



# MarLIN

## Marine Information Network

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

## St John's jellyfish (*Calvadosia cruxmelitensis*)

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/14>]. All terms and the MarESA methodology are outlined on the website (<https://www.marlin.ac.uk>)

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*Calvadosia cruxmelitensis*

Photographer: David Fenwick

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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 Harvey Tyler-Walters & Saskiya Richards | Refereed by | Admin   |
| Authority          | (Corbin, 1978)                             |             |   |
| Other common names | -  | Synonyms    | <i>Lucernariopsis cruxmelitensis</i> (Corbin, 1978) |

## Summary

### Description

This stalked jellyfish is the smallest member of its family. *Calvadosia cruxmelitensis* has a translucent, maroon, broad funnel-shaped bell that can reach 1.2 cm in diameter and 0.8 cm in height. The bell is divided by hollow septa. The reproductive gonads are thick and linear, and arranged inside the bell in halves which join at the base and extend in a linear fashion to the arms. The 8 arms are arranged in a circle and well-developed with up to 35 tentacles each. Each of the tentacles has a rounded head. Unique to the *Calvadosia cruxmelitensis* is the arrangement of the nematocyst organs, which appear as white spots in the shape of a 'maltese cross', from which the species name 'cruxmelitensis' is derived. A distinguishing feature of *Calvadosia cruxmelitensis* is its stalkless appearance due to the base of the bell involuting around the stalk that is 0.8 cm in height and attached to the substratum by a broad basal disc. Tentacle anchors are absent in *Calvadosia cruxmelitensis* compared to *Haliclystus salpinx*.

### Recorded distribution in Britain and Ireland

*Calvadosia cruxmelitensis* is recorded from the south-west of England, from Swanage to north Devon, and the Isles of Scilly and the Atlantic coasts of Ireland, with occasional records from

Pembrokeshire and the Llyn Peninsula in Wales, the Firth of Lorn in Scotland.

## 📍 Global distribution

*Calvadosia cruxmelitensis* is only recorded from the British Isles.

## 🖼️ Habitat

*Calvadosia cruxmelitensis* inhabits moderately-exposed rocky shores in the low intertidal and shallow sublittoral zones. In contrast to most species of Stauromedusae it is rarely attached to *Zostera* spp. but is often found on the macroalgae *Chondrus crispus* and *Mastocarpus stellatus*.

## ↓ Depth range

Lower eulittoral to shallow sublittoral

## 🔍 Identifying features

- Stalk-less appearance.
- 8 arms.
- Up to 35 tentacles on each arm.
- Translucent, maroon colour.
- White spots on surface of bell form a distinctive maltese cross.
- No tentacle anchors.

## 🏛️ Additional information

The nematocyst capsules are large, vivid white against the maroon of the body, and arranged in the pattern of 'maltese cross' (Corbin, 1978). The species name '*cruxmelitensis*' refers to this 'maltese cross' pattern (Corbin, 1978).

Information on the ecology of *Calvadosia cruxmelitensis* is limited. Information from similar species or other members of the group (Stauromedusae) was used to complete this review. Information relevant to sensitivity assessment was particularly lacking. Sensitivity assessments are based on proxies (e.g. the sensitivity of its preferred substratum) and expert judgement where possible. Miranda *et al.* (2010, 2016a&b) provide detailed studies of the morphology, histology and taxonomy of the Stauromedusae.

## ✓ Listed by



## 🔗 Further information sources

[Stauromedusae UK](#)

Search on:

  NBN WoRMS

## Biology review

### ☰ Taxonomy

|                 |  |  |
|-----------------|--|--|
| Phylum          | Cnidaria                                     | Sea anemones, corals, sea firs & jellyfish |
| Class           | Staurozoa                                    | Stalked jellyfish                          |
| Order           | Stauromedusae                                |  |
| Family          | Kishinouyeidae                               |  |
| Genus           | Calvadosia                                   |  |
| Authority       | (Corbin, 1978)                               |  |
| Recent Synonyms | Lucernariopsis cruxmelitensis (Corbin, 1978) |  |

### 🌿 Biology

|                               |   |
|-------------------------------|---|
| Typical abundance             | High density  |
| Male size range               | up to 0.8 cm  |
| Male size at maturity         | up to 0.8 cm  |
| Female size range             | up to 0.8 cm  |
| Female size at maturity       | up to 0.8 cm  |
| Growth form                   | Radial  |
| Growth rate                   | No information  |
| Body flexibility              | High (greater than 45 degrees)  |
| Mobility                      | Temporary attachment  |
| Characteristic feeding method | Predator  |
| Diet/food source              | Carnivore   |
| Typically feeds on            | Copepods, amphipods, ostracods, small juvenile decapods, polychaetes and gastropods |
| Sociability                   | Not relevant  |
| Environmental position        | Epifloral   |
| Dependency                    | None.   |
| Supports                      | None  |
| Is the species harmful?       | No  |

### 🏛️ Biology information

#### Population dynamics.

Stauromedusae are annuals that develop seasonally, reproduce, and die back until the following year, although they have a complex life cycle that may include resting or overwintering stages (see 'life history' below) (Berrill, 1962; Corbin, 1978, 1979, Zagal, 2004a; Miranda *et al.*, 2012). Although the number of studies is limited, Stauromedusae exhibit seasonal periods of high abundance in both the northern and southern hemispheres (Miranda *et al.*, 2012, Table 2). In Wembury, the UK, Corbin (1978, 1979) noted that *Haliclystus auricula* exhibited its highest abundance in mid-summer, *Calvadosia* (as *Lucernariopsis*) *campanulata* in autumn and *Calvadosia* (as *Lucernariopsis*) *cruxmelitensis* in winter, based on 23 years of observations. Between 1953 and 1974, Corbin (1979) also observed years with exceptionally high counts of *Calvadosia campanulata* in 1962 and 1974, of *Calvadosia cruxmelitensis* in 1968 (when ca 2000 individuals were found) and of *Haliclystus auricula*

in 1972 and 1973. The annual mean numbers of individuals was 37 in *Haliclystus auricula*, 39 in *Calvadosia cruxmelitensis* but 5 in *Calvadosia campanulata* (Corbin, 1979). In southern Chile, Zagal (2004a) noted a summer peak in abundance in *Haliclystus auricula*, with a maximum density of 1,405 individuals/m<sup>2</sup>, after which it disappeared in winter. The stauromedusae adult phase is the only conspicuous phase of the life cycle. Although it is small and often camouflaged on its algal substratum, the other life stages (planulae and stauropolyps) are small and hard to observe (Corbin, 1979; Miranda *et al.*, 2012). The environmental cues for the seasonal growth and exceptional years are unknown but their abundance coincides with the greatest algal cover and is probably correlated with optimal conditions for feeding and hence growth (Zagal, 2004a; Miranda *et al.*, 2012).

