.IFaVS.CcasEin	*Cordylophora caspia* and *Einhornia crustulenta* on reduced salinity infralittoral rock
JNCC 2004	IR.LIR.IFaVS.CcasEle	*Cordylophora caspia* and *Electra crustulenta* on reduced salinity infralittoral rock
1997 Biotope	IR.SIR.EstFa.CorEle	*Cordylophora caspia* and *Electra crustulenta* on reduced salinity infralittoral rock

Description

Shallow sublittoral rock in the upper estuary of one of the south-west inlets (Tamar) with very high turbidity and, therefore, no seaweeds. The brackish-water hydroid *Cordylophora caspia* and small colonies of the encrusting bryozoan *Einhornia crustulenta* and a few *Balanus crenatus* characterize this biotope. (Information taken from the Marine Biotope Classification for Britain and Ireland, Version 97.06: Connor *et al*., 1997a, b).

Depth range

0-5 m

Additional information

Little direct information on the ecology of this biotope was available and reference has been made to other hydroid communities, especially estuarine fouling communities where appropriate. The biotope has been described from only two records in the MNCR database (JNCC, 1999). Notably, the brackish water barnacle *Balanus improvisus* was once found in the same area as this biotope (MBA, 1957) and may sometimes be a characteristic species in this biotope.

Listed By

- none -

Further information sources

Search on:

G G JNCC

Habitat review

Ecology

Ecological and functional relationships

Hydroids may be important in transferring energy from the plankton to the benthos (bentho-pelagic coupling), due to their high feeding rates (Gili & Hughes, 1995), and bryozoans may be equally important in this community. For example, *Obelia* was reported to be an important regulator of local populations of copepods (Gili & Hughes, 1995). Bryozoans such as *Einhornia crustulenta* are active suspension feeders on bacteria, small flagellate phytoplankton, algal spores and small pieces of abraded macroalgae or detritus, although they are probably dependant on currents to bring adequate food within reach (Winston, 1977; McKinney, 1986; Best & Thorpe, 1994; Hayward & Ryland, 1998). Hydroids such as *Cordylophora caspia* are passive carnivores that capture prey that swim into, or are brought into contact with their tentacles by currents. Prey are then killed or stunned by the nematocysts born on the tentacles and swallowed. Diet varies but is likely to include small zooplankton (e.g. nauplii, copepods), small crustaceans, chironomid larvae, detritus and oligochaetes, but may include a wide variety of other organisms such as the larvae or small adults of numerous groups (see Gili & Hughes, 1995). The barnacle *Balanus crenatus* is also a suspension feeder on phytoplankton, zooplankton and detritus.

The three species recorded in the biotope probably compete for space when they occupy the same hard substrata and all grow rapidly. However, *Cordylophora caspia* can probably grow on the shells of *Balanus crenatus* and encrusting bryozoans may survive overgrowth by other species (Gordon, 1972; Todd & Turner, 1988). However, in the Tamar estuary *Cordylophora caspia* dominated the shallower areas of the biotope, while *Einhornia crustulenta* and *Balanus crenatus* occurred in deeper water, presumably removed from the lowest salinities and freshwater influence at nearer the surface.

Few of the typical predators of hydroids and bryozoans (Ryland, 1976; Gili & Hughes, 1995) are present in the low, variable salinities characteristic of this biotope. Roos (1979) reported that the freshwater amphipod *Gammarus tigrinus* ate the polyps of *Cordylophora caspia* in the low and variable salinity river system of western Holland. It is likely that estuarine and freshwater amphipods and fish (e.g. sticklebacks) are potential predators on the hydroid in this biotope. The lagoonal sea slug *Tenellia adspersa* feeds on *Cordylophora caspia* in lagoons and brackish waters (Gaulin *et al.*, 1986; Chester *et al.*, 2000) and tolerates salinities as low as 3 psu (see *MarLIN*, review). Arndt (1989) suggested that the marine distribution of the brackish water hydroid *Cordylophora caspia* was probably limited by food availability, competition from *Clava* spp. or *Laomedea* spp. and predation e.g. from the nudibranch *Tenellia adspersa* (as *Embletonia pallida*). However, *Tenellia adspersa*, *Clava* spp or *Laomedea* spp. were not recorded in this biotope.

Seasonal and longer term change

Cordylophora caspia shows a clear annual cycle. It dies back in late autumn and overwinters as dormant stolons and resting stages (menonts) inside the remnants of the uprights (Roos, 1979; Arndt, 1989; Jormalainen *et al.* 1994). Arndt (1989) reported that colonies died back in autumn when the temperature fell to about 10 C only to germinate in spring when the temperature exceeded 5 C. Roos (1979) reported that colonies died back in October and new polyps budded again in early spring in the Netherlands. In the Baltic Sea growth was maximal in spring, uprights reaching maximal height at the peak of sexual reproduction in July, with a decline in growth after sexual reproduction (and regression to dormancy in one observation), and subsequent growth in August (Jormalainen *et al.*, 1994).

Einhornia crustulenta breeds between March and July in British waters (Hayward & Ryland, 1998). *Einhornia crustulenta* probably has a similar life history to *Electra pilosa*, and is probably adapted to ephemeral habitats, growing and reproducing rapidly, although the colony may potentially survive for many years.

The barnacle *Balanus crenatus* reproduces between February and September, larvae settling in a peak in April from October. *Balanus crenatus* has a lifespan of only 18 months, and unless recruitment is continuous, the population probably fluctuates but no evidence was found.

The biotope probably experiences seasonal changes in physical conditions, with increased riverine input and hence suspended sediment, nutrients, and reduced salinity in winter months, followed by reduced riverine input, water levels and water flow rates in the summer months.

