MarLIN
Marine Information Network
Information on the species and habitats around the coasts and sea of the British Isles

DeFolin's lagoon snail (*Caecum armoricum*)

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

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The Marine Life Information Network, Marine Biological Association of the United Kingdom.

Please note. This MarESA report is a dated version of the online review. Please refer to the website for the most up-to-date version [https://www.marlin.ac.uk/species/detail/1166]. All terms and the MarESA methodology are outlined on the website (https://www.marlin.ac.uk)

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Six specimens of *Caecum armoricum*.
Photographer: Dennis R. Seaward
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See online review for distribution map

Distribution data supplied by the Ocean Biogeographic Information System (OBIS). To interrogate UK data visit the NBN Atlas.

Researched by	Dr Heidi Tillin & Nicola White	**Refereed by**	Dennis R. Seaward
Authority	de Folin, 1869		
Other common names	-	**Synonyms**	*Caecum incomptum* Monterosata 1884

Summary

Description

A minute snail, up to 2 mm long. Its shell is neither spirally coiled nor limpet-shaped, but forms a small, short, slightly curved tube open at one end and closed at the other by a septum.

Recorded distribution in Britain and Ireland

Recorded from The Fleet, Dorset; Broad Rife, near Pagham, and Dungeness. One shell record from Connemara, W. Ireland (J.E. Phorson, per. comm.).

Global distribution

Shell records from the Black Sea, Mediterranean, Azores, Canary Isles and the Atlantic coast from Gibraltar to the Channel. A live colony was recorded from a site in the south Gibraltar Strait, North Africa.

Habitat

Recorded Seaward (1987) in the mid and lower Fleet, Dorset, where it lives in the spaces between 1-2 cm size pebbles. It was restricted to lagoonal shingle at the water level in positions where sea water percolates into the Fleet through Chesil beach. It was also recorded from Broad Rife, near Pagham, and Dungeness (in 2007).

Depth range

-

Identifying features

- Adult shell neither spirally coiled nor limpet-shaped, but forming a small, short, slightly curved tube open at one end and closed at the other.
- Up to 2 mm long.
- The shape of the septum ("often looks like the top of a little finger with the nail cut short") is of importance in separating *Caecum armoricum* from other *Caecum* species.

Additional information

The taxonomy of the Gastropoda has been recently revised (Taylor, 1996; Ponder & Lindberg 1997). Ponder & Lindberg (1997) suggest that Mesogastropoda should be included in a monophyletic clade, the Caenogastropoda.

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Further information sources

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Biology review

Taxonomy

Phylum	Mollusca	Snails, slugs, mussels, cockles, clams & squid
Class	Gastropoda	Snails, slugs & sea butterflies
Order	Littorinimorpha	
Family	Caecidae	
Genus	Caecum	
Authority	de Folin, 1869	
Recent Synonyms	Caecum incomptum Monterosata 1884	

Biology

Typical abundance	Moderate density
Male size range	1.5-2 mm
Male size at maturity	
Female size range	1.5-2 mm
Female size at maturity	
Growth form	Cylindrical
Growth rate	Insufficient information
Body flexibility	None (less than 10 degrees)
Mobility	Burrower
Characteristic feeding method	Sub-surface deposit feeder
Diet/food source	Detritivore
Typically feeds on	Vegetable detritus. Bacterial and diatom film.
Sociability	
Environmental position	Interstitial
Dependency	Independent.
Supports	Not relevant
Is the species harmful?	No information

Biology information

Little is known of the biology of this species. Early shell form is a spiral disc of about one whorl. Subsequent growth is tangential, slightly curved and tapering. As the shell tube lengthens, the animal's body only occupies the newer part of the shell near the mouth. A septum is laid down closing off the unwanted part of the shell which then breaks off, keeping the shell small, this is repeated throughout the animals life. It is presumably an adaptation to interstitial life.

