MarLIN

Marine Information Network

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

Edible sea urchin (*Echinus esculentus*)

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

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2008-04-29

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/1311]. All terms and the MarESA methodology are outlined on the website (https://www.marlin.ac.uk)

This review can be cited as:
Tyler-Walters, H., 2008. *Echinus esculentus* Edible sea urchin. In Tyler-Walters H. and Hiscock K. (eds) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*, [on-line]. Plymouth: Marine Biological Association of the United Kingdom.
DOI https://dx.doi.org/10.17031/marlinsp.1311.1

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***Echinus esculentus* and hermit crabs on grazed rock.**
Photographer: Sue Scott
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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	**Refereed by**	Prof. David Nichols
Authority	Linnaeus, 1758		
Other common names	-	**Synonyms**	-

Summary

Description

A large globular sea urchin, up to 15 -16 cm in diameter at 7-8 years of age, although the largest diameter recorded was 17.6 cm. The test may be relatively flat in shallow water but taller in deep water. Test pinkish-red but occasionally yellow, green or purple. Spines closely cover the test and are reddish, usually with violet points and white bosses. Primary and secondary spines and their bosses are similar in size, except in small specimens in which the primaries are conspicuous. Ambulacral plates bear 3 pairs of pores. Primary tubercles (bosses) found on every second or third ambulacral plate. All coronal plates bear pedicellariae (modified spines). Plates covering the mouth membrane bear small, club shaped spines as well as pedicellariae. Globeriferous pedicellariae bear 1 lateral tooth below the terminal tooth. The polychaete *Flabelligera affinis* may be found amongst its spines.

Recorded distribution in Britain and Ireland

Common on most coasts of the British Isles but absent from most of east coast of England, the eastern English Channel and some parts of north Wales.

Global distribution

Abundant in the N.E. Atlantic from Iceland, north to Finmark, Norway and south to Portugal.

Absent from the Mediterranean.

Habitat

Found on rocky substrata from the sublittoral fringe to circa 40 m, although it may be found at depths of 100 m or more.

Depth range

Low water to circa 40m

Identifying features

- Rounded and radially symmetrical test slightly flattened but overall globular.
- Test reddish in colour.
- Each ambulacral plate with 3 pairs of pores.
- Globiferous pedicellariae with one lateral tooth below terminal tooth.
- Primary and secondary spines and their bosses are similar in size, except in small specimens.
- Buccal spines bear short, club shaped spines.

Additional information

The genus *Echinus* is derived from the Greek 'echinos' meaning 'a hedgehog'. An omnivorous grazer feeding on seaweeds (e.g. *Laminaria* spp. sporelings), Bryozoa, barnacles and other encrusting invertebrates. Size range varies depending on age and locality, e.g. c. 4 cm at 1 year, 4-7 cm at 2 years, 7 -9 cm at 3 years and 9-11 cm at 4 years. This species may hybridize with *Echinus acutus* if sympatric.

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Biology review

Taxonomy

Phylum	Echinodermata Starfish, brittlestars, sea urchins & sea cucumbers
Order	Camarodonta
Family	Echinidae
Genus	Echinus
Authority	Linnaeus, 1758
Recent Synonyms	-

Biology

Typical abundance	High density
Male size range	
Male size at maturity	circa 4cm
Female size range	circa 4cm
Female size at maturity	
Growth form	Globose
Growth rate	See text
Body flexibility	
Mobility	
Characteristic feeding method	Active suspension feeder
Diet/food source	
Typically feeds on	Recorded feeding on; worms, barnacles (e.g. *Balanus* spp.), hydroids, tunicates, bryozoans (e.g. *Membranipora* spp.), macroalgae (e.g. *Laminaria* spp.), bottom material and detritus (reviewed by Lawrence 1975).
Sociability	
Environmental position	Epifaunal
Dependency	Independent.
Supports	Host Turbellarian parasites *Syndesmis rubida* sp. nov. and *Syndesmis albida* sp. nov. (Kozloff & Westervelt 1990), the parasitic nematode *Echinomermella grayi* and external parasitic amphipod *Euonyx chelatus* (Comely & Ansell 1988)
Is the species harmful?	No Edible