Habitat structure and complexity

This community is impoverished and does not exhibit the degree of species diversity and habitat complexity characteristic of other epifaunal communities. In the Tamar estuary, *Cordylophora caspia* dominated the steep bedrock (ca 100% cover) from +1 to 3m deep. However, from 3-4m the bedrock and small boulders were almost bare except for a few scattered colonies of *Cordylophora caspia*, frequent *Einhornia crustulenta* and rare *Balanus crenatus* (Moore & Hiscock, 1986). The upper waters in the upper estuary are probably more liable to variations in salinity due to freshwater runoff and riverine input, while the deeper waters may be more saline, allowing *Einhornia crustulenta* and *Balanus crenatus* to survive, albeit at the limit of their range.

- Hydroid branches form a turf that slow water flow within it and may accumulate a modicum of sediment that may itself support some meiofauna, while branches provide substratum for sessile ciliates (Roos, 1979).
- Hydroid turf may also support 'crowds' of the freshwater amphipod *Gammarus tigrinus* (Roos, 1979).
- *Balanus crenatus* provides additional surface roughness and creates spatial refuges for other species if present (Standing, 1976; Roos, 1979; Brault & Bourget, 1985).

Productivity

The majority of productivity within the biotope is secondary through suspension feeding on phytoplankton by bryozoans and passive carnivory by hydroids. Gili & Hughes (1995) suggested that hydroid turfs were important in transferring energy from the plankton to the benthos, however, productivity in this impoverished community is probably low.

Recruitment processes

Hydroids are often initial colonizing organisms in settlement experiments and fouling communities (Jensen *et al.*, 1994; Gili & Hughes, 1995; Hatcher, 1998). In settlement experiments in the Warnow estuary, *Cordylophora caspia* was found to colonize artificial substrata within ca one month of deployment, its abundance increasing from June to the end of September with a peak in July (Sandrock *et al.*, 1991). Long-term panels at their low salinity station became dominated by *Cordylophora caspia*, *Balanus improvisus* and *Nais elinguis*. Similarly, Roos (1979) reported that *Cordylophora caspia* recruited to and grew luxuriantly on water lily stalks in summer after early reproduction of nearby colonies in early spring.*Cordylophora caspia* releases a planula larva, no medusoid phase in formed, although planula may occasionally develop in the parent gonophores being released as juvenile polyps. Planula larvae swim or crawl for short periods (e.g. <24hrs) so that while local recruitment may be good, dispersal away from the parent colony is probably very limited (Gili & Hughes, 1995). Fragmentation may also provide another route for short distance dispersal. However, it has been suggested that rafting on floating debris (or hitch hiking on ships hulls or in ship ballast water) as dormant stages or reproductive adults, together with their potentially long lifespan, may have allowed hydroids to disperse over a wide area in the long-term and explain the near cosmopolitan distributions of many hydroid species, including *Cordylophora caspia* (Gili & Hughes, 1995; Folino, 1999).

Balanus crenatus releases planktonic nauplii that develop into a specialized settlement phase, the cyprid (see review). The nauplii may spend >30 days in the plankton, and cyprids settle between April and October with a peak in April. Therefore, dispersal potential is high, depending on the local hydrographic regime. *Balanus crenatus* also colonized settlement plates or artificial reefs within 1-3 months of deployment in summer, (Brault & Bourget, 1985; Hatcher, 1998), and became abundant on settlement plates shortly afterwards (Standing, 1976; Brault & Bourget, 1985). In this biotope most recruits probably come from other populations within the Tamar and Plymouth Sound.

Einhornia crustulenta probably has a similar life history to that of *Electra pilosa*, which has a planktonic larvae with a protracted life in the plankton and potentially extended dispersal, and can colonize a wide variety of substrata. It is probably adapted to rapid growth and reproduction (*r*-selected), capable of colonizing ephemeral habitats, but may also be long lived in ideal conditions (Hayward & Ryland, 1998). In settlement studies, *Einhornia crustulenta* (as *Electra crustulenta*) recruited to plates within 5 -6months of deployment, although it did not recruit to the low salinity panels occupied by *Cordylophora caspia* in their study (Sandrock *et al*, 1991). Standing (1976) noted that the branches of *Obelia longissima* physically interfered with recruitment in *Balanus crenatus* and dense *Cordylophora caspia* branches may have a similar effect as well as potentially consuming larvae of other species such as *Einhornia crustulenta*. However, in the riverine/estuarine transition occupied by this biotope, *Balanus crenatus* and *Einhornia crustulenta* are probably at their limit of salinity tolerance and recruitment is probably low.

Time for community to reach maturity

All the species present in the biotope colonize, grow and occupy space rapidly. The community is largely dominated by the hydroid *Cordylophora caspia*, which while perennial, dies back in the winter months, only to grow back in the spring months. Therefore, the visible cover of *Cordylophora caspia* probably develops within the first few months of spring, rapidly occupying space. *Balanus crenatus* grows rapidly in winter (see review) and probably benefits from the lack of competition for food with the hydroid. Overall, the community is species poor and not known to support more than sessile ciliates and mobile amphipods (see habitat complexity) and hence reaches maturity within only a few months in spring.