Habitat preferences

Physiographic preferences	Isolated saline water (Lagoon)
Biological zone preferences	Lower eulittoral, Mid eulittoral
Substratum / habitat preferences	Gravel / shingle

Tidal strength preferences	No information, Very Weak (negligible)
Wave exposure preferences	Very sheltered
Salinity preferences	Variable (18-40 psu)
Depth range	
Other preferences	No text entered
Migration Pattern	Non-migratory / resident

Habitat Information

Found in the mid to lower eulittoral within marine percolation. The fleet population occurs at depth within loose shingle of about 2 cm size, where sea water percolates and where soft flocculent silty material is present but leaving plenty space subject to gently flowing water. Molluscan associates are another small prosobranch *Onoba aculeus* and the bivalve *Lasaea adansoni*; in the pale variety *pallida*.

Life history

Adult characteristics

Reproductive type	No information
Reproductive frequency	No information
Fecundity (number of eggs)	No information
Generation time	Insufficient information
Age at maturity	Insufficient information
Season	Insufficient information
Life span	Insufficient information

Larval characteristics

Larval/propagule type	No information
Larval/juvenile development	No information
Duration of larval stage	No information
Larval dispersal potential	No information
Larval settlement period	Insufficient information

Life history information

Dispersal potential is likely to be low.

Sensitivity review

Resilience and recovery rates

Caecum armoricum is considered likely to directly develop from eggs without a pelagic phase (Hoenslaar & Hoenslaar, 1990) so populations are likely to recover in-situ from disturbances, as long as some adults remain. If the population is removed entirely from a lagoon then recovery would depend on recolonization of that lagoon. Methods of dispersal of lagoonal specialists between lagoons is unclear, birds may transport animals via debris caught on their feet or algae or other debris containing animals may be transported into lagoons by water movements (Barnes, 1994). Whatever the original method of transport of *Caecum armoricum* into lagoons it is likely that these migrations rely on chance events and that populations would be unlikely to recover from an extinction event if the current restricted distribution of *Caecum armoricum* represents the true distribution of this species. It is possible, however, that *Caecum armoricum* is more widely distributed and also occurs in fully marine environments, as a specimen was reportedly collected in Plymouth Sound (Hoenslaar & Hoenslaar, 1990). Individuals may, therefore, be transported into lagoons from the open coast via water action or transport within sediments or other debris in the water column. Where coastal defenses are heightened, lagoons may end up cut-off from the sea so that the populations contained within are isolated and local extinctions may occur (Barnes, 1994).

Sensitivity assessment. If the population were to be removed entirely then it is considered unlikely to recover and resilience has been assessed as 'Very low' where resistance is 'None'. No evidence was found to assess recovery from impacts where a proportion of the population is removed. As a precaution, recovery has been assessed as 'Medium' (recovery within 2-10 years) where resistance is assessed as 'Medium' or 'Low'.

Hydrological Pressures

	Resistance	Resilience	Sensitivity
Temperature 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

No direct evidence was found to assess this pressure. The genus *Caecum* is distributed worldwide and across the geographic range, the genus will be exposed to colder and warmer waters than the UK. The species *Caecum armoricum* is known from Brittany, Portugal and Spain (Aartsen & Hoenselaar, 1984) and the Mediterranean and Black Sea (Hoeksema & Segers, 1993). The UK may represent the northern limit of its distribution, although this species may be undersampled across its range so that other, more northerly populations may exist. The distribution suggests that *Caecum armoricum* may be able to tolerate warmer waters than those found in the UK, however, populations may have become acclimated to local prevailing conditions, so that thermal tolerances vary between populations.

In general, species that inhabit lagoons are naturally subject to wide variations in temperature as shallow waters, isolated from the sea may experience wide temperature fluctuations as air temperatures vary (although these temperature shocks are probably lower than those that species in the upper intertidal experience). Due to their presence in the interstitial spaces in shingle through which seawater percolates there is likely to be some buffering of short-term temperature changes.

Sensitivity assessment. A chronic change at the pressure benchmark is likely to fall within the natural range of temperature variation and *Caecum armoricum* is assessed as 'Not sensitive'. An acute change at the pressure benchmark may have some effects on survival or sub-lethal effects on reproductive success. Increases may exceed thermal tolerances during the hotter months or may result in stress where species acclimated to colder temperatures are exposed suddenly to warmer waters. As there is no evidence, sensitivity to this pressure could not be assessed.