Biology information

Growth rates are variable depending on time of larval settlement, food availability, water temperature and age. Growth rates vary with locality although there is evidence to suggest that largest specimens are found in the south west (Nichols 1979). Growth rates based on growth lines in skeletal plates are probably underestimates (Gage 1992a & b). In the UK population growth is continuous in the first year after metamorphosis and considerably faster than adults in their 2nd year. In adults maximal growth occurs in a few months in spring and early summer but mature adults are slow growing. Comely & Ansell (1988) recorded 28 invertebrate species associated with *Echinus esculentus* from the west cost of Scotland near Oban. These included the parasites *Echinomermella grayi* and *Euonyx chelatus* mentioned above and in additional; 4 species of commensal polychaetes, a copepod and 10 amphipod species. The polychaete *Adyte assimilis* and the copepod *Pseudoanthessius liber* were regular commensals amongst the spines. Hyman (1955) states that *Echinus esculentus* is often infested with parasitic copepods e.g. *Asterocheres echinola*.

Habitat preferences

Physiographic preferences	Open coast, Strait / sound, Sea loch / Sea lough, Ria / Voe, Enclosed coast / Embayment
Biological zone preferences	Lower circalittoral, Lower infralittoral, Sublittoral fringe, Upper circalittoral, Upper infralittoral
Substratum / habitat preferences	Artificial (man-made), Bedrock, Caves, Crevices / fissures, Large to very large boulders, Overhangs, Rockpools, Small boulders, Under boulders
Tidal strength preferences	Moderately Strong 1 to 3 knots (0.5-1.5 m/sec.)
Wave exposure preferences	Exposed, Moderately exposed, Sheltered
Salinity preferences	Full (30-40 psu)
Depth range	Low water to circa 40m
Other preferences	At very wave exposed sites, *Echinus esculentus* is unlikely to be present in shallow depths because of displacement by wave action. However, presence of this species as shallow as 15m depth at Rockall suggests an ability to withstand severe wave action (Keith Hiscock pers. comm.).
Migration Pattern	Non-migratory / resident

Habitat Information

No text entered

Life history

Adult characteristics

Reproductive type	Gonochoristic (dioecious)
Reproductive frequency	Annual episodic
Fecundity (number of eggs)	>1,000,000
Generation time	1-2 years
Age at maturity	1-3 years
Season	February - June
Life span	5-10 years

Larval characteristics

Larval/propagule type	-

Larval/juvenile development	Planktotrophic
Duration of larval stage	1-2 months
Larval dispersal potential	Greater than 10 km
Larval settlement period	

Life history information

- Nichols (1979) estimates the maximum lifespan to be between 8-10 years, whereas Gage (1992a) reports a specimen (based on growth bands) of at least 16 years of age.
- The number of eggs produced will vary with location and nutritive state of the adult but it is likely to be high. MacBride (1903) states that a well-grown female contains about 20 million eggs.
- Maximum spawning occurs in spring although individuals may spawn over a protracted period. Gonad weight is maximal in February / March in English Channel (Comely & Ansell 1989) but decreases during spawning in spring and then increases again through summer and winter until the next spawning; there is no resting phase. Spawning occurs just before the seasonal rise in temperature in temperate zones but is probably not triggered by rising temperature (Bishop 1985). Spawning may coincide with spring phytoplankton bloom although there is no evidence to substantiate this suggestion.
- Comely & Ansell (1989) demonstrated differences in reproductive condition between sites and habitats. Emson & Moore (1998) noted that gonad size varied with diet in the Isle of Cumbrae, Scotland; specimens feeding on barnacles had a higher gonad index than those feeding within the kelp forest.
- Planktonic development is complex and takes between 45 -60 days in captivity (MacBride 1914). Development includes a blastula, gastrula and a characteristic, four armed echinopluteus stage that forms an important component of the zooplankton. The development of *Echinus esculentus* is described in detail by MacBride (1903, 1914). Photographs of the echinopluteus and fully formed juveniles are given by Todd *et al.* (1996).
- Recruitment is sporadic or variable depending on locality, e.g. Millport populations showed annual recruitment, whereas few recruits were found in Plymouth populations during Nichols studies between 1980-1981 (Nichols 1984). Bishop & Earll (1984) suggested that the population of *Echinus esculentus* at St Abbs had a high density and recruited regularly whereas the Skomer population was sparse, ageing and had probably not successfully recruited larvae in the previous 6 years.
- Settlement is thought to occur in autumn and winter (Comely & Ansell, 1988). Newly settled juveniles have an ambital diameter of 0.68 - 0.95mm (Nichols 1984).
- Comely & Ansell (1988) noted that the largest number of *Echinus esculentus* occurred below the kelp forest. Similarly, Lang & Mann (1978) noted that young *Strongylocentrotus droebachiensis* recruited in urchin barrens, suggesting that urchin recruitment is improved in the absence of kelp, presumably due to differences in microclimate, the absence of suspension feeders and other predators associated with kelp beds.