Additional information

No text

Preferences & Distribution

Habitat preferences

Depth Range	0-5 m
Water clarity preferences	Low clarity / High turbidity
Limiting Nutrients	Data deficient
Salinity preferences	Reduced (18-30 psu)
Physiographic preferences	Enclosed coast / Embayment
Biological zone preferences	Infralittoral
Substratum/habitat preferences	Bedrock, Cobbles, Large to very large boulders, Small boulders
Tidal strength preferences	Moderately Strong 1 to 3 knots (0.5-1.5 m/sec.), Strong 3 to 6 knots (1.5-3 m/sec.)
Wave exposure preferences	Extremely sheltered, Very sheltered
Other preferences	Low / Reduced salinity

Additional Information

This biotope was recorded at the riverine/estuarine transition, from steeply broken shale bedrock at +1 to 3m deep, dominated by a 100% cover of *Cordylophora caspia* (as *lacustris*), and from deeper sloping horizontal bedrock with scattered *Cordylophora caspia*, frequent *Electra crustulenta* and rare *Balanus* spp. (Hiscock & Moore, 1986; Moore *et al.*, 1999). At this site the salinity was reported to always below 20psu and could drop to zero. In nature, well developed colonies of *Cordylophora caspia* are usually found in water of 2 -12psu where tidal influence is considerable or between 2 -6psu where conditions are constant (Arndt, 1989). Arndt (1989) regarded *Cordylophora caspia* to be truly brackish water species, requiring eutrophic or hypertrophic conditions to maintain growth and reproduction, thermophilic but limited by low temperatures declining once temperatures drop below 5 °C and not regrowing in winter until temperatures exceed 10 °C (see species review for detail). Hayward & Ryland (1998) note that *Electra crustulenta* is limited to estuarine habitats but euryhaline in tolerance and probably widespread in distribution but commonly confused with other brackish water and estuarine species of encrusting bryozoans (e.g. *Conopeum* spp.).

Species composition

Species found especially in this biotope

- *Cordylophora caspia*
- *Electra crustulenta*

Rare or scarce species associated with this biotope

-

Additional information

This biotope is represented by only two records from the Tamar estuary, Plymouth, Devon (Hiscock & Moore, 1986; Connor *et al.*, 1997; JNCC, 1999; Moore *et al.*, 1999). The biotope description only includes the species listed above and is very impoverished: in one record the biotope consisted of *Cordylophora caspia* alone (Hiscock & Moore, 1986). However, the biotope probably supports a species of meiofauna and microfauna/flora that were not recorded in the original survey. Also survey conditions should be taken into account, as the original survey was carried out by diving in the highly turbid waters of the upper Tamar estuary.

Sensitivity review

Sensitivity characteristics of the habitat and relevant characteristic species

Cordylophora caspia is the dominant species in this biotope, and if lost would result in loss of the biotope. *Einhornia crustulenta* is a characteristic species that probably competes for space with *Cordylophora caspia*. In the absence of a full key information for *Einhornia crustulenta*, *Electra pilosa* has been used to represent its sensitivity except its estuarine habitat preferences. *Balanus crenatus* is probably another competitor for space. However, in one of the two records of this biotope, *Cordylophora caspia* was the only macrofauna recorded. Therefore, the sensitivity of this biotope is based on the sensitivity of *Cordylophora caspia.*

Note *Cordylophora caspia* and other hydroids have the ability to produce dormant resting stages (menonts) that are far more resistant to environmental change than the colony itself. Therefore, although colonies may be removed or destroyed, the resting stages may survive in remnants of the hydrorhizae attached to the substratum. For the sake of assessment, the sensitivity of the branched colonies themselves (the clearly visible component) has been recorded. The resting stages provide a mechanism for rapid recovery.

In addition, recent genetic analysis has identified at least four genetic lineages of *Cordylophora* spp., which may represent cryptic species, in Europe and both North and South America (Folino-Rorem *et al*., 2009; cited in Fofonoff *et al*., 2015). The distribution of most of the lineages overlapped, but one was recorded only from the Pacific coast of North America. They also exhibit differences in ecological preferences, e.g. one was restricted to freshwater, while two were restricted to brackish waters, while another was found in both. However, Fofonoff *et al.* (2015) concluded that further analysis was required before it could be treated as separate species. Therefore, the sensitivity assessments consider *Cordylophora caspia* as a single species.

Resilience and recovery rates of habitat

Hydroids are often initial colonizing organisms in settlement experiments and fouling communities (Jensen *et al*., 1994; Gili & Hughes, 1995; Hatcher, 1998). In settlement experiments in the Warnow estuary, *Cordylophora caspia* was found to colonize artificial substrata within ca one month of deployment, its abundance increasing from June to the end of September with a peak in July (Sandrock *et al*., 1991). long-term panels at their low salinity station became dominated by *Cordylophora caspia*, *Balanus improvisus* and *Nais elinguis*. Similarly, Roos (1979) reported that *Cordylophora caspia* recruited to and grew luxuriantly on water lily stalks in summer after early reproduction of nearby colonies in early spring. In laboratory experiments, *Cordylophora caspia* colonies regenerated from thermal and chlorine treatments that removed polyps with 3 -20 days (depending on treatment) (Folino-Rorem & Indelicata, 2005; Mant *et al*., 2012).

Early seasonal growth from winter dormancy in early spring is rapidly followed by formation of gonophores and sexual reproduction in midsummer followed by active growth in late summer. However, sexual reproductive effort may retard growth (see general biology). Jormalainen *et al.* (1994) reported that reproduction began in early June, peaked in July (80% uprights with gonophores) and rapidly reduced by August (30% uprights with gonophores). Similar reproductive periods have been reported by other authors (Allman, 1871-1872; MBA, 1957; Roos, 1979; Foster-Smith, 2000). Roos (1979) and Jormalainen *et al.* (1994) reported that the sex ratio was biased in favour of females. Each upright branch may bear between 1-3 gonophores each with between 10 - 6 eggs, the number decreasing in autumn (Hincks, 1868; Jormalainen *et al*., 1994).