Temperature decrease (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

No direct evidence was found to assess this pressure. The genus *Caecum* is distributed worldwide and across the range, populations of *Caecum* spp. will be exposed to colder and warmer waters than the UK. The species *Caecum armoricum* is known from Brittany, Portugal and Spain (Aartsen & Hoenselaar, 1984) and the Mediterranean and Black Sea (Hoeksema & Segers, 1993). The UK may represent the northern limit of its distribution, although this species may be undersampled across its range so that other, more northerly populations may exist. The distribution suggests that *Caecum armoricum* may not be able to tolerate colder waters than those found in the UK, however, populations may become acclimated to local prevailing conditions.

In general, species that inhabit lagoons are naturally subject to wide variations in temperature as shallow waters, isolated from the sea may experience wide temperature fluctuations as air temperatures vary (although these temperature shocks are probably lower than those that species in the upper intertidal experience). Due to their presence in the interstitial spaces in shingle through which seawater percolates there is likely to be some buffering of short-term temperature changes.

Sensitivity assessment. A chronic change at the pressure benchmark is likely to fall within the natural range of temperature variation and *Caecum armoricum* is assessed as 'Not sensitive'. An acute change at the pressure benchmark may have some effects on survival or sub-lethal effects on reproductive success. Increases may exceed thermal tolerances during the colder months or may result in stress where species acclimated to warmer temperatures are exposed suddenly to colder waters. Due to the lack of evidence, this pressure could not be assessed. As there is no evidence, sensitivity to this pressure could not be assessed.

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

Caecum armoricum is found in the Fleet lagoon in the UK where seawater close to full salinity percolates either constantly or intermittently through the shingle and into the lagoon (Seaward, 1989, Little et *al*., 1989). *Caecum armoricum* occurs in fully marine waters in other parts of its range (inferred from Aartsen & Hoenselaar, 1984).

No evidence was found to assess whether exposure to hypersaline waters would impact this species and an assessment of sensitivity has not been made.

Salinity decrease (local)	None Q: High A: Low C: NR	Very Low Q: Low A: NR C: NR	High Q: Low A: Low C: Low

Caecum armoricum is found in the Fleet lagoon in the UK where seawater close to full salinity percolates either constantly or intermittently through shingle and into the lagoon (Seaward, 1989,

Little *et al*., 1989). *Caecum armoricum* occurs in fully marine waters in other parts of its range (inferred from Aartsen & Hoenselaar, 1984).

The habitat records suggest *Caecum armoricum* is restricted to fully marine habitats or those that are close to fully marine habitats. In parts of the Fleet lagoon *Caecum armoricum* may be exposed to lower salinities where rain water washes into the upper layers of shingle, however, this exposure is short-term.

Sensitivity assessment. At the pressure benchmark, a reduction in salinity refers to a change from full to variable or low salinity. The habitat records suggest that a change to a low salinity habitat for extended periods may not be tolerated by *Caecum armoricum*. Resistance is assessed as 'None' based on the loss of suitable habitat and resilience is assessed as 'Very low' due to the isolation of the UK population of *Caecum armoricum* from other known populations. Sensitivity is, therefore, assessed as 'High'.

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: NR C: NR

Caecum armoricum lives in lagoons that are separated from the sea by a barrier where there is reduced tidal influence and therefore low flow. An increase in water flow rate could move shingle increasing abrasion (see abrasion pressure) and could result in loss of habitat where the sediment barriers are eroded and removed. It is not clear what level of change would be required to remove the lagoon habitat and this threshold would be likely to be site-specific and depend on the size of the barriers and sediments.

Sensitivity assessment. *Caecum armoricum* is a lagoon species occurring in habitats with low water movement. Reduction in water flow is not considered relevant. Increases in water flow at the pressure benchmark, within the lagoon, are considered unlikely to exert the shear stress required to move shingle but may result in re-suspension of fine sediments. These are considered unlikely to directly affect *Caecum armoricum* which lives within the shingle. Resistance is therefore assessed as 'High' and resilience as 'High' (by default) so that this species is considered to be 'Not sensitive'.

