Sea potato (*Echinocardium cordatum*)

MarLIN – Marine Life Information Network
Biology and Sensitivity Key Information Review

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A report from:
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/1417]. All terms and the MarESA methodology are outlined on the website (https://www.marlin.ac.uk)

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***Echinocardium cordatum* dug up from coarse sediment.**
Photographer: Keith Hiscock

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	Jacqueline Hill	**Refereed by**	Prof. David Nichols
Authority	(Pennant, 1777)		
Other common names	-	**Synonyms**	-

Summary

Description

A heart shaped urchin covered in a dense felt of yellow spines, mostly directed backwards. Yellow-brown in colour and usually 6 cm in length although can grow up to 9 cm long.

Recorded distribution in Britain and Ireland

Echinocardium cordatum is a common infaunal species found on sheltered sandy beaches, on all coasts of Britain and Ireland.

Global distribution

Almost cosmopolitan except for polar seas: Norway to South Africa, Mediterranean, Australasia and Japan.

Habitat

Echinocardium cordatum lives in a permanent burrow buried about 8 cm deep (to 15 cm) in sandy sediments. The species is found from the intertidal to the subtidal and offshore to about 200 m.

Depth range

0 to -200m

Identifying features

- Heart shaped test 6-9 cm in length, fawn in colour, spines yellowish. In profile, highest point of test posterior to apical system.
- Ambulacra rather broad and furrow like, extending down the sides of test, forming a stellate shape.
- The two series of tube feet in the anterior ambulacrum each forms a double row as seen by the pore-pairs on the test.
- Some large spines and their prominent tubercles scattered ventro-laterally on the anterior interambulacra.

Additional information

The common name of this species refers to the brittle, brownish test, which is often found washed up on sheltered sandy shores.

Listed by

Further information sources

Search on:

NBN WoRMS

Biology review

Taxonomy

Order	Spatangoida
Family	Loveniidae
Genus	Echinocardium
Authority	(Pennant, 1777)
Recent Synonyms	-

Biology

Typical abundance	High density
Male size range	
Male size at maturity	
Female size range	Small-medium(3-10cm)
Female size at maturity	
Growth form	Globose
Growth rate	1-2cm/year
Body flexibility	None (less than 10 degrees)
Mobility	
Characteristic feeding method	Sub-surface deposit feeder
Diet/food source	
Typically feeds on	Detritus
Sociability	
Environmental position	Infaunal
Dependency	Independent.
Supports	See additional information
Is the species harmful?	No

Biology information

- **Growth rate:** Growth in *Echinocardium cordatum* is particularly rapid during the first and second years of life. There are also seasonal variations that are characterised by an alternation of slow and rapid growth rates, with rapid growth during spring and summer months (Ridder de *et al*., 1991).
- The bivalve *Tellimya ferruginosa* is a commensal of *Echinocardium cordatum*, and as many as 14 or more of this bivalve have been recorded with a single echinoderm. Adult specimens live freely in the burrow of *Echinocardium cordatum*, while the young are attached to the spines of the echinoderm by byssus threads (Fish & Fish, 1996). The amphipod crustacean *Urothoe marina* (Bate) is another common commensal (Hayward & Ryland, 1995).

Habitat preferences

Physiographic preferences	Open coast, Offshore seabed, Strait / sound, Enclosed coast / Embayment

Biological zone preferences	Circalittoral offshore, Lower circalittoral, Lower eulittoral, Lower infralittoral, Sublittoral fringe, Upper circalittoral, Upper infralittoral
Substratum / habitat preferences	Coarse clean sand, Fine clean sand, Muddy sand, Sandy mud
Tidal strength preferences	No information
Wave exposure preferences	Extremely sheltered, Sheltered, Very sheltered
Salinity preferences	Full (30-40 psu), Reduced (18-30 psu)
Depth range	0 to -200m
Other preferences	No text entered
Migration Pattern	Seasonal (reproduction)

Habitat Information

The species has an annual tendency to form aggregations during the breeding season (Buchanan, 1966). There is also a migration of individuals from the subtidal to the intertidal at about 2 years of age.

Life history

Adult characteristics

Reproductive type	Gonochoristic (dioecious)
Reproductive frequency	Annual episodic
Fecundity (number of eggs)	>1,000,000
Generation time	Insufficient information
Age at maturity	2-3 years
Season	Spring - Summer
Life span	10-20 years

Larval characteristics

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

Life history information

- **Lifespan** Observation of populations of *Echinocardium cordatum* over a period of 7 years suggests the species has a lifespan greater than 10 years (Buchanan, 1966; Hayward *et al.*, 1996). However, in the Mediterranean Guillou (1985) suggests the lifespan is one or two years.
- **Age at maturity:** On the north-east coast of England a littoral population bred for the first time when three years old. In the warmer waters of the west of Scotland breeding has

been recorded at the end of the second year (Fish & Fish, 1996). However, it has been observed that subtidal populations appear never to reach sexual maturity (Buchanan, 1967).