Therefore, fecundity is dependant on the number of branches and hence the number of gonophores, and in large colonies of 70-2000 polyps (Fulton, 1962), may be high.

Cordylophora caspia releases a planula larva, no medusoid phase in formed, although planula may occasionally develop in the parent gonophores being released as juvenile polyps. Planula larvae swim or crawl for short periods (e.g. <24hrs) so that while local recruitment may be good, dispersal away from the parent colony is probably very limited (Gili & Hughes, 1995). Hydroids exhibit remarkable powers of regeneration and *Cordylophora caspia* can be cloned in culture from detached uprights or excised tissue (Moore, 1952; Fulton, 1961, 1962). Asexual reproduction by fission or mechanical fragmentation of the colony may be an important factor in dispersal (Gili & Hughes, 1995). In addition, *Cordylophora caspia* (as most hydroids) forms highly resistant dormant stages (menonts).

However, it has been suggested that rafting on floating debris (or hitch hiking on ships hulls or in ship ballast water) as dormant stages or reproductive adults, together with their potentially long lifespan, may have allowed hydroids to disperse over a wide area in the long-term and explain the near cosmopolitan distributions of many hydroid species, including *Cordylophora caspia* (Gili & Hughes, 1995; Folino, 1999). *Cordylophora caspia* is presumed to orginate from the Caspian Sea but has spread through the waters of Europe, inc. British Isles, across North and South America, China, Australia and New Zealand (Fofonoff *et al.*, 2015) probably due to shipping. It is reported as biofouling species, particulary in power plant cooling water systems, and as an invasive species resulting in competiion for space with native species and habitat modification (Folino-Rorem & Indelicata, 2005; Mant *et al.*, 2012; Fofonoff *et al.*, 2015). It is, therefore, an adaptive, resistant and resilient species.

Balanus crenatus releases planktonic nauplii that develop into a specialized settlement phase, the cyprid (see review). The nauplii may spend >30 days in the plankton, and cyprids settle between April and October with a peak in April. Therefore, dispersal potential is high, depending on the local hydrographic regime. *Balanus crenatus* also colonized settlement plates or artificial reefs within 1-3 months of deployment in summer, (Brault & Bourget, 1985; Hatcher, 1998), and became abundant on settlement plates shortly afterwards (Standing, 1976; Brault & Bourget, 1985). In this biotope most recruits probably come from other populations within the Tamar and Plymouth Sound. *Einhornia crustulenta* probably has a similar life history to that of *Electra pilosa*, which has a planktonic larvae with a protracted life in the plankton and potentially extended dispersal, and can colonize a wide variety of substrata. It is probably adapted to rapid growth and reproduction (r-selected), capable of colonizing ephemeral habitats, but may also be long lived in ideal conditions (Hayward & Ryland, 1998). In settlement studies, *Einhornia crustulenta* recruited to plates within 5 -6months of deployment, although it did not recruit to the low salinity panels occupied by *Cordylophora caspia* in their study (Sandrock *et al.*, 1991). Standing (1976) noted that the branches of *Obelia longissima* physically interfered with recruitment in *Balanus crenatus* and dense *Cordylophora caspia* branches may have a similar effect as well as potentially consuming larvae of other species such as *Einhornia crustulenta*. However, in the riverine/estuarine transition occupied by this biotope, *Balanus crenatus* and *Einhornia crustulenta* are probably at their limit of salinity tolerance and recruitment is probably low.

All the species present in the biotope colonize, grow and occupy space rapidly. The community is largely dominated by the hydroid *Cordylophora caspia*, which while perennial, dies back in the winter months, only to grow back in the spring months. Therefore, the visible cover of *Cordylophora caspia* probably develops within the first few months of spring, rapidly occupying space. *Balanus crenatus* grows rapidly in winter (see review) and probably benefits from the lack of competition for food with the hydroid. Overall, the community is species poor and not known to support more than sessile ciliates and mobile amphipods (see habitat complexity) and hence reaches maturity within only a few months in spring.

Resilience assessment. The biotope and its dominant species (*Cordylophora caspia*) could probably recover from disturbance within days or months, due to regeneration from dormant stages, remaining hydrorhiza, vertical stolons or fragments. Even where the species had been completely erradicated, there is the potential for rapid recruitment and colonization from surrounding colonies. So that recovery is likely to be rapid, and resilience 'High'.

Hydrological Pressures

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

Cordylophora caspia can survive as resistant dormant stages (menonts) at -10°C and at 35°C. Colonies tolerate 5 to 35°C, and reproduce between 10 to 28°C (Kinne, 1971; reviewed by Arndt, 1986, 1989). Arndt (1989) reported that colonies died back in autumn when the temperature fell to about 10°C only to germinate in spring when the temperature exceeded 5°C. Arndt (1989) concluded that *Cordylophora caspia* was thermophilic but that low temperature had an important influence on growth and reproduction. In addition, the distribution of *Cordylophora caspia* extends into subtropical habitats (Arndt, 1986, 1989). In laboratory experiments, colonies degenerated but recovered after 1-8 hr exposure to 35°C and 36.1°C, but died (and did not regenerate within seven days) after exposure to 1-2 hr at 37.7°C and 40.5°C. However, it was unknow if they would have regenerated if examined for longer than seven days (Folino-Rorem & Indelicato, 2005). Therefore, this species is unlikely to be adversely affected by chronic or acute temperature change at the benchmark level in British waters.