### Feeding

Stauromedusae are passive predators that catch food using stinging nematocysts. In southern Chile, Zagal (2004b) reported that the prey of *Haliclystus auricula* consisted mainly of gammarid amphipods, chironomid fly larvae, ostracods (seed shrimp), juvenile decapods crustaceans and gastropods, and that the smaller medusae took the smallest prey. These prey are typical mobile grazers and scavengers in seaweed canopies. In South Georgia (subantarctic) *Haliclystus antarcticus* preyed mainly on calanoid copepods, amphipods and, in one case, an errant polychaete (Davenport, 1998). Davenport (1998) concluded that they took both benthic and planktonic prey. It is probable that *Calvadosia* spp. take similar prey, depending on size.

Davenport (1998) also noted that *Haliclystus antarcticus* in South Georgia (subantarctic) was preyed on by aeolid nudibranchs and the fish *Notothenia rossii* (the marbled rockcod).



### Habitat preferences

|                                  |   |
|----------------------------------|---|
| Physiographic preferences        | Enclosed coast / Embayment, Strait / sound                |
| Biological zone preferences      | Lower eulittoral, Sublittoral fringe, Upper infralittoral |
| Substratum / habitat preferences | Macroalgae  |
| Tidal strength preferences       | Weak < 1 knot (<0.5 m/sec.)                               |
| Wave exposure preferences        | Moderately exposed, Sheltered                             |
| Salinity preferences             | Full (30-40 psu)  |
| Depth range                      | Lower eulittoral to shallow sublittoral                   |
| Other preferences                | No text entered   |
| Migration Pattern                |   |

### Habitat Information

*Haliclystus auricula*, *Calvadosia* (as *Lucernariopsis*) *cruxmelitensis* and *Calvadosia* (as *Lucernariopsis*) *campanulata* grow on a variety of macroalgae on the lower half of the shore, in pools or 'moving with the waves' 'at the tides edge' (Corbin, 1979). Corbin (1979) noted that *Calvadosia cruxmelitensis* rarely settled on *Zostera* and that no specimen was seen attached to a solid substratum. It occurred most frequently on *Chondrus* and *Gigartina*, frequently on *Ulva*, *Gracilaria*, *Furcellaria*, *Polyides*, *Corallina*, *Ceramium* and other feathery macroalgae, infrequently on *Codium*, *Cystoseira* and *Calliblepharis*, but also on a wider range of other macroalgae. In 25 years of observation, only one specimen was noted on *Zostera* or *Fucus* and none on *Halidrys*, *Laminaria*, *Chorda*, or *Himantalia*. He also noted that *Calvadosia cruxmelitensis* is perfectly camouflaged on *Corallina*, as the white tips of the pink branches match the stauromedusan's colouration; a

camouflage enhanced by the presence of encrusting *Lithothamnium* (Corbin, 1978).

## Life history

### Adult characteristics

|                            |  |
|----------------------------|--|
| Reproductive type          | Asexual, Gonochoristic (dioecious), Sexual |
| Reproductive frequency     | Annual episodic                            |
| Fecundity (number of eggs) | No information                             |
| Generation time            | <1 year                                    |
| Age at maturity            | <1 year                                    |
| Season                     | Winter                                     |
| Life span                  | <1 year                                    |

### Larval characteristics

|                             |                     |
|-----------------------------|---------------------|
| Larval/propagule type       | Planula             |
| Larval/juvenile development |                     |
| Duration of larval stage    | 2-10 days           |
| Larval dispersal potential  | Very limited (<1 m) |
| Larval settlement period    | Winter              |

## Life history information

Stauromedusae have a potentially complex life cycle with sexual and asexual stages, although the larval and early stages have been observed in few genera (*Haliclystus* and *Stylocoronella*) (Miranda *et al.*, 2010, 2012). In addition, Miranda *et al.* (2010) concluded that the hydrozoan *Microhydrula limopsicola* was a life-stage of *Haliclystus antarcticus* (based on morphology and molecular markers) and, therefore, suggested that the 'microhydrula' was part of the Stauromedusan life cycle.

- Individual medusae are dioecious. Spawning in *Haliclystus stejnegeri* was induced by exposure to light after an 8 hour dark period, while spawning was more intense in *Haliclystus salpinx* rather than induced under the same light regime (Otto, 1978).
- Eggs were in diameter 35 µm in *Haliclystus stejnegeri* and 40 µm in *Haliclystus salpinx* (Otto, 1978).
- Once fertilized the embryos become extremely sticky, stick to the substratum, and develop into planulae within 24 hours at 12-15°C (Otto, 1978).
- The non-ciliated benthic planulae settle within 1-3 days, on an available substratum, or already settled planulae, and many form aggregations of 1 to 8 planulae (Otto, 1978, 1979). They develop nematocysts within a week. In *Haliclystus octoradiatus* planulae settle in aggregations of 3-20 larvae (Miranda *et al.*, 2010).
- Otto (1979) noted that in one culture, the planulae underwent cell division and developed gastric cavities after several weeks, but was unable to stimulate further development in culture.
- Miranda *et al.* (2010, 2012) suggest that the planulae develop into the microhydrula stage, which further develops into the stauropoly (the juvenile or intermediate stauromedusa).