Emergence regime changes	None Q: High A: Low C: NR	Very Low Q: Low A: NR C: NR	High Q: Low A: Low C: Low

No direct evidence was found to assess this pressure. *Caecum armoricum* is recorded in two locations in the Fleet lagoon, where seawater seeps through the shingle, emerges as a spring and enters the lagoon (Little *et al*., 1989; Seaward, 1989). In the lower Fleet area the tidal range is high (2 m) and the spring flows constantly (Little *et al*., 1989) In the mid-Fleet area the tidal range is lower (a few cm's) and the community living in that area is subject to periodic emmersion (Seaward, 1987). Ther percolation of seawater through the shingle is probably a key factor in creating a suitable habitat. A reduction in sea level that resulted in the loss of seawater springs into the lagoon is likely to result in the loss of suitable habitat for *Caecum armoricum*. An increase in sea level, that did not alter the presence of springs and flow of seawater would not result in an impact or may create more areas of favorable habitat.

It should be noted that lagoon habitats may be extremely sensitive to changes in sea level, decreased levels may prevent replenishment of sea water through percolation through sediments, so that salinity may decrease until the lagoon becomes a freshwater lake. Conversely sea level rise may result in the drowning of a lagoon resulting in the loss of the habitat.

Sensitivity assessment. A decrease in sea level or alteration in tidal range that altered the flow of seawater into the lagoon would result in the loss of suitable habitat as *Caecum armoricum* is only recorded in the areas of the Fleet associated with springs. Resistance is assessed as 'None' based on the loss of suitable habitat and resilience is assessed as 'Very low' due to the isolation of the UK population of *Caecum armoricum* from other known populations. Sensitivity is, therefore, assessed as 'High'.

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

Caecum armoricum lives in shingle within lagoons that are separated from the sea by a barrier and where wave action is reduced. An increase in wave action could cause habitat loss and the species to be washed away or disturbed where the sediment barriers that create the lagoon are removed. A change at the pressure benchmark is not considered likely to remove shingle

Sensitivity assessment. *Caecum armoricum* lives within shingle in lagoons. Reduction in wave action is not considered relevant. Increases in wave action, at levels greater than the pressure benchmark, outside and within the lagoon may result in increased erosion resulting in loss of shingle and changes to the lagoon. As an increase in wave action at the pressure benchmark within the lagoon is likely to be negligible, resistance is assessed as 'High' and resilience as 'High' so that *Caecum armoricum* is considered to be 'Not sensitive' at the pressure benchmark. The lagoon habitat itself may be more sensitive to increases in wave action (greater than the pressure benchmark) outside of the lagoon.

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**.

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**.

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**.

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	Low Q: Medium A: NR C: NR	Medium Q: Low A: NR C: NR	Medium Q: Low A: Low C: Low

No direct evidence was found to assess this pressure. In general, respiration in most marine invertebrates does not appear to be significantly affected until extremely low concentrations are reached. For many benthic invertebrates this concentration is about 2 ml/l (ca 2.66 mg/l) (Herreid, 1980; Rosenberg *et al*., 1991; Diaz & Rosenberg, 1995). Cole *et al*. (1999) suggest possible adverse effects on marine species below 4 mg/l and probable adverse effects below 2 mg/l. *Caecum armoricum* is recorded in two locations in the Fleet lagoon, where well-oxygenated seawater seeps through the shingle, emerges as a spring and enters the lagoon (Little *et al*., 1989; Seaward, 1989). In one area the tidal range is high and the spring flows constantly, in another (the mid-Fleet) the tidal range is lower and the spring is intermittent). Both habitats are likely to be well-oxygenated as these habitats have little organic matter and hence low levels of oxygen demand and are re-oxygenated via seawater or emersion to air. A reduction in oxygen concentration at the benchmark level may have adverse effects on *Caecum armoricum*.

Sensitivity assessment. No evidence was found to assess this pressure, the habitats where *Caecum armoricum* is found in the Fleet are likely to be well-oxygenated and this species may not be acclimated to or tolerate lowered oxygen concentration. Resistance is, therefore, assessed as 'Low' and resilience as 'Medium', so that sensitivity is assessed as 'Medium'. It should be noted that confidence in this assessment is 'Low'.