Growth rates were reported to increase with temperature in several bryozoans species, however, zooid size decreased, which may be due to increased metabolic costs at higher temperature (Menon, 1972; Ryland, 1976; Hunter & Hughes, 1994). The recorded distribution of *Einhornia crustulenta* is limited from southern England to Orkney but may be more widespread (Hayward & Ryland, 1998; JNCC, 1999). *Balanus crenatus*, however, is a boreal species and may be lost due to long-term increases in temperature at the benchmark level, causing a minor decline in species richness.

Overall, the biotope is unlikely to be adversely afected at the benchmark level. Therefore a resistance of 'High', resilience of 'High' and hence sensitivity of 'Not sensitive' is recorded at the benchmark level.

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

Cordylophora caspia can survive as resistant dormant stages (menonts) at -10°C and at 35°C. Colonies tolerate 5 to 35°C, and reproduce between 10 to 28°C (Kinne, 1971; reviewed by Arndt, 1986, 1989). Arndt (1989) reported that colonies died back in autumn when the temperature fell to about 10°C only to germinate in spring when the temperature exceeded 5°C. Arndt (1989) concluded that *Cordylophora caspia* was thermophilic but that low temperature had an important influence on growth and reproduction.

Electra pilosa was reported to survive below freezing temperatures (Menon, 1972) although colonies are probably more tolerant of low temperatures in winter than summer (see review for details). E*lectra crustulenta* may exhibit a similar response. Brault & Bourget (1985) noted that recruitment was delayed until spring on settlement plates deployed in winter. However, all the dominant species within the biotope are boreal or recorded from north of the British Isles. Therefore, although growth and reproduction may be reduced, they are unlikely to be adversely affected by reductions in temperature in British waters.

Therefore, while low temperatures may trigger premature die back or regression, colonies are likely to survive changes in temperature at the benchmark level. A resistance of 'High' is suggested, with a resilience of 'High' and a sensitvity of 'Not sensitive'.

Salinity increase (local)	Low Q: High A: Medium C: Low	High Q: High A: High C: High	Low Q: High A: Medium C: Low

Cordylophora caspia can survive 0 to 35 psu as resistant stages, grow between 0.2-30 psu, reproduce between 0.2-20psu and possesses the ability to ionic regulate (Kinne, 1971; reviewed by Arndt, 1986, 1989). In nature, well developed colonies are usually found in water of 2 -12 psu where tidal influence is considerable or between 2 -6 psu where conditions are constant (Arndt, 1989) but it may also occur at full salinities. Kinne (1971) noted that high salinities (24 or 30 psu) occasionally resulted in developmental abnormalities in older colonies in the laboratory. Arndt (1989) suggested that its marine distribution was probably limited by food availability, competition from *Clava* spp. or *Laomedea* spp. and predation e.g. from the nudibranch *Tenellia adspersa* (as *Embletonia pallida*).

Therefore, a change in salinity from reduced to variable in the long-term (see benchmark) or from full to hypersaline (>40 units) may result in loss of a proportion of the population due to die back or competitive exclusion and predation, and an resistance of 'Low' has been recorded. Survival of resting stages is likely to result in rapid recovery, so resilience is 'High' resulting in a sensitivity of 'Low'.

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

Cordylophora caspia can survive 0 to 35 psu as resistant stages, grow between 0.2-30 psu, reproduce between 0.2-20 psu and possesses the ability to ionic regulate (Kinne, 1971; reviewed by Arndt, 1986; 1989). In nature, well developed colonies are usually found in water of 2 -12 psu where tidal influence is considerable or between 2 -6 psu where conditions are constant (Arndt, 1989). It may also occur at full salinities, and fast flowing, well oxygenated freshwater containing Ca, Mg, Na, Cl and K ions (Fulton, 1962; Arndt, 1989). It has been reported from estuaries that receive significant seasonal freshwater input, and tolerates variable salinities (Arndt, 1986; 1989). Therefore, it is probably relatively tolerant of a change in salinity at the benchmark level. A reduction from full to reduced salinity may be beneficial and allow *Cordylophora caspia* to colonize new habitats. In addition, this biotope was recorded at the riverine/estuarine transition where the salinity was reported to be always below 20 psu but could drop to zero (Hiscock & Moore, 1986; Moore *et al*., 1999).

Therefore, a long-term change in salinity (see benchmark) from full to variable, or variable to reduced or low to freshwater is unlikely to adversely affect the dominant species (*Cordylophora caspia*) and may allow it to extend its range. Therefore, the biotope is probably 'Not sensitive' at the benchmark level (resistance and resilience are 'High').

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

Water movement is essential for suspension feeding species to supply adequate food, remove metabolic waste products, prevent accumulation of sediment and disperse larvae. Hydroids are expected to be abundant where water movement is sufficient to supply adequate food but not cause damage (Hiscock, 1983; Gili & Hughes, 1995). In *Cordylophora caspia*, flexibility of the otherwise rigid perisarc of hydroids is provided by annulations at the base of branches. In addition, in athecates, the neck of the polyp is flexible enough to allow the polyp adopt an efficient 'lee-side' feeding posture in water flow. However, most hydroids have a narrow range of water flow rates for effective feeding. For example in the athecate *Tubularia indivisa*, food capture rate increased up to 20 cm/s, but decreased as water flow rates increased (Hiscock, 1983). In *Cordylophora inkermania* food capture rates were higher in fluctuating flows than in unidirectional flows (Gili & Hughes, 1995), presumably because more polyps were brought into play in fluctuating flow, than in unidirectional flow where upstream branches 'shaded' down stream branches. Loomis (in Fulton, 1961) noted that *Cordylophora caspia* did not grow in still water cultures presumably because of the build up of CO_2 from respiration.