- **Recruitment:** Often sporadic, with reports of *Echinocardium cordatum* recruiting in only 3 years over a 10 year period (Buchanan, 1966) although this relates to subtidal populations. Intertidal individuals reproduce more frequently.
- The sexes are separate and fertilization external, with the development of a pelagic larva (Fish & Fish, 1996). The fact that *Echinocardium cordatum* is to be found associated with several different bottom communities would indicate that the larvae are not highly selective and discriminatory and it is probable that the degree of discrimination in 'larval choice' becomes diminished with the age of the larvae (Buchanan, 1966). Metamorphosis of larvae takes place within 39 days after fertilization (Kashenko, 1994).

Sensitivity review

This MarLIN sensitivity assessment has been superseded by the MarESA approach to sensitivity assessment. MarLIN assessments used an approach that has now been modified to reflect the most recent conservation imperatives and terminology and are due to be updated by 2016/17.

Physical Pressures

	Intolerance	Recoverability	Sensitivity	Confidence
Substratum Loss	High	High	Moderate	Moderate

Loss of the substratum will also remove the resident population of the burrowing *Echinocardium cordatum* and so intolerance is high. The species has high fecundity, normally reproduces every year and has pelagic larvae so recovery should be good. Individuals can also migrate from unaffected areas. The time for re-establishment of faunal biomass after a period of anoxia related mortality in the south-eastern North Sea was 2 years (Niermann, 1997). However, Buchanan (1966) studied a North Sea subtidal population that had not recruited for several years so recovery could take longer.

Smothering	Tolerant	Not relevant	Not sensitive	High

Echinocardium cordatum lives buried in sand up to 15 cm deep so will be not sensitive to smothering by 5 cm of sediment.

Increase in suspended sediment	Low	High	Low	High

Echinocardium cordatum is probably tolerant of increases in siltation. In the bay of Mevagissey for example, where fine-grained mineral waste from the china clay industry was dumped over many years, *Echinocardium cordatum* was present in high numbers (Probert, 1981). However, the species feeds on detritus that accumulates on the bottom and so its growth consequently relies on the regular supply of detritus (Ridder de, *et al*., 1991). Therefore, a decline in siltation levels may impair growth although the species is able to migrate, albeit rather slowly, to other areas.

Decrease in suspended sediment

Dessication	Low	High	Low	Moderate

Echinocardium cordatum occurs in the subtidal and the lower intertidal. In the intertidal *Echinocardium cordatum* is protected from desiccation because it inhabits a burrow in soft sediments to a depth of up to 15cm. Subtidal populations are not likely to be affected by desiccation.

Increase in emergence regime	Low	High	Low	Moderate

Echinocardium cordatum occurs in the subtidal and the lower intertidal. Subtidal populations will not be affected by emergence at the level of the benchmark. However, an increase in emergence for intertidal populations is likely to depress the height up the shore that intertidal populations can occur. During extreme low water spring tides serious predation by gulls of shallow-burrowing *Echinocardium cordatum* which are normally safely out of the reach of gulls (D. Nichols pers. comm.).

Decrease in emergence regime

Increase in water flow rate	Intermediate	High	Low	Moderate

Spatangoid echinoderms such as *Echinocardium cordatum* can be washed out by water currents generated by gales (Lawrence, 1989). Therefore, the species is likely to be intolerant of increases in water flow rates that similarly wash out sediments and intolerance is assessed as intermediate.

Decrease in water flow rate

Increase in temperature	Intermediate	High	Low	Moderate

Echinocardium cordatum has a relatively wide degree of tolerance to temperature (Higgins, 1974) in accordance with its cosmopolitan distribution. Growth rates are generally higher growth rates in warmer waters (Duineveld & Jenness, 1984). Temperature may also be a factor fine tuning the seasonal pattern of growth where somatic growth (summer) alternates with gonadial growth (winter) (D. Nichols pers. comm.) Very low water temperature can cause mass mortalities of *Echinocardium cordatum* and so intolerance has been assessed as intermediate. During the severe winter of 1963 the species was almost completely eliminated from the German Bight to a depth of about 20m (Lawrence, 1996) and very heavy mortality was observed in the English Channel and North Sea (Crisp (ed.), 1964). High temperatures can also cause a suffocation effect: there can be mass mortality of *Echinocardium cordatum* on sandy shores following oxygen depletion during extreme low water tides on hot days (D. Nichols pers. comm.).