- The planula develops into the fully developed stauropolyp in ca 15 days in *Haliclystus octoradiatus* (Wietrzykowski, 1912; cited in Miranda *et al.*, 2012).
- The stauropolyp develops apically into the stauromedusa (Kikinger & von Salvini-Plawen, 1995; Miranda *et al.*, 2010, 2012), in about 2 months in *Stylocoronella* (Kikinger & von Salvini-Plawen, 1995).

Asexual reproduction can occur at several stages. The adult stauromedusa can bud 'frustules' from the upper part of the animal, while frustules can also bud from special tentacles on the stauropolyp and from the 'microhydula' stage (Kikinger & von Salvini-Plawen, 1995; Miranda *et al.*, 2010, 2012). Kikinger & von Salvini-Plawen (1995) noted that 'frustules' divided and then encysted, and suggested that they were 'resting stages'. Otto (1979) also noted that the lack of further development within her cultures suggested that the larvae had entered an overwintering stage, especially as larvae did not develop immediately after settlement in the field. Miranda *et al.* (2012) suggested that the 'microhydrula' stage might represent the 'resistant' stage of Otto (1978).

Miranda *et al.* (2012) noted that stauromedusae appear in specific seasons and then disappear. Adults are small (1-4 cm) and often camouflaged against the background of macroalgae and their abundance may be underestimated (Corbin, 1979; Miranda *et al.*, 2012). However, the tiny planulae (ca 100 µm in length) and stauropolyps (0.3-0.8 mm in height) are more difficult to find and have only been documented for nine of the 51 known species of Stauromedusae (Miranda *et al.*, 2010). It was also suggested that there might be a subtidal 'reservoir' population (Gwilliam, 1956, cited in Miranda *et al.*, 2012). The 'microhydrula' stage of *Haliclystus anatarcticus* was collected at a depth of 31 m, and the stauropolyp of *Haliclystus octoradiatus* can detach itself from the substratum, even in calm water. However, no other evidence was found for seasonal migration of planulae, stauropolyps and stauromedusae to or from deeper water (Miranda *et al.*, 2012). Field observations suggest that Stauromedusae disappear for several months before the young stages appear, which suggests that encystment occurs in the field (Otto, 1979; Miranda *et al.*, 2012). Also, Wietrzykowski (1912, cited in Miranda *et al.*, 2012) noted young polyps in April and mature stauromedusae in July. Miranda *et al.* (2012) concluded that three months from December to March would be adequate for planulae to become mature stauromedusae.

In addition, although a single stauropolyp only develops into a single adult (sexual) stauromedusae, the 'microhydula' and 'stauropolyp' stages can create numerous asexual 'frustules'. Frustules and planulae provide the potential to create a 'resevoir' of resistant or overwintering stages (Otto, 1978, 1979; Kikinger & von Salvini-Plawen, 1995; Miranda *et al.*, 2010) towards the end of the season, which may then develop when favourable conditions return the following year resulting in the seasonal peak in abundance. But frustules 'from asexual reproduction' may also rapidly develop many new polyps, contributing to the seasonal peaks in abundance, and in particular, exceptional 'blooms' in some years (Miranda *et al.*, 2012). Miranda *et al.* (2010) also noted that intense asexual reproduction was consistent with the low genetic diversity of the *Haliclystus antarcticus* populations they studied and, provide Stauromedusae with the potential to develop large populations in isolated areas.

## Sensitivity review

### Resilience and recovery rates

Stauromedusae are sedentary and spend their lives attached to the substratum, although they can attach to seaweeds and plants with their tentacles and adhesive disks and undertake limited locomotion. Their planulae are benthic and non-ciliated, as are the rest of their life stages (Otto, 1978, 1979; Miranda *et al.*, 2012) so that dispersal is limited. However, benthic life stages have been recorded in the subtidal and stauropolyps may detach (Miranda *et al.*, 2012). Therefore, it is probable that water flow and wave action may be important for dispersal (authors comment) although no evidence was found.

Although a single stauropolyp only develops into a single adult (sexual) stauromedusae, the 'microhydula' and 'stauropolyp' stages can create numerous asexual 'frustules'. Frustules and planulae provide the potential to create a 'resevoir' of resistant or overwintering stages (Otto, 1978, 1979; Kikinger & von Salvini-Plawen, 1995) towards the end of the season, which may then develop when favourable conditions return the following year resulting in the seasonal peak in abundance. But frustules (from asexual reproduction) may also rapidly develop many new polyps, contributing to the seasonal peaks in abundance, and in particular, exceptional 'blooms' in some years (Corbin, 1979; Miranda *et al.*, 2012). Miranda *et al.* (2010) also noted that intense asexual reproduction was consistent with the low genetic diversity of the *Haliclystus antarcticus* populations they studied and, provide Stauromedusae with the potential to develop large populations in isolated areas. This may also explain why Stauromedusae in the UK are locally abundant but nationally uncommon or rare (depending on species).

Hiscock *et al.* (2011, 2013) noted that *Haliclystus auricula*, *Calvadosia cruxmelitensis* and *Calvadosia campanulata* had declined, markedly in parts of the south-west compared to their abundance between the 1950s and 1970s (Corbin, 1979), and were 'little seen' in the UK. As a result, *Haliclystus auricula* was regarded 'uncommon', *Calvadosia campanulata* was regarded as 'scarce' and *Calvadosia cruxmelitensis* was regarded as 'rare' in the UK. Hiscock *et al.* (2011) suggested that the loss of seagrass beds or other habitat may have contributed to the decline but that the reason for the decline was unknown.

Annual increases in abundance and occasional exceptional 'natural true blooms' (*sensu* Miranda *et al.*, 2012) have been recorded in several Stauromedusae. It is suggested that the early life stages of the Stauromedusae provide a 'resevoir' of overwintering and resistant stages (as above) that persist in the environment awaiting favourable conditions for growth of the sexual stauromedusae stage. It is possible that the 'reservoir' of early life-stage may persist (e.g. via asexual reproduction or resistant stages) for many years awaiting favourable conditions. It may also be possible that this 'resevoir' exists in the subtidal, and that early life stages may be dispersed passively (by water flow and wave action) (authors comments). However, the lack of information on the ecology of the Stauromedusae does not allow support a conclusion, at present (see Miranda *et al.*, 2012).