Electra pilosa (and by inference *Einhornia crustulenta*) was able to grow in strong water flows (e.g. Menai Strait and Lough Ine rapids) (Ryland, 1970; Hermansen et al., 2001). *Balanus crenatus* is found in a wide range of water flow rates is often dominant in very strong tidal streams.

This biotope occurs in moderately strong to strong tidal streams (i.e. between 0.5 and 3 m/s). Therefore, a change of 0.1-0.2 m/s is unlikely to adversely affect the biotope, although a reduction may decrease feeding and hence growth rates. Therefore, a resistance of 'High' is recorded, with a resilience of 'High' and a sensitivity of 'Not sensitive' at the benchmark level.

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

This biotope was recorded from steeply broken shale bedrock at +1 to 3m deep, dominated by a 100% cover of *Cordylophora caspia* (as *lacustris*), and from deeper sloping horizontal bedrock with scattered *Cordylophora caspia*, frequent *Einhornia crustulenta* and rare *Balanus* spp. (Hiscock & Moore, 1986; Moore et al., 1999). Intertidal populations of *Cordylophora caspia* are restricted to damp habitats such as underboulders and overhangs. The branched growth form of this species is likely to retain water on emersion (see image). However, an increase in desiccation (associated with increased emergence) is likely to result in drying and death of the uprights. Increased desiccation may result in the formation of resistant, dormant stages, however, no information on their desiccation tolerance was found.

Sensitivity assessment. An increase in emergence is likely to result in death of a proportion of the population and reduction in its upper shore extent. Therefore, a resistance of Low is recorded. However, recovery from resting stages and recolonization is likely to be rapid, so that resilience is probably 'High and sensitivity, therefore, 'Low'.

Wave exposure changes (local)	Low Q: Low A: NR C: NR	High Q: High A: High C: High	Low Q: Low A: Low C: Low

The very sheltered situations in which this biotope occurs are unlikely to experience an increase in wave exposure at the benchmark level due to natural causes, except perhaps extreme storm conditions. However, an increase in large or fast boat traffic and the resultant wash may have a similar effect to an increase in wave exposure. *Balanus crenatus* is tolerant of a wide range of wave exposures. However, *Cordylophora caspia* and *Einhornia crustulenta* have only been recorded from very or extremely wave sheltered habitats, and this biotope has only been recorded in very to extremely wave sheltered conditions. Therefore, it is likely than an increase in wave exposure at the benchmark level is likely to result in loss or damage of the their colonies. Populations occupying small rocks, cobbles or pebbles are likely to be more sensitive and the resultant movement of the substratum and sediment scour may also remove attached hydrorhizae, the resting stages of the hydroid, and encrusting bryozoan colonies. Therefore, resitance of 'Low' has been recorded. Recovery of the biotope will depend on recruitment of *Cordylophora caspia* from other areas. However, any resting stages and fragments of colonies remaining may contribute to the recovery. Therefore, resilience is probably 'High' and sensitivity 'Low'.

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.

Although subtidal, this biotope is relatively shallow and may be exposed to oils and hydrocarbons adsorbed onto particulates and ingested or through the water soluble fractions of oils and hydrocarbons. The water soluble fractions of Monterey crude oil and drilling muds were reported to cause polyp shedding and other sublethal effects in the athecate *Tubularia crocea* in laboratory tests (Michel & Case, 1984; Michel *et al.*, 1986; Holt *et al.*, 1995). The athecate *Cordylophora caspia* may show similar sublethal effects assuming similar physiology. Species of the encrusting bryozoan *Membranipora* and the erect bryozoan *Bugula* were reported to be lost or excluded from areas subject to oil spills (Mohammad, 1974; Soule & Soule, 1979). Houghton *et al.*(1996) reported a reduction in the abundance of intertidal encrusting bryozoans (no species given) at oiled sites after the *Exxon Valdez* oil spill. Littoral populations of encrusting bryozoans and hydroids are also probably intolerant of the smothering effects of oil pollution, resulting in suffocation of colonies. Littoral barnacles generally have a high tolerance to oil (Holt *et al.*, 1995) and were little impacted by the *Torrey Canyon* oil spill (Smith, 1968) so *Balanus crenatus* is probably fairly resistant to oil.

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.

Stebbing (1981) reported that Cu, Cd, and tributyl tin fluoride affected growth regulators in *Laomedea* (as*Campanularia*) *flexuosa* resulting in increased growth. Bryan & Gibbs (1991) reported that virtually no hydroids were present on hard bottom communities in TBT contaminated sites and suggested that some hydroids were intolerant of TBT levels between 100 and 500 ng/l. Bryozoans are common members of the fouling community, and amongst those organisms most resistant to antifouling measures, such as copper containing anti-fouling paints (Soule & Soule, 1977; Holt *et al.*, 1995). Bryan & Gibbs (1991) reported that there was little evidence regarding TBT toxicity in bryozoans with the exception of the encrusting *Schizoporella errata*, which suffered 50% mortality when exposed for 63 days to 100ng/l TBT. However, Hoare & Hiscock (1974) suggested that Polyzoa (Bryozoa) were amongst the most intolerant species to acidified halogenated effluents in Amlwch Bay, Anglesey. Hoare & Hiscock (1974) found that *Balanus crenatus* survived near to an acidified halogenated effluent discharge where many other species were killed, suggesting a high tolerance to chemical contamination. However, barnacles have a low resilience to chemicals such as dispersants, dependant on the concentration and type of chemical involved and Holt *et al.* (1995) concluded that barnacles were fairly intolerant of chemical pollution.