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	Very low

Sea urchins are slow moving and unlikely to escape removal of their substratum. However, a proportion of the population would probably survive removal of algal substratum. Investigation of the effects of algal destruction on populations of *Strongylocentrotus droebachiensis* suggested that populations of urchins do not migrate away from or starve in areas devoid of kelp, presumably because they are able to feed on alternative prey. Areas lacking algae were dominated by young urchins up to 4 years after removal of the kelp suggesting that kelp barrens afforded improved recruitment (Lang & Mann 1978), presumably because of the lack of suspension feeding organisms associated with kelp beds. The presence of coralline algae in 'urchin barrens' may encourage larval metamorphosis in echinoids (Pearce & Scheibling 1990).

	Intolerance	Recoverability	Sensitivity	Confidence
Smothering	Intermediate	High	Low	Low

The adults are slow moving and unlikely to be able to avoid smothering. A 5 cm layer of sediment is likely to affect smaller specimens more than large specimens. Smothered individuals are unlikely to be able to move through sediment. However, individuals are unlikely to starve within a month. Comely & Ansell (1988) recorded large *Echinus esculentus* from kelp beds on the west coast of Scotland in which the substratum was seasonally covered with "high levels" of silt. This suggests that *Echinus esculentus* is unlikely to be killed by smothering, however, smaller specimens and juveniles may be more intolerant. A layer of sediment may interfere with larval settlement. Lewis & Nichols (1979) found that adults were able to colonize an artificial reef in small numbers within 3 months and the population steadily grew over the following year. Recruitment is sporadic or annual depending on locality and factors affecting larval pre-settlement and post-settlement survival.

	Intolerance	Recoverability	Sensitivity	Confidence
Increase in suspended sediment	Low	Very high	Very Low	Low

Moore (1977) suggested that *Echinus esculentus* was unaffected by turbid conditions. Similarly, Comely & Ansell (1988) recorded this species in the presence of suspended material up to 5-6 mg/l. Echinoderm pedicellariae keep the test clear of settling larvae, spores and presumably sediment particles. *Echinus esculentus* is known to ingest sediment (Comely & Ansell, 1988) possibly to extract microalgae. Therefore, an increase in siltation may not kill this species but is likely to interfere with feeding and additional scour may reduce larval settlement. The increased turbidity associated with siltation is likely to adversely affect its main food species, the kelps, benthic macroalgae and epi-fauna.

Decrease in suspended sediment

	Intolerance	Recoverability	Sensitivity	Confidence
Dessication	Intermediate	High	Low	Very low

The majority of *Echinus esculentus* are subtidal although they occur occasionally in the lower intertidal. They are slow moving and unlikely to be able to return to water quickly. If exposed to desiccation it is likely to be intolerant of exposure to air and sunshine for 1 hour.