Decrease in temperature

Increase in turbidity	Low	High	Low	Moderate

Echinocardium cordatum lives buried in sand up to 15 cm deep so is not likely to be affected by changes in turbidity. However, a decrease in turbidity may result in a decline in the supply of organic matter to the seabed surface from which the species feeds possibly causing reduced growth and fecundity.

Decrease in turbidity

Increase in wave exposure	Intermediate	High	Low	Low

Echinocardium cordatum is typically a sheltered shore species although in coastal waters of the Netherlands the species occurs in the tidal zone on some sandflats exposed to wave-action, at the entrances of the Oosterschelde and the Westerschelde (Wolff, 1968). In the bay of Douarnenez, Brittany *Echinocardium cordatum* was found only in areas of fine sand dominated by high sediment instability, due to marked exposure to westerly swells (Guillou, 1985). However, *Echinocardium cordatum* is unlikely to survive in areas of extreme wave exposure so intolerance is assessed as intermediate.

Decrease in wave exposure

Noise	Tolerant	Not relevant	Not sensitive	Not relevant

No evidence of sound or vibration reception in echinoids was found.

Visual Presence	Not relevant	Not relevant	Not relevant	Not relevant

Some response to visual disturbance has been detected in echinoderms. There is some evidence that the basiepithelial nerve plexus below the entire outer skins is sensitive to light (D. Nichols pers. comm.). However, *Echinocardium cordatum* generally lives buried in sand up to 15cm deep and so visual disturbance is not relevant. When on the surface of the substratum visual disturbance may cause the urchin to re-burrow into the substratum.

Abrasion & physical disturbance	High	High	Moderate	High

The species has a fragile test that is likely to be damaged by an abrasive force such as movement of trawling gear over the seabed. A substantial reduction in the numbers of *Echinocardium cordatum* due to physical damage from scallop dredging has been observed (Eleftheriou & Robertson, 1992). Smaller size classes of the heart urchin are found near the surface of the sediment and are therefore likely to be more vulnerable to physical damage (Jennings & Kaiser, 1998). *Echinocardium cordatum* was also reported to suffer between 10 and 40% mortality due to fishing gear, depending on the type of gear and sediment after a single trawl event (Bergman & van Santbrink, 2000). They suggested that mortality may increase to 90% in summer when individuals migrate to the surface of the sediment during their short reproductive season. Bergman & van Santbrink (2000) suggested that *Echinocardium cordatum* was one of the most vulnerable species to trawling. Therefore, an intolerance of high has been recorded.
The species has high fecundity, normally reproduces every year and has pelagic larvae so recovery should be good. The time for re-establishment of faunal biomass after a period of anoxia, for example, related mortality in the south-eastern North Sea was two years (Niermann, 1997)

Displacement	Low	High	Low	Moderate

In the intertidal displacement from the sediment is likely to expose *Echinocardium cordatum* to an increased risk of predation. However, once on the substratum surface *Echinocardium cordatum* is capable of re-burrowing into the sediment within 20 minutes and so intolerance is low. Recovery is good because the species has a pelagic larva and individuals can migrate from unaffected areas.

Chemical Pressures

	Intolerance	Recoverability	Sensitivity	Confidence
Synthetic compound contamination	High	High	Moderate	Moderate

Detergents used to disperse oil from the *Torrey Canyon* oil spill caused mass mortalities of *Echinocardium cordatum* (Smith, 1968). The toxicity of TBT to *Echinocardium cordatum* is similar to that of other benthic organisms with LC_{50} values of 222ng Sn/l in pore water and 1594ng Sn/g dry weight of sediment (Stronkhorst *et al*., 1999). Sea-urchins, especially the eggs and larvae, are used for toxicity testing and environmental monitoring (reviewed by Dinnel *et al*. 1988). It is likely therefore, that *Echinocardium cordatum* and especially its larvae are highly sensitive to synthetic contaminants.

Heavy metal contamination	Intermediate	High	Low	Moderate

Information about the effects of heavy metals on echinoderms is limited and no details specific to *Echinocardium cordatum* were found. However, Bryan (1984) reports that early work has shown that echinoderm larvae are intolerant of heavy metals, e.g. the intolerance of larvae of *Paracentrotus lividus* to copper (Cu) had been used to develop a water quality assessment. Kinne (1984) reported developmental disturbances in *Echinus esculentus* exposed to waters containing 25 µg / l of copper (Cu). Therefore, it is likely that *Echinocardium cordatum* is intolerant of heavy metal contamination and intolerance is assessed as high.