Therefore, hydroids are probably intolerant of TBT contamination (which may be highest in estuarine environments) and bryozoans and barnacles are probably intolerant of chemical pollution. *Cordylophora caspia* was also a dominant species on settlement plates placed on a floating shipyard dock in Warnock river (Sandrock *et al.*, 1991). Floating docks are likely to result in local contamination with heavy metals and antifouling agents from ship paints, as well as oils and other chemicals used in ship maintenance. Hydroid species adapted to a wide variation in environmental factors and with cosmopolitan distributions tend to be more tolerant of polluted waters (Boero, 1984; Gili & Hughes, 1995).

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

Fulton (1962) found that some polyps of *Cordylophora caspia* fell off or were reabsorbed after 7 days in the complete absence of oxygen but remaining polyps began feeding shortly after the re-introduction of oxygen. Fulton (1962) concluded that *Cordylophora caspia* had a low oxygen requirement for growth and was able to grow at oxygen levels of >2 mg/l (ca 1.4 ml/l). Similarly, the hydroid *Melicertum octocostatum* annually over-summers as stolons in anoxic conditions in Abereiddy Quarry, growing back in autumn (Hiscock & Hoare, 1975).

Sagasti *et al.* (2000) reported that epifauna communities, including dominant species such as the bryozoans *Conopeum tenuissimum* and *Membranipora tenuis*, and the hydroid *Obelia bicuspidata* were unaffected by periods of moderate hypoxia (ca 0.35 -1.4 ml/l) and short periods of hypoxia (<0.35 ml/l) in the York River, Chesapeake Bay. Their study suggests that estuarine epifaunal communities are relatively tolerant of hypoxia. However, *Balanus crenatus* was reported to survive an average of 3.2 days in the absence of oxygen (Barnes *et al.*, 1963), and it is probable that a proportion of the *Balanus crenatus* population would be lost, resulting in a loss of species richness.

Overall, *Cordylophora caspia* is probably resistant of low oxygen levels resitance of 'High' is recorded. Therefore, resilience is 'High' and the biotope is probably ' Not sensitive' at the benchmark level.

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

Cordylophora caspia became one of the dominant species to colonize settlement plates placed beneath a floating dock in the Warnock river (Sandrock *et al.*, 1991). This station was characterized by low salinities, and higher organic and mineral nutrient loads (ca 20-100 µmol NO_3/l) than their other experimental station. Arndt (1986, 1989) suggested that food intake in *Cordylophora caspia* was high in comparison to other hydroids so that growth and reproduction rates required for the survival of the species could only occur in eutrophic or hypertrophic waters where food is plentiful. Therefore, *Cordylophora caspia* is likely to tolerate relatively high nutrient levels, and may benefit from moderate increases in nutrients.

The biotope is 'Not sensitive' at the pressure benchmark that assumes compliance with good status as defined by the WFD.

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

Cordylophora caspia became one of the dominant species to colonize settlement plates placed beneath a floating dock in the Warnock river (Sandrock *et al.*, 1991). This station was characterized by low salinities, and higher organic and mineral nutrient loads (ca 20-100 µmol NO3/l) than their other experimental station. Arndt (1986, 1989) suggested that food intake in *Cordylophora caspia* was high in comparison to other hydroids so that growth and reproduction rates required for the survival of the species could only occur in eutrophic or hypertrophic waters where food is plentiful. Therefore, *Cordylophora caspia* is may tolerate relatively high nutrient levels, and may benefit from moderate increases in organic enrichment, although no direct evidence was found. Therefore, a resistance of High is suggested, with a resilience of 'High', resulting in a sensitivity rank of '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 is recorded from hard substrata, that is, bedrock, small to large boulders and cobbles. The key species, *Cordylophora caspia*, also grows on artificial hard substrata, ships hulls, plants, wood and debris (see species review). However, a permanent change to soft substrata (muds, sands etc.) would result in exclusion of the species from the habitat. It may colonize areas where boulder remain, but removal or loss of the available substratum (the benchmark) would result in loss of all encrusting species and hence loss of the biotope. Therefore, resistance is 'None', and resilience 'Very low' (it is a permanent change), and hence sensitivity is '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

This biotope is recorded from hard substrata, that is, bedrock, small to large boulders and cobbles. Therefore a change in sediment type is not relevant.

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	Low Q: Low A: NR C: NR	High Q: High A: High C: High	Low Q: Low A: Low C: Low

Abrasion by a passing anchor or fishing gear, or by trampling on the lower shore is likely to remove relatively delicate uprights of hydroids, damage bryozoan colonies and crush barnacles. However, in hydroids the surface covering of hydrorhizae may remain largely intact, from which new uprights are likely to grow. In addition, the resultant fragments of hydroid colonies may be able to develop into new colonies. Populations on small hard substrata (e.g. cobbles) may be removed by fishing gear, constituting substratum loss. Overall, a proportion of the hydroid and bryozoan colonies or barnacles are likely to be destroyed and an resistance of 'Low' has been recorded. However, recovery from surviving hydrorhizae and occasional fragments is likely to be rapid so that resilience is probably 'High', resulting in a sensitivity of '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

The species characterizing this biotope group are epifauna or epiflora occurring on rock which is resistant to subsurface penetration. The assessment for abrasion at the surface only is therefore considered to equally represent sensitivity to this pressure.