**Resilience assessment.** *Calvadosia cruxmelitensis* is an annual that can develop large populations quickly within the summer months only to die back in winter. The potential that numerous planulae and resistant frustules can overwinter, its short lifespan, together with the potential for asexual development in Stauromedusae suggests that recovery could be rapid. Therefore, where resistance is 'Medium' or 'Low', resilience is probably 'High'. But, where a pressure results in severe impacts 'the loss of over 75% of the species population and modification of the habitat' and, hence, removal of the species substratum (i.e. macroalgae and seagrass) and any resident 'resevoir'

of resistant or overwintering stages, recovery may be prolonged. Therefore, the resilience of *Calvadosia cruxmelitensis* to severe impacts is discussed, where relevant, on a pressure by pressure basis **and the explanatory text for each assessment must be consulted**. The resilience assessment is based evidence on the Stauromedusae as a whole, a scarcity of information on the ecology of this species, and a scarcity of any direct evidence of recovery in the field. Therefore, the confidence in the assessment is 'Low'.

## Hydrological Pressures

|                                     | Resistance                        | Resilience                             | Sensitivity                                  |
|-------------------------------------|-----------------------------------|--|--|
| <b>Temperature increase (local)</b> | <b>High</b><br>Q: Low A: NR C: NR | <b>High</b><br>Q: High A: High C: High | <b>Not sensitive</b><br>Q: Low A: Low C: Low |

No evidence on the temperature tolerance of the Stauromedusae, and *Calvadosia cruxmelitensis*, in particular, was found. It is recorded from Scotland to the Isles of Scilly in the British Isles. It also occurs on seaweeds on the lower intertidal, although often protected by the seaweed from direct sunlight and hence desiccation (Corbin, 1979). Therefore, it is likely to resist a 2°C change in temperature over a period of a year in UK waters. It is a winter annual (Corbin, 1979) so that long-term changes in temperature may affect its seasonal growth and reproduction but the environmental factors that result in its seasonal abundance are not know (Corbin, 1979; Miranda *et al.*, 2012). No information was found on the effect, if any, of short-term acute temperature change (e.g. by 5°C).

**Sensitivity assessment.** Therefore, it is probably resistant to a 2°C change in temperature over a period of a year in UK waters and a resistance of '**High**' is recorded, albeit with 'Low' confidence. Hence, resilience is assessed as '**High**' and the species is recorded as '**Not sensitive**' at the benchmark level.

|                                     |                                   |  |  |
|-------------------------------------|-----------------------------------|--|--|
| <b>Temperature decrease (local)</b> | <b>High</b><br>Q: Low A: NR C: NR | <b>High</b><br>Q: High A: High C: High | <b>Not sensitive</b><br>Q: Low A: Low C: Low |
|-------------------------------------|-----------------------------------|--|--|

No evidence on the temperature tolerance of the Stauromedusae, and *Calvadosia cruxmelitensis*, in particular, was found. It is recorded from Scotland to the Isles of Scilly in the British Isles. It also occurs on seaweeds on the lower intertidal, although often protected by the seaweed from direct sunlight and hence desiccation (Corbin, 1979). Therefore, it is likely to resist a 2°C change in temperature over a period of a year in UK waters. It is a summer annual (Corbin, 1979) so that long-term changes in temperature may affect its seasonal growth and reproduction but the environmental factors that result in its seasonal abundance are not know (Corbin, 1979; Miranda *et al.*, 2012). No information was found on the effect, if any, of short-term acute temperature change (e.g. by 5°C).

**Sensitivity assessment.** Therefore, it is probably resistant to a 2°C change in temperature over a period of a year in UK waters and a resistance of '**High**' is recorded, albeit with 'Low' confidence. Hence, resilience is assessed as '**High**' and the species is recorded as '**Not sensitive**' at the benchmark level.

|                                  |   |   |   |
|----------------------------------|---|---|---|
| <b>Salinity increase (local)</b> | <b>No evidence (NEv)</b><br>Q: NR A: NR C: NR | <b>Not relevant (NR)</b><br>Q: NR A: NR C: NR | <b>No evidence (NEv)</b><br>Q: NR A: NR C: NR |
|----------------------------------|---|---|---|

*Calvadosia cruxmelitensis* is recorded from full salinity conditions. It also occurs on seaweeds on the lower intertidal, although often protected by the seaweed from direct sunlight and hence desiccation that might result in localised increases in salinity (Corbin, 1979). It is also found in lower shore rockpools, which are unlikely to experience the range of salinities typical of upper shore rockpools. It is unlikely to be exposed to hypersaline (>40) conditions but hypersaline effluents are probably detrimental. However, no evidence was found on which to base an assessment.

### Salinity decrease (local)

**Low**

Q: **Low** A: **NR** C: **NR**

**High**

Q: **Medium** A: **Medium** C: **Medium**

**Low**

Q: **Low** A: **Low** C: **Low**

*Calvadosia cruxmelitensis* is recorded from full salinity conditions. It also occurs on seaweeds on the lower intertidal, although often protected by the seaweed from direct sunlight (Corbin, 1979), although it may be exposed to rainfall and reduced salinity for short periods at low tide. It is also found in lower shore rockpools, which are unlikely to experience the range of salinities typical of upper shore rockpools. No evidence of salinity tolerance of the adult or other life stages was found. However, its position on the shore suggests that it could tolerate occasional rainfall at low tide but that a change from 'full' salinity to 'reduced' would be detrimental. Therefore, a resistance of '**Low**' is suggested, with 'Low' confidence. Resilience is probably '**High**' so sensitivity is assessed as '**Low**'.