Hydrocarbon contamination	High	High	Moderate	High

Echinoderms seem especially intolerant of the toxic effects of oil, likely because of the large amount of exposed epidermis (Suchanek, 1993). The high intolerance of *Echinocardium cordatum* to hydrocarbons was seen by the mass mortality of animals, down to about 20m, shortly after the *Amoco Cadiz* oil spill (Cabioch *et al*., 1978). Reduced abundance of the species was also detectable up to > 1000m away one year after the discharge of oil-contaminated drill cuttings in the North Sea (Daan & Mulder, 1996). The species has high fecundity, normally reproduces every year and has a pelagic larva so recovery should be good. Individuals can also migrate from unaffected areas. The first repopulation of *Echinocardium cordatum* after the *Torrey Canyon* accident was noticed two years after the oil spill (Southward & Southward, 1978).

Radionuclide contamination — Not relevant

Insufficient information.

Changes in nutrient levels — High | High | Moderate | High

Echinocardium cordatum is generally found in sediments with low organic content and the species appears to be intolerant of increases in nutrient concentration. Growth levels have been observed to be lower in sediments with high organic content although it is suggested that this may be due to higher levels of intraspecific competition (Duineveld and Jenness, 1984). The species was also absent from an area in the southern North Sea into which large quantities of sewage sludge from Hamburg had been dumped and the species was never seen to settle in the area (Caspers, 1980). Pearson & Rosenberg (1976) describe the changes in fauna along a gradient of increasing organic enrichment by pulp fibre where *Echinocardium cordatum* is absent from all but distant sediments with low organic input and so intolerance is assessed as high.

Increase in salinity — Intermediate | High | Low | Moderate

Echinoderms are considered to be stenohaline animals that lack the ability to osmo- and ion-regulate (Stickle & Diehl, 1987). However, *Echinocardium cordatum* has been recorded from brackish waters in the Delta region of the Netherlands to about the 15psu isohaline (Wolff, 1968). Echinoderm larvae have a narrow range of salinity tolerance and will develop abnormally and die if exposed to reduced or increased salinity.

Decrease in salinity

Changes in oxygenation — High | High | Moderate | High

Echinocardium cordatum is highly intolerant of reductions in oxygen concentration. Buchanan (1966) found that individuals of *Echinocardium cordatum* at Newton Haven burrowed into sand to a depth of 15cm but avoided penetrating into dark sand with presumably reducing conditions. In the south-eastern North Sea a period of reduced oxygen resulted in the death of many individuals of *Echinocardium cordatum* (Niermann, 1997) and during periods of hypoxia the species migrates to the surface of the sediment (Diaz & Rosenberg, 1995). High intolerance has also been demonstrated in laboratory experiments. At 4mg/l individuals appeared on the sediment surface and many were dead at a concentration of 2.4mg/l (Nilsson & Rosenberg, 1994). The species has high fecundity, normally reproduces every year and has a pelagic larva so recovery should be good. Individuals can also migrate from unaffected areas. The time for re-establishment of faunal biomass after a period of anoxia related mortality in the south-eastern North Sea was 2 years (Niermann, 1997).

Biological Pressures

	Intolerance	Recoverability	Sensitivity	Confidence
Introduction of microbial pathogens/parasites	Low	High	Low	Low

The occurrence of several parasitic gregarine protozoans, such as *Urospora neapolitana*, have been observed in the body cavity of *Echinocardium cordatum* (Coulon & Jangoux, 1987). However, no information concerning infestation or disease related mortalities was found.

Introduction of non-native species	Not relevant	Not relevant	Not relevant	Low

No alien or non-native species is known to compete with *Echinocardium cordatum*.

Extraction of this species	Intermediate	High	Low	Not relevant

Targeted extraction of *Echinocardium cordatum* is unlikely although dredging may remove populations in some habitats. Recovery from dredging should be good because the species has a pelagic larva and individuals can migrate from unaffected areas.

Extraction of other species	Intermediate	High	Low	High

Hydraulic dredging for razor shells (*Ensis* spp.) may also disturb and damage *Echinocardium cordatum* which is often found in the same habitat. Recovery should be good because the species has a relatively long lived pelagic larvae and individuals can migrate from unaffected areas.

Additional information

Importance review

Policy/legislation

- no data -

Status

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

Non-native

Native	-		
Origin	-	**Date Arrived**	-

Importance information

-none-

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