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

Cordylophora caspia and *Einhornia crustulenta* are found in estuarine and sheltered lagoonal habitats, which are characterized by relatively high suspended sediment loads. This biotope probably experiences marked changes in suspended sediment loads between winter and summer, due to winter storms and rainfall. *Cordylophora caspia* was also reported in saltmarsh pools (JNCC, 1999) and salt marshes are a depositional environment characterized by siltation. Therefore, *Cordylophora caspia* and *Einhornia crustulenta* are probably not sensitive to increases in suspended sediment loads at the benchmark level. *Balanus crenatus* is found a wide variety of habitats including estuaries and on the back of crustaceans in sedimentary habitats, although increased sediment loads may reduce growth rates.

A reduction in suspended sediment is unlikely to directly affect the biotope. A decrease in suspended sediment may reduce the availability of organic particulates and hence reduce food availability. Arndt (1986, 1989) suggested that Cordylophora caspia had a high food requirement for growth and reproduction and that the species could only occur in eutrophic or hypertrophic waters where food is plentiful. It is therefore, likely to be intolerant of any reduction in food availability. Overall, a reduction in suspended sediment may reduce food availability and hence growth and reproduction in all the species in the biotope.

Estuarine environments are typically very turbid in comparison to coastal waters, therefore a change in turbidity of one rank in the UKTAG scale (the benchmark) may not be significant. In addition the biotope probably experiences marked changes in sedimentary loads between the winter and summer months. Therefore, the resistance is probably 'High', resilience is 'High', and the biotope 'Not sensitive' at the benchmark level.

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

At low salinities *Cordylophora caspia* forms short, un-branched colonies and smothering by 5 cm of sediment is likely to cover a large proportion of the colony, preventing feeding and hence reducing growth and reproduction in the hydroid, while local hypoxic conditions are also likely to inhibit growth (Fulton, 1961, 1963). Smothering will also prevent feeding and growth in both *Einhornia crustulenta* and *Balanus crenatus*. The encrusting bryozoan grows rapidly and may be adversely affected, while *Balanus crenatus* was considered to be resistant (see review). The hydroid colony is likely to survive or become dormant, and recover rapidly once the sediment is removed. Examples of the biotope on overhangs and other vertical or near vertical surfaces are unlikely to be affected, while examples on small boulders and cobbles that retain the sediment will probably be the most affected. In estuarine conditions, tidal flow is likely to remove 5 cm of deposited sediment within a number of tidal cycles, depending on site, so the duration of smothering is probably fairly short.

Therefore, a resistance of 'Moderate' is suggested, with a 'High' resilience', so that sensitivity is probably 'Low'.

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

At low salinities *Cordylophora caspia* forms short, un-branched colonies and smothering by 5 cm of sediment is likely to cover a large proportion of the colony, preventing feeding and hence reducing growth and reproduction in the hydroid, while local hypoxic conditions are also likely to inhibit growth (Fulton, 1961, 1963). Smothering will also prevent feeding and growth in both *Einhornia crustulenta* and *Balanus crenatus*. The encrusting bryozoan grows rapidly and may be adversely affected, while *Balanus crenatus* was considered to be resistant (see review). The hydroid colony is likely to survive or become dormant, and recover rapidly once the sediment is removed. Examples of the biotope on overhangs and other vertical or near vertical surfaces are unlikely to be affected, while examples on small boulders and cobbles that retain the sediment will probably be the most affected. In estuarine conditions, tidal flow is likely to remove 30 cm of deposited sediment within several months, depending on site, so the duration of smothering is probably variable. Therefore, a resistance of 'Low' is suggested, with a 'High' resilience', so that sensitivity is probably '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

The characterizing epifauna have no known ability to perceive noise. although they can perceive localised vibration, changes in noise levels are probably 'Not relevant' to this biotope.

Introduction of light or shading	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 dominant characterizing epifauna are predators and filter feeders with no direct dependency on light. Although, phytoplankotn productivity may be locally reduced by shading or possibly increase by additional illumination, most of their food supply is transported by the local currents. Therefore, this pressure is probably 'Not relevant' to this biotope.

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

Barrier to water flow may restrict larval recruitment for this biotope. However, *Cordylophora caspia* is a potentially invasive non-indigenous species,thought to have been transported in ballast water and on ship hulls, as larvae, fragments or dormant stages. Therefore, only complete cessation of water flow and water transport is likely to adversely affect recruitment of the dominant characteristic species. In addition, the hydroid colony (or colonies) is probably not dependent on external recruitment for it continued survival, except if severely damaged. Therefore, this pressure is 'Not relevant' to this biotope.

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

The characteristic epifaunal species have no known visual perception.

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 sensitive Q: Low A: NR C: NR

Cordylophora caspia is considered to be a invasive non-indigenous species in Europe, and both South and North America, probably transported by shipping (Fofonoff *et al.*, 2015). Its 'translocation' has probably extended its geographic range and can be regarded as beneficial to the species. Therefore, this biotope is probably 'Not sensitive' to this pressure.

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

Cordylophora caspia is regarded as an invasive non-indigenous species (INIS) in parts of Europe and both North and South America. However, no evidence on the effects of other INIS on *Cordylophora caspia* 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 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

It is extremely unlikely that any of the species indicative of sensitivity (i.e. *Cordylophora caspia*) would be targeted by a fishery or other commercial activity. Therefore, this pressure (as defined in the benchmark) is 'Not relevant' to this biotope. However, in areas where the *Cordylophora caspia* is regarded as an invasive or biofouling species, physical removal might be adopted as a control measure but his is not considered here.

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

This biotope is unlikely to be exposed to commercial fisheries or shell fisheries, angling or harvesting activities (as defined in the benchmark) . Therefore, this pressure is 'Not relevant'. Any potential abrasion to the habitat via canoe or boat landing points, recreational access etc., is considered under the abrasion pressure above.

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