Nutrient enrichment	High Q: Medium 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. In the UK, living *Caecum armoricum* have only been recorded from the Fleet lagoon in areas where seawater percolates through shingle and where the chemical character of the percolating water is similar to the seawater outside of the lagoon (Little *et al*., 1989). No evidence was found to suggest that *Caecum armoricum* occurs in enriched habitats.

Sensitivity assessment. At the pressure benchmark (compliance with WFD criteria for good status), the resistance of *Caecum armoricum* is assessed as 'High' and resilience as 'High', and this species is assessed as 'Not sensitive'. A deterioration in water quality status that led to algal blooms may alter habitats that support *Caecum armoricum* through de-oxygenation or accumulation of debris (see deoxygenation and siltation pressures and sediment change).

Organic enrichment	Medium Q: Low A: NR C: NR	Medium Q: Low A: NR C: NR	Medium Q: Low A: Low C: Low

No direct evidence was found to assess this pressure. *Caecum armoricum* is recorded in two locations in the Fleet lagoon where seawater seeps through the shingle, emerges as a spring and enters the lagoon (Little *et al*., 1989; Seaward, 1989). In one area the tidal range is high and the spring flows constantly and the shingle in that habitat is described as 'clean', with little organic matter and free of the fine muds characteristic of non-spring areas (Little et al., 1989). The mid-Fleet area of intermittent springs where *Caecum armoricum* were abundant is not described by

Seaward (1989). However, it is assumed that in this habitat the percolation of seawater through layers of shingle also filters out marine debris so that the shingle in that area is also kept free of fine material. It is inferred from the habitat descriptions that *Caecum armoricum* may prefer habitats without the presence of fine material and that the presence of fine material may inhibit movement of *Caecum armoricum* or cause other impacts such as smothering.

Sensitivity assessment. An increase in organic matter may cause some impacts on *Caecum armoricum* through the addition of fine material to otherwise clean shingle. At the pressure benchmark, the rate of addition and the amount added is relatively small and organic matter may be removed by the percolated seawater as it flows out of the shingle and into the Fleet. As a precaution resistance is assessed as 'Medium' and resilience as 'Medium' so that sensitivity is assessed as 'Medium'.

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

No direct evidence was found to assess this pressure. *Caecum armoricum* is recorded in two locations in the Fleet lagoon, where seawater seeps through shingle (Little *et al.*, 1989, Seaward, 1989). These records suggest that *Caecum armoricum* have particular substratum preferences. A change to a hard rock habitat or fine sediment is likely to result in the habitat being unsuitable.

Sensitivity assessment. A change in substratum type would remove suitable habitat for this species. Resistance is assessed as 'None' and resilience as 'Very low' (based on permanent change at the pressure benchmark), so that sensitivity is assessed as 'High'.

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

No direct evidence was found to assess this pressure. *Caecum armoricum* is recorded in two locations in the Fleet lagoon, where seawater seeps through the shingle, emerges as a spring and enters the lagoon (Little *et al.*, 1989; Seaward, 1989). In one area the tidal range is high, the spring flows constantly, and the shingle in that habitat is described as 'clean', with little organic matter and free of the fine muds characteristic of non-spring areas (Little *et al.*, 1989) organic matter and fine muds. The mid-Fleet area of intermittent springs where *Caecum armoricum* were abundant is not described by Seaward (1989). However, it is assumed that in this habitat the percolating seawater also kept the shingle free of debris. These records suggest that *Caecum armoricum* may have particular substratum preferences.

Sensitivity assessment. A change in sediment type would remove suitable habitat for this species. Resistance is assessed as 'None', resilience as 'Very low' (based on permanent change at the pressure benchmark) and sensitivity is assessed as 'High'.

Habitat structure changes - removal of substratum (extraction)	None	Very Low	High
	Q: High A: Low C: NR	Q: Low A: NR C: NR	Q: Low A: Low C: Low

Caecum armoricum is found living a few cm deep in shingle in the Fleet lagoon (Seaward, 1989), the population would be removed if the shingle in which it lives was extracted to a depth of 30cm.

Sensitivity assessment. Resistance is 'None' to the extraction of the sediments in which *Caecum armoricum* lives. Resilience is 'Very low' if the entire population is removed, due to its isolation. Sensitivity is therefore assessed as 'High'.