### Water flow (tidal current) changes (local)

**High**

Q: **Low** A: **NR** C: **NR**

**High**

Q: **High** A: **High** C: **High**

**Not sensitive**

Q: **Low** A: **Low** C: **Low**

*Calvadosia cruxmelitensis* is recorded from the lower intertidal dominated by abundant fucoids and red seaweeds (e.g. *Chondrus* or *Gigartina*) (Corbin, 1979). It is, therefore, probably adapted to wave exposed to sheltered conditions in weak flow, that is, low to moderate energy habitats (see Connor *et al.*, 2004). Fenwick (2017) also remarked that the *Stauromedusae* in mounts Bay, Cornwall were most likely to occur close to a constriction in the runnels and interlinked pools of the bay where the water flow was increased locally. Therefore, a significant change in water flow may be detrimental, partly as the species may be removed but mainly as the seaweed substrata it requires would be removed or lost. However, a 1-2% change in water flow (the benchmark) is not likely to be significant. Therefore, a resistance of '**High**' is recorded so that resilience is '**High**' and the species is probably '**Not sensitive**' at the benchmark level.

### Emergence regime changes

**Low**

Q: **Low** A: **NR** C: **NR**

**High**

Q: **Medium** A: **Medium** C: **Medium**

**Low**

Q: **Low** A: **Low** C: **Low**

*Calvadosia cruxmelitensis* is recorded from the lower intertidal dominated by abundant fucoids and red seaweeds and from seagrass beds (Corbin, 1979). Lower shore populations are likely to be affected by changes in emergence. A decrease in emergence will probably provide additional habitat. However, an increase in emergence (for a year) will increase the potential for desiccation and reduce the cover of its required macroalgal substratum. Therefore, a resistance of '**Low**' is recorded. Resilience is probably '**High**' so that sensitivity is assessed as '**Low**'.

### 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**

*Calvadosia cruxmelitensis* is recorded from the lower intertidal dominated by abundant fucoids and red seaweeds (e.g. *Chondrus* or *Gigartina*) (Corbin, 1979). It is, therefore, probably adapted to wave exposed to sheltered conditions in weak flow, that is, low to moderate energy habitats (see Connor

*et al.*, 2004). Therefore, a significant change in wave action (e.g. to very exposed) may be detrimental, partly as the species may be removed but mainly as the seaweed or plant substrata it requires would be reduced in abundance or lost, presumably together with any resistant stages or early life stages, depending on the season. However, a 3-5% change in significant wave height (the benchmark) is not likely to be significant. Therefore, a resistance of '**High**' is recorded so that resilience is '**High**' and the species is probably '**Not sensitive**' at the benchmark level.

## Chemical Pressures

|   | Resistance                             | Resilience                             | Sensitivity                            |
|---|--|--|--|
| <b>Transition elements &amp; organo-metal contamination</b> | Not Assessed (NA)<br>Q: NR A: NR C: NR | Not assessed (NA)<br>Q: NR A: NR C: NR | Not assessed (NA)<br>Q: NR A: NR C: NR |

This pressure is **Not assessed**.

|  |  |  |  |
|--|--|--|--|
| <b>Hydrocarbon &amp; PAH contamination</b> | Not Assessed (NA)<br>Q: NR A: NR C: NR | Not assessed (NA)<br>Q: NR A: NR C: NR | Not assessed (NA)<br>Q: NR A: NR C: NR |
|--|--|--|--|

This pressure is **Not assessed**.

|   |  |  |  |
|---|--|--|--|
| <b>Synthetic compound contamination</b> | Not Assessed (NA)<br>Q: NR A: NR C: NR | Not assessed (NA)<br>Q: NR A: NR C: NR | Not assessed (NA)<br>Q: NR A: NR C: NR |
|---|--|--|--|

This pressure is **Not assessed**.

|                                   |  |  |  |
|-----------------------------------|--|--|--|
| <b>Radionuclide contamination</b> | No evidence (NEv)<br>Q: NR A: NR C: NR | Not relevant (NR)<br>Q: NR A: NR C: NR | No evidence (NEv)<br>Q: NR A: NR C: NR |
|-----------------------------------|--|--|--|

No evidence was found.

|   |  |  |  |
|---|--|--|--|
| <b>Introduction of other substances</b> | Not Assessed (NA)<br>Q: NR A: NR C: NR | Not assessed (NA)<br>Q: NR A: NR C: NR | Not assessed (NA)<br>Q: NR A: NR C: NR |
|---|--|--|--|

This pressure is **Not assessed**.

|                       |  |  |  |
|-----------------------|--|--|--|
| <b>De-oxygenation</b> | No evidence (NEv)<br>Q: NR A: NR C: NR | Not relevant (NR)<br>Q: NR A: NR C: NR | No evidence (NEv)<br>Q: NR A: NR C: NR |
|-----------------------|--|--|--|

*Haliclystus* and *Calvadosia* spp. have a preference for areas with flowing water, which suggests that low oxygen levels would be detrimental. However, no evidence was found.

|                            |                            |                                 |                                       |
|----------------------------|----------------------------|---------------------------------|---------------------------------------|
| <b>Nutrient enrichment</b> | High<br>Q: Low A: NR C: NR | High<br>Q: High A: High C: High | Not sensitive<br>Q: Low A: Low C: Low |
|----------------------------|----------------------------|---------------------------------|---------------------------------------|

No information on the effects of nutrient enrichment on this species was found. However, its sensitivity is probably determined by the macroalgae it requires for substratum.