Increase in emergence regime Low Very high Very Low Very low

The majority of *Echinus esculentus* are subtidal although they occur occasionally in the lower intertidal. An increase in emergence will depress the height up the shore that this species can occur.

Decrease in emergence regime

Increase in water flow rate Low Very high Very Low Low

Echinus esculentus occurred in kelp beds on the west coast of Scotland in currents of about 1 knot. Outside the beds specimens were occasionally seen being rolled by the current (Comely & Ansell 1988), which may have been up to 2.6 knots. Urchins are removed from the stipe of kelps by wave and current action. *Echinus esculentus* are also displaced by storm action. However, urchins were found to feed normally only when provided with 'good' water flow (Boolootian 1966). After disturbance *Echinus esculentus* migrates up the shore, an adaptation to being washed to deeper water by wave action (Lewis & Nichols 1979b). Therefore, increased water flow may remove the population from the affected area; probably to deeper water although individuals would probably not be killed in the process and could recolonize the area if the factor returned to its pre-impact condition.

Decrease in water flow rate

Increase in temperature Intermediate High Low Low

Echinus esculentus occurred at temperatures between 0 - 18 °C in the Limfjord, Denmark (Ursin 1960). Bishop (1985) noted that gametogenesis proceeded at temperatures between 11 - 19 °C although continued exposure to 19 °C destroyed synchronicity of gametogenesis between individuals. Embryos and larvae developed abnormally after up to 24hr at 15 °C (Tyler & Young 1998) but normally at the other temperatures tested (4, 7 and 11 °C at 1 atmosphere). Tyler & Young (1998) concluded that embryos and larvae were more tolerant of depth and temperature than adults. Bishop (1985) suggested that this species cannot tolerate high temperatures for prolonged periods due to increased respiration rate and resultant metabolic stress. Therefore, *Echinus esculentus* is likely to exhibit a 'low' intolerance to chronic long term temperature change but would probably be more intolerant of sudden or short term acute change (e.g. 5 °C for 3 days) in temperature.

Decrease in temperature

Increase in turbidity Low Very high Very Low Low

Moore (1977) suggested that *Echinus esculentus* was unaffected by turbid conditions. However, increased turbidity and resultant reduced light penetration is likely to affect macroalgal populations e.g. kelps, which are a preferred food species for *Echinus esculentus*. However, it can feed on alternative prey, detritus or dissolved organic material (Lawrence, 1975, Comely & Ansell, 1988).

Decrease in turbidity

Increase in wave exposure Low Very high Very Low Low

Wave exposure prevents urchins invading the sub-littoral fringe in exposed sites. Higher levels of wave action are likely to depress the upper extent of *Echinus esculentus* populations. Decreased wave action is likely to allow the local urchin population to migrate into shallow water depths with resultant impact of algal communities. Lewis & Nichols (1979b) reported that *Echinus esculentus* migrated to shallow water after disturbance, an adaptation to being washed to deeper water by wave action. However, in the most wave exposed location in the British Isles at Rockall, *Echinus esculentus* occurred in significant numbers as shallow as 15m below low water level (Keith Hiscock pers. comm.).

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	Low	Immediate	Not sensitive	Low

Bright light and shading elicit well studied reactions in echinoderms. In echinoids shading results in the 'shadow reaction' in which the pedicellariae and spines are pointed in the direction of the shade in a defensive reaction. Echinoids move away from bright light and seek out crevices and / or cover themselves with debris such as shells and drift algae, the 'covering reaction' (see Boolootian (1966) for discussion). Movement of boats is unlikely to be noticed, especially under a kelp canopy in which light may penetrate intermittently with passing currents. If echinoids such as *Echinus esculentus* react to the approach of divers and snorkelers at closer proximity, the reaction is likely to be short lived and insignificant.