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

No evidence was found to assess this pressure. *Caecum armoricum* lives within the shingle and has a thin, delicate shell. Movement of the shingle is likely to result in abrasion with resulting damage or mortality of exposed individuals.

Sensitivity assessment. Resistance to abrasion is assessed as 'Low' as this species has delicate shells. Within interstitial spaces, some species may escape crushing from single, short-lived events. Resilience is assessed as 'Medium' and sensitivity is assessed as 'Medium'.

Penetration or disturbance of the substratum subsurface	None	Very Low	High
	Q: Low A: NR C: NR	Q: Low A: NR C: NR	Q: Low A: NR C: NR

No evidence was found to assess this pressure. *Caecum armoricum* lives within the shingle and has a thin, delicate shell. Penetration and disturbance of the shingle are likely to result in damage and mortality of exposed individuals, either directly, or through displacement to shallower or deeper parts of the substratum that are unsuitable.

Sensitivity assessment. Resistance to penetration and disturbance of the sediment is assessed as 'None' as most exposed individuals could be crushed. Resilience is assessed as 'Very low' due to the isolation of the UK population of *Caecum armoricum* from other known populations. Sensitivity is, therefore, assessed as 'High'.

Changes in suspended solids (water clarity)	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

Caecum armoricum inhabit interstitial gaps between shingle, they are therefore unlikely to be directly exposed to, changes in suspended solids and the pressure is therefore considered to be 'Not relevant'. Indirect impacts through siltation may arise and this is assessed separately (see siltation pressure).

Smothering and siltation rate changes (light)

None
Q: Low A: NR C: NR

Very Low
Q: Low A: NR C: NR

High
Q: Low A: Low C: Low

No direct evidence was found to assess this pressure. Fine sediments deposited at the surface are likely to inhibit air penetration, possibly reducing oxygen levels (although this may be mitigated by oxygenated seawater percolating through the shingle). Fine sediments would become incorporated into lower layers of shingle through entrainment in rain water that seeped into the shingle or through shingle movements. These fine sediment may be removed over time by the flow of seawater through the shingle.

Caecum armoricum is recorded in two locations in the Fleet lagoon, where seawater seeps through the shingle, emerges as a spring and enters the lagoon (Little *et al*., 1989; Seaward, 1989). In one area the tidal range is high, the spring flows constantly and the shingle in that habitat is described as 'clean', with little organic matter and free of the fine muds characteristic of non-spring areas (Little *et al*., 1989). The mid-Fleet area of intermittent springs where *Caecum armoricum* were abundant is not described by Seaward (1989). However, it is assumed that in this habitat the percolation of seawater through layers of shingle also filtered out marine debris, so that the shingle in that area was also kept free of fine material. It is inferred from the habitat descriptions that *Caecum armoricum* may prefer habitats without the presence of fine material and that the presence of fine material within shingle may inhibit movements or cause other impacts such as smothering.

Sensitivity assessment. As *Caecum armoricum* is not found in shingle in the Fleet where fine muds are present it is considered that fine sediments washed into the shingle may reduce the suitability of the habitat to support this species. Resistance is therefore assessed as 'None' and resilience as 'Very low' so that sensitivity is assessed as 'High'.

Smothering and siltation rate changes (heavy)

None
Q: Low A: NR C: NR

Very Low
Q: Low A: NR C: NR

High
Q: Low A: Low C: Low

No direct evidence was found to assess this pressure. Fine sediments deposited at the surface are likely to inhibit air penetration, possibly reducing oxygen levels (although this may be mitigated by oxygenated seawater percolating through the shingle). Fine sediments would become incorporated into lower layers of shingle through entrainment in rain water that seeped into the shingle or through shingle movements. These fine sediments may be removed over time by the flow of seawater through the shingle.

Caecum armoricum is recorded in two locations in the Fleet lagoon, where seawater seeps through the shingle, emerges as a spring and enters the lagoon (Little *et al*., 1989; Seaward, 1989). In one area the tidal range is high, the spring flows constantly and the shingle in that habitat is described as 'clean', with little organic matter and free of the fine muds characteristic of non-spring areas (Little *et al*., 1989). The mid-Fleet area of intermittent springs where *Caecum armoricum* were abundant is not described by Seaward (1989). However, it is assumed that in this habitat the percolation of seawater through layers of shingle also filtered out marine debris so that the shingle on in that area was also kept free of fine material. It is inferred from the habitat descriptions that *Caecum armoricum* may prefer habitats without the presence of fine material, and that the presence of fine material within shingle may inhibit movements or cause other impacts such as smothering.