Green algae species have been identified worldwide as species that occur in areas subject to increased nutrient input within the vicinity of sewage outfalls and at intermediately polluted sites (Littler & Murray, 1975; Bellgrove *et al.*, 1997; Bellgrove *et al.*, 2010). Atalah & Crowe (2010) added nutrients to rockpools occupied by a range of algae including encrusting corallines, turfs of *Mastocarpus stellatus*, *Chondrus crispus* and *Corallina officinalis* and green and red filamentous algae. The invertebrates present were mostly *Patella ulyssiponensis*, the winkle *Littorina littorea* and the flat top shell *Gibbula umbilicalis*. Nitrogen and phosphorous enhancement was via the addition of fertilisers, as either 40 g/litre or 20 g/litre. The treatments were applied for seven month and experimental conditions were maintained every two weeks. The experimental treatments do not directly relate to the pressure benchmark but indicate some general trends in sensitivity. The cover of green filamentous algae was significantly increased both by reduced grazing and increased nutrients, although the effect size was synergistically magnified by the combined effect of grazer removal and nutrients. Nutrient enrichment caused an absolute increase in the average cover of green filamentous algae of 19% ( $\pm 3.9$  S.E.) respect to the control treatments while the cover of red turfing algae was not affected by nutrient addition (Atalah & Crowe, 2010).

**Sensitivity assessment.** *Calvadosia cruxmelitensis* can occur on a variety of macroalgae. In the intertidal hard rock habitats and rock pools the macroalgal substratum for the species is unlikely to be removed by nutrient enrichment. Although the species may change in abundance, adequate substratum is likely to be present, together with more grazers, on which the Stauromedusae may also feed (e.g. amphipods). Therefore, a resistance of 'High', resilience of 'High' are recorded and the species is probably 'Not sensitive' at the benchmark level in intertidal hard rock habitats.

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

No information on the effects of organic enrichment on this species was found. However, its sensitivity is probably determined by the macroalgae it requires for substratum.

Organic enrichment and nutrient enrichment commonly co-occur, for example, sewage deposits or outputs from fish farms may enhance nitrogen and phosphorous and organic matter. Nutrient enrichment alters the selective environment by favouring fast growing, ephemeral species such as *Ulva lactuca* and *Ulva intestinalis* (Berger *et al.*, 2004, Kraufvelin, 2007). Rohde *et al.* (2008) found that both free growing filamentous algae and epiphytic microalgae can increase in abundance with nutrient enrichment. This stimulation of annual ephemerals may accentuate the competition for light and space and hinder perennial species development or harm their recruitment (Berger *et al.*, 2003; Kraufvelin *et al.*, 2007). Nutrient enrichment can also enhance fouling of *Fucus* fronds by biofilms (Olsenz, 2011). Nutrient enriched environments can not only increase algae abundance but the abundance of grazing species (Kraufvelin, 2007). High nutrient levels may directly inhibit spore settlement and hinder the initial development of *Fucus vesiculosus* (Bergström *et al.*, 2003). Bellgrove *et al.* (2010) found that coralline turfs out-competed fucoids at a site associated with organic enrichment caused by an ocean sewage outfall. Therefore, in hard rock habitats, adequate substratum for the Stauromedusae is likely to remain so that resistance is recorded as 'High', resilience as 'High' and the species is probably 'Not sensitive' at the benchmark level in hard rock habitats.

## A 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

The species lives attached to macroalgae in the lower littoral and shallow subtidal. In rock habitats, a change in seabed type from hard rock to sediment would result in the loss the most macroalgae and, hence, the species and any early life stages. Based on the loss of species habitat (substratum), resistance is assessed as 'None'. The change is defined as permanent so that resilience is assessed as 'Very low' and sensitivity is assessed as 'High'. Although no specific evidence is described, confidence in this assessment is 'High' due to the incontrovertible nature of this pressure.

**Physical change (to another sediment type)****Not relevant (NR)**

Q: NR A: NR C: NR

**Not relevant (NR)**

Q: NR A: NR C: NR

**Not relevant (NR)**

Q: NR A: NR C: NR

This pressure is not 'Not relevant' as *Calvadosia cruxmelitensis* occurs on macroalgae on hard rock habitats.

**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

This pressure is not 'Not relevant' where *Calvadosia cruxmelitensis* occurs on macroalgae on hard rock habitats.

**Abrasion/disturbance of the surface of the substratum or seabed****Low**

Q: Low A: NR C: NR

**Medium**

Q: Medium A: Medium C: Medium

**Medium**

Q: Low A: Low C: Low

No evidence on the effect of abrasion (e.g. from trampling or vehicular access) of this species was found. Stauromedusae are small and soft-bodied and probably not physically robust. Similarly, their early life stages (e.g. stauropolyp, 'microhydula', encysted frustules, and overwintering planulae) are tiny and potentially susceptible to physical disturbance. However, most importantly, they are likely to be lost if their macroalgal or seagrass substratum is damaged or removed by abrasion.

Most macroalgae are very flexible but not physically robust. The trampling of shores by humans will result in increased breakage of algal thalli, decreased thallus height and a net reduction in biomass (Tyler-Walters & Arnold, 2008). The effects of trampling are dependent on intensity, expressed as frequency and force per unit area of the impacting 'footprint' (see Liddle, 1997, Tyler-Walters & Arnold, 2008). Mechanical abrasion due to vehicles, jack-up-barges, or grounding vessels will exceed the abrasive 'intensity' of trampling by humans or livestock. Overall, the

abundance of fucoids and red seaweeds are likely to be reduced (see reviews of [LR.MLR.MusF.MytFR](#), [LR.MLR.BF.FvesB](#) for detail).

**Sensitivity assessment.** The sensitivity of *Calvadosia cruxmelitensis* to abrasion is linked to the sensitivity of its preferred substratum; i.e macroalgae in the intertidal and the shallow subtidal. Therefore, if abrasion causes a significant reduction in the abundance of available substratum in the affected area, resistance is recorded as '**Low**'. It is difficult to know if removal of macroalgal substratum would also remove a significant proportion of the resistant or overwintering stages, although that seems likely. However, recovery is also dependent on the recovery of a suitable substratum. Therefore, a resilience of '**Medium**' (2-10 years) is suggested to account for the return of suitable substratum (which is likely to vary between 1-2 years or 2-10 years depending on species) and subsequent recovery of the resident population from the surrounding area. Hence, sensitivity is assessed as '**Medium**'.