Abrasion & physical disturbance	Intermediate	High	Low	Low

Species with fragile tests, such as *Echinus esculentus* and *Echinocardium cordatum* were reported to suffer badly as a result of impact with passing scallop or queen scallop dredges (Bradshaw *et al.*, 2000; Hall-Spencer & Moore, 2000a). Adults can repair non-lethal damage to the test and spines can be re-grown but most dredge impact is likely to be lethal. Therefore, physical abrasion due to a passing anchor or dredge is likely to kill a proportion of the population and an intolerance of intermediate has been recorded. Lewis & Nichols (1979) found that adults were able to colonize an artificial reef in small numbers within 3 months and the population steadily grew over the following year. Recoverability is probably high. However, recruitment is sporadic or annual depending on locality and factors affecting larval pre-settlement and post-settlement survival.

Displacement	Low	Very high	Very Low	Moderate

Echinus esculentus is probably regularly displaced to deeper water by storms. Displaced specimens are able to move up the shore after displacement (Lewis & Nichols 1979b).

Chemical Pressures

	Intolerance	Recoverability	Sensitivity	Confidence
Synthetic compound contamination	High	High	Moderate	Moderate

Echinus esculentus is subtidal and unlikely to be directly exposed to oil spills, except from dissolved oil or oil adsorbed to particulates. However, large numbers of dead *Echinus esculentus* were found between 5.5 and 14.5 m in the vicinity of Sennen, presumably due to a combination of wave exposure and heavy spraying of dispersants in that area (Smith 1968). Smith (1968) also demonstrated that 0.5 -1ppm of the detergent BP1002 resulted in developmental abnormalities in echinopluteus larvae of *Echinus esculentus*. *Echinus esculentus* populations in the vicinity of an oil terminal in A Coruna Bay, Spain, showed developmental abnormalities in the skeleton. The tissues contained high levels of aliphatic hydrocarbons, naphthalenes, pesticides and heavy metals (Zn, Hg, Cd, Pb, and Cu) (Gomez & Miguez-Rodriguez 1999). However, the observed effects may have been due to a single contaminant or synergistic effects of all present. 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 *Echinus esculentus* and especially its larvae are highly intolerant of synthetic contaminants.

Heavy metal contamination High High Moderate Very low

Little is known about the effects of heavy metals on echinoderms. Bryan (1984) reported that early work had shown that echinoderm larvae were 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). Sea-urchins, especially the eggs and larvae, are used for toxicity testing and environmental monitoring (reviewed by Dinnel *et al*. 1988). Taken together with the findings of Gomez & Miguez-Rodriguez (1999) above it is likely that *Echinus esculentus* is intolerant of heavy metal contamination.

Hydrocarbon contamination High High Moderate Moderate

Echinus esculentus is subtidal and unlikely to be directly exposed to oil spills, except from dissolved oil or oil adsorbed to particulates. However, large numbers of dead *Echinus esculentus* were found between 5.5 and 14.5 m in the vicinity of Sennen, presumably due to a combination of wave exposure and heavy spraying of dispersants in that area (Smith 1968). Smith (1968) also demonstrated that 0.5 -1ppm of the detergent BP1002 resulted in developmental abnormalities in its echinopluteus larvae. *Echinus esculentus* populations in the vicinity of an oil terminal in A Coruna Bay, Spain, showed developmental abnormalities in the skeleton. The tissues contained high levels of aliphatic hydrocarbons, naphthalenes, pesticides and heavy metals (Zn, Hg, Cd, Pb, and Cu) (Gomez & Miguez-Rodriguez 1999). However, the observed effects may have been due to a single contaminant or synergistic effects of all present. 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 *Echinus esculentus* and especially its larvae are highly intolerant of hydrocarbon contamination.

Radionuclide contamination Not relevant

Insufficient information.

Changes in nutrient levels Tolerant* Not relevant Not sensitive* Very low

The addition of nutrients may encourage the growth of ephemeral and epiphytic algae and therefore increase the food available to sea-urchin populations. Lawrence (1975) reported that sea urchins had persisted over 13 years on barren grounds near sewage outfalls, presumably feeding on dissolved organic material, detritus, plankton and microalgae, although individuals died at an early age. The ability to absorb dissolved organic material was suggested by Comely & Ansell (1988).