Sensitivity assessment. As *Caecum armoricum* is not found in shingle in the Fleet where fine muds

are present it is considered that fine sediments washed into the shingle may reduce the suitability of the habitat to support this species. Resistance is therefore assessed as 'None' and resilience as 'Very low' so that sensitivity is assessed as 'High'.

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

No evidence was found to assess this pressure. *Caecum armoricum* can probably detect sound waves through vibrations but it is likely that within the shingle where it lives exposure to this pressure will be reduced. Changes in noise level at the pressure benchmark are considered unlikely to cause population-level impacts and this pressure is considered to be 'Not relevant'.

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

Caecum armoricum live within shingle and will therefore not be directly exposed to changes in light levels. This pressure is considered to be 'Not relevant'.

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

The lagoon habitat in which *Caecum armoricum* is found in the UK is enclosed by sediment barriers which reduce wave action and water flow. Barriers (either natural or man-made) can, therefore, be considered an essential habitat component of lagoons. *Caecum armoricum* have a benthic dispersal strategies (production of eggs with direct development rather than a pelagic phase (Hoenslaar & Hoenslaar, 1990), water transport is, therefore, not a key method of dispersal over wide distances, as it is for some marine invertebrates that produce pelagic larvae. Barriers may result in habitat fragmentation and changes to barrier systems within lagoons may alter tidal flushing resulting in changes in salinity. As these effects arising from barriers are indirect they are assessed through the relevant changes in salinity pressures.

Sensitivity assessments. Barriers within lagoons are unlikely to result in direct effects on *Caecum armoricum* populations. Resistance is therefore assessed as 'High' and resilience as 'High', by default, so that *Caecum armoricum* is considered to be 'Not sensitive'. Barriers may result in indirect effects where habitat conditions such as temperature and salinity are affected (see relevant pressures). At the pressure benchmark, habitats are not impermeable so habitat fragmentation with concomitant effects of genetic diversity and prevention of recovery where populations in habitat fragments are lost are not considered.

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 and associated species. NB. Collision by interaction with bottom towed fishing gears and moorings are 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

Caecum armoricum inhabits interstitial gaps between shingle, therefore they are unlikely to be exposed to, or to detect if exposed, visual disturbance at the pressure benchmark and the pressure is considered to be '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

Caecum armoricum are not cultivated or translocated. This pressure is therefore considered 'Not relevant' to this species.

Introduction or spread of invasive non-indigenous species	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.

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	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 species is not targeted by commercial or recreational fishers or harvesters. This pressure is, therefore, considered 'Not relevant'.

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

Caecum armoricum lives within shingle and could be accidentally damaged by abrasion or penetration of the shingle occurring while other species are targeted for harvesting (see physical damage pressures). *Caecum armoricum* does not live alongside other species that might be targeted for commercial or recreational hand collecting and is, therefore, unlikely to be accidentally removed as bycatch, although cockle harvesting (*Cerastoderma glaucum*) or harvesting of lugworms in pockets of finer sediments could result in sediment disturbance and redeposition.

Sensitivity assessment. Resistance to incidental removal as by-catch is assessed as 'Low', due to small size *Caecum armoricum* are likely to be moved within the sediment and redeposited. Redeposition may lead to individuals being placed in unsuitable habitats. Resilience is assessed as 'Medium' and sensitivity is assessed as 'Medium'.

Importance review

Policy/legislation

Wildlife & Countryside Act	Schedule 5, section 9
Features of Conservation Importance (England & Wales)	☑

Status

National (GB) importance	Nationally rare	**Global red list (IUCN) category**	-

Non-native

Native	-		
Origin	-	**Date Arrived**	-

Importance information

Conservation measure: protect percolation areas along Fleet shore of Chesil Beach, which provide micro-habitat for this species.

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