**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

Hard rock is resistant of sub-surface penetration. Therefore, where this species' preferred substratum (i.e. macroalgae) occur on hard rock the pressure is recorded as '**Not relevant**'. The assessment for 'abrasion at the surface' only is, therefore, considered to equally represent sensitivity to this pressure. Please refer to 'abrasion' above for **hard rock habitats**.

**Changes in suspended solids (water clarity)**

Medium

Q: Low A: NR C: NR

High

Q: Low A: NR C: NR

Low

Q: Low A: Low C: Low

*Calvadosia cruxmelitensis* grows on macroalgae. In the intertidal, they grow on macroalgae on rock, and also in pools and runnels where some sediment may accumulate (Corbin, 1979; Fenwick, 2017). But no evidence on the effects of suspended sediments on the Stauromedusae was found. However, suspended sediments may adversely affect their preferred substratum.

Increases in the cover of sediment trapping, turf-forming red algae at the expense of canopy forming species have been observed worldwide in temperate systems and have been linked to increased suspended solids linked to human activities worldwide (Airoidi, 2003). For example, canopy-forming fucoids may be replaced by more sediment tolerant species such as *Chondrus crispus*. As *Haliclystus auricula*, *Calvadosia campanulata* and *Calvadosia cruxmelitensis* can grow on a variety of macroalgae an increase in suspended sediment may not be detrimental, especially as the macroalgae would probably recover within two years (i.e. 'High' resilience; for example [LR.MLR.MusF.MytFR](#)). Therefore, resistance is probably '**Medium**', with a resilience of '**High**' and a sensitivity of '**Low**' on **hard rock shores**.

**Smothering and siltation rate changes (light)**

Medium

Q: Low A: NR C: NR

High

Q: Low A: NR C: NR

Low

Q: Low A: Low C: Low

*Calvadosia cruxmelitensis* grows on macroalgae. In the intertidal, they grow on macroalgae on hard rock, and also in pools and runnels where some sediment may accumulate (Fenwick, 2017). No evidence on the effects of sedimentation or smothering on the Stauromedusae was found. However, sedimentation or smothering may adversely affect their preferred substratum.

Increased abundance of algal turfs worldwide has been linked to sediment perturbations although



not all the pathways and mechanisms of these effects are clear (Airoldi, 2003). However, even the most tolerant of organisms would eventually suffer from inhibition and mortality following smothering although the thresholds for these effects have not been identified (Airoldi, 2003). In a review of the effects of sedimentation on rocky coast assemblages, Airoldi (2003) outlined the evidence for the sensitivity of coralline algae to sedimentation. The reported results are contradictory with some authors suggesting that coralline algae are negatively affected by sediments while others report that encrusting corallines are often abundant or even dominant in a variety of sediment impacted habitats (Airoldi, 2003 and references therein). Crustose corallines have been reported to survive under a turf of filamentous algae and sediment for 58 days (the duration of the experiment) in the Galapagos (species not identified, Kendrick, 1991). The crustose coralline *Hydrolithon reinboldii* has also been reported to survive deposition of silty sediments on subtidal reefs off Hawaii (Littler, 1973).

Atalah & Crowe (2010) added sediment to rockpools in controlled experiments. The rockpools were occupied by a range of algae including encrusting corallines, turfs of *Mastocarpus stellatus*, *Chondrus crispus* and *Corallina officinalis* and green and red filamentous algae. The invertebrates present were mostly *Patella ulyssiponensis*, the winkle *Littorina littorea* and the flat top shell *Gibbula umbilicalis*. Sediment treatment involved the addition of a mixture of coarse and fine sand of either 300 mg/cm<sup>2</sup>/month or 600 mg/cm<sup>2</sup> every 15 days (the depth of sediment was not reported). The experimental treatments do not directly relate to the pressure benchmark but indicate some general trends in sensitivity. In the pools, the chronic addition of both levels of sediment led to a significant decrease in grazers and crustose coralline algae also decreased. Sedimentation had no significant effect on the cover of green filamentous algae (*Ulva* sp.) but led to an increase in the mean cover of red turfing algae (*Mastocarpus stellatus* and *Chondrus crispus* and *Corallina officinalis*) from 11.7% (±1.0 S.E.) in controls to 26.1% (±4.7 S.E.) in sedimented assemblages, but there were no differences between the two levels of sedimentation. The cover of red filamentous algae (*Ceramium* spp. *Gelidium* spp.) was also significantly increased in the sedimentation experiments. The experimental results support the general trend of greater sensitivity of grazers and encrusting corallines to sedimentation than turf-forming algae.

**Sensitivity assessment.** On intertidal rocky shores exposed to wave action, 5 cm of deposited sediment is unlikely to persist for more than a few tidal cycles. However, sediment may be retained on wave sheltered shores and in sheltered rockpools. The evidence summarised above suggests that suitable substrata for *Calvadosia cruxmelitensis* would remain in pools and on sheltered shores. However, there is no information on the resistance of the stauromedusae themselves or their early life stages, which might be damaged or suffocated by a layer of sediment. Therefore, a resistance of **'Medium'** is suggested, with a resilience of **'High'** and sensitivity is assessed as **'Low'** on hard rock shores.

#### Smothering and siltation rate changes (heavy)

**Medium**

Q: Low A: NR C: NR

**High**

Q: Low A: NR C: NR

**Low**

Q: Low A: Low C: Low

As above the duration of smothering by 30 cm of deposited material is dependent on the wave exposure of the shore. In wave exposed conditions the deposit is likely to be removed within a few tidal cycles while it may remain on sheltered shores and in sheltered rock pools. The evidence summarised above suggests that suitable substrata for *Calvadosia cruxmelitensis* would remain in pools and on sheltered shores (see evidence under 'siltation (light)' above). However, there is no information on the resistance of the stauromedusae themselves or their early life stages, which might be damaged or suffocated by a layer of sediment. Therefore, a resistance of **'Medium'** is suggested, with a resilience of **'High'** and sensitivity is assessed as **'Low'** on hard rock shores.

|               |   |   |   |
|---------------|---|---|---|
| <b>Litter</b> | <b>Not Assessed (NA)</b><br>Q: NR A: NR C: NR | <b>Not assessed (NA)</b><br>Q: NR A: NR C: NR | <b>Not assessed (NA)</b><br>Q: NR A: NR C: NR |
|---------------|---|---|---|

Not assessed

|                                |   |   |   |
|--------------------------------|---|---|---|
| <b>Electromagnetic changes</b> | <b>No evidence (NEv)</b><br>Q: NR A: NR C: NR | <b>Not relevant (NR)</b><br>Q: NR A: NR C: NR | <b>No evidence (NEv)</b><br>Q: NR A: NR C: NR |
|--------------------------------|---|---|---|

No evidence was found

|                                 |   |   |   |
|---------------------------------|---|---|---|
| <b>Underwater noise changes</b> | <b>No evidence (NEv)</b><br>Q: NR A: NR C: NR | <b>Not relevant (NR)</b><br>Q: NR A: NR C: NR | <b>No evidence (NEv)</b><br>Q: NR A: NR C: NR |
|---------------------------------|---|---|---|

No evidence was found

|   |   |   |   |
|---|---|---|---|
| <b>Introduction of light or shading</b> | <b>No evidence (NEv)</b><br>Q: NR A: NR C: NR | <b>Not relevant (NR)</b><br>Q: NR A: NR C: NR | <b>No evidence (NEv)</b><br>Q: NR A: NR C: NR |
|---|---|---|---|

Otto (1978) noted spawning in *Haliclystus stejnegeri* was induced by exposure to light after an 8 hour dark period, while spawning was more intense in *Haliclystus salpinx* rather than induced under the same light regime (Otto, 1978). However, this observation does not provide any evidence about the response of Stauromedusae to increased light or shading in the natural environment. No assessment was made.

|                                    |   |   |   |
|------------------------------------|---|---|---|
| <b>Barrier to species movement</b> | <b>Not relevant (NR)</b><br>Q: NR A: NR C: NR | <b>Not relevant (NR)</b><br>Q: NR A: NR C: NR | <b>Not relevant (NR)</b><br>Q: NR A: NR C: NR |
|------------------------------------|---|---|---|

**Not relevant** - this pressure is considered applicable to mobile species, e.g. fish and marine mammals rather than seabed habitats. Adult *Calvadosia cruxmelitensis* are sedentary and unlikely to move far, and their early life stages are also benthic and non-motile (Miranda *et al.*, 2012). The dispersal of larval stages or propagules is not considered under the pressure definition and benchmark.

|                                     |   |   |   |
|-------------------------------------|---|---|---|
| <b>Death or injury by collision</b> | <b>Not relevant (NR)</b><br>Q: NR A: NR C: NR | <b>Not relevant (NR)</b><br>Q: NR A: NR C: NR | <b>Not relevant (NR)</b><br>Q: NR A: NR C: NR |
|-------------------------------------|---|---|---|

**Not relevant** to seabed habitats. NB. Collision by interaction with bottom towed fishing gears and moorings are addressed under 'surface abrasion'.

|                           |   |   |   |
|---------------------------|---|---|---|
| <b>Visual disturbance</b> | <b>Not relevant (NR)</b><br>Q: NR A: NR C: NR | <b>Not relevant (NR)</b><br>Q: NR A: NR C: NR | <b>Not relevant (NR)</b><br>Q: NR A: NR C: NR |
|---------------------------|---|---|---|

The Stauromedusae are sedentary and do not exhibit an escape response. Visual disturbance by passing vessels or humans at the sea surface is probably **Not relevant**.

## Biological Pressures

Resistance

Resilience

Sensitivity

**Genetic modification & translocation of indigenous species**

No evidence (NEv)

Q: NR A: NR C: NR

Not relevant (NR)

Q: NR A: NR C: NR

No evidence (NEv)

Q: NR A: NR C: NR

No evidence on the translocation, breeding or species hybridization was found.

**Introduction or spread of invasive non-indigenous species**

No evidence (NEv)

Q: NR A: NR C: NR

Not relevant (NR)

Q: NR A: NR C: NR

No evidence (NEv)

Q: NR A: NR C: NR

No evidence was found to suggest a positive or negative interaction between non-indigenous invasive species and *Calvadosia cruxmelitensis*.

**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 of microbial or other pathogens was found.

**Removal of target species**

Not relevant (NR)

Q: NR A: NR C: NR

Not relevant (NR)

Q: NR A: NR C: NR

Not relevant (NR)

Q: NR A: NR C: NR

**Not relevant.** This species is not subject to a targetted commercial or recreational fishery.

**Removal of non-target species**

Low

Q: Low A: NR C: NR

Low

Q: Low A: NR C: NR

High

Q: Low A: Low C: Low

Removal of macroalgae or seagrass would directly affect the population of Stauromedusae by removal of its substratum. Recovery would depend on the recovery of suitable substratum, which in the case of macroalgae could take between 1-2 or 2-10 years depending on species (for example see [LR.MLR.MusF.MytFR](#)). Hence a resistance of 'Low' is suggested, with a resilience of 'Medium' and a sensitivity of 'Medium'.

## Importance review

### Policy/legislation

- UK Biodiversity Action Plan Priority
- Species of principal importance (England)
- Features of Conservation Importance (England & Wales)

### ★ Status

|                                 |                 |  |   |
|---------------------------------|-----------------|--|---|
| <b>National (GB) importance</b> | Nationally rare | <b>Global red list (IUCN) category</b> | - |
|---------------------------------|-----------------|--|---|

### Non-native

|               |        |                     |   |
|---------------|--------|---------------------|---|
| <b>Native</b> | Native |                     |   |
| <b>Origin</b> | -      | <b>Date Arrived</b> | - |

### Importance information

This species was found in often high numbers (ca 2000 individuals in one shore search in 1968; Corbin, 1979) on shores in south-west England but is now rarely seen (Hiscock *et al.*, 2011). Hiscock *et al.* (2011) suggested that the population had declined by 90% from the 1970s to 2005, although the reason for the decline was unknown.

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