Increase in salinity Intermediate High Low Low

Echinoderms are generally unable to tolerate low salinity (stenohaline) and possess no osmoregulatory organ (Boolootian 1966). At low salinity urchins gain weight, and the epidermis loses its pigment as patches are destroyed; prolonged exposure is fatal. The coelomic fluid of *Echinus esculentus* is isotonic with seawater (Stickle & Diehl 1987). There is some evidence for intracellular regulation of osmotic pressure due to increased amino acid concentrations. Populations in the sublittoral fringe probably encounter reduced salinity due to low water and fresh water runoff or heavy rain and may tolerate low salinity for short periods. However, echinoderm larvae have a narrow range of salinity tolerance and develop abnormally and die if exposed to reduced or increased salinity.

Decrease in salinity

Changes in oxygenation	Intermediate	High	Low	Low

Under hypoxic conditions echinoderms become less mobile and stop feeding. Death of a bloom of the phytoplankton *Gyrodinium aureolum* in Mounts Bay, Penzance in 1978 produced a layer of brown slime on the sea bottom. This resulted in the death of fish and invertebrates, including *Echinus esculentus*, presumably due to anoxia caused by the decay of the dead dinoflagellates (Griffiths *et al.* 1979).

Biological Pressures

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

Echinus esculentus is susceptible to 'Bald-sea-urchin disease', which causes lesions, loss of spines, tube feet, pedicellariae, destruction of the upper layer of skeletal tissue and death. It is thought to be caused by the bacteria *Vibrio anguillarum* and *Aeromonas salmonicida*. Bald sea-urchin disease was recorded from *Echinus esculentus* on the Brittany Coast. Although associated with mass mortalites of *Strongylocentrotus franciscanus* in California and *Paracentrotus lividus* in the French Mediterranean it is not known if the disease induces mass mortality (Bower 1996). However, no evidence of mass mortalities of *Echinus esculentus* associated with disease have been recorded in Britain and Ireland.

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

No alien or non-native species is known to compete with *Echinus esculentus*.

Extraction of this species	Intermediate	High	Low	Moderate

Collecting of *Echinus esculentus* for the curio trade was studied by Nichols (1984). He concluded that the majority of divers collected only large specimens that are seen quickly and often missed individuals covered by seaweed or under rocks, especially if small. As a result, a significant proportion of the population remains. He suggested that exploited populations should not be allowed to fall below 0.2 individuals per square metre.

Extraction of other species	Intermediate	High	Low	Low

Populations of *Strongylocentrotus droebachiensis* do not migrate away after destroying an area of kelp, although individuals growth rate and gonad production decreases. Over the next 3-4 years the population became dominated by younger urchins, suggesting that recruitment (larval settlement and post-settlement survival) was improved within the 'urchin barren' (Lang & Mann, 1979). Since *Echinus esculentus* is an omnivore it is likely that kelp harvesting will have little effect on the population and may improve recruitment in the short term.

Species with fragile tests, such as *Echinus esculentus* and *Echinocardium cordatum* were reported to suffer badly as a result of impact with passing scallop or queen scallop dredges (Bradshaw et al., 2000; Hall-Spencer & Moore, 2000a). Kaiser *et al.* (2000) reported that *Echinus esculentus* were less abundant in areas subject to high trawling disturbance in the Irish Sea. Adults can repair non-lethal damage to the test and spines can be re-grown but most dredge impact is likely to be lethal. Therefore, *Echinus esculentus* is likely to be of intermediate intolerance to the effects of fishing activities for other species.

Additional information

Importance review

Policy/legislation

IUCN Red List Near Threatened (NT)

Status

National (GB) importance	Not rare/scarce	**Global red list (IUCN) category**	Near Threatened (NT)

Non-native

Native	-		
Origin	-	**Date Arrived**	-

Importance information

- *Echinus esculentus* is an important grazer of epiflora and epifauna in the subtidal. It may have a keystone role in kelp communities, where grazing by sea urchins may control the lower limit of *Laminaria hyperborea* beds, increase species diversity in the understorey epiflora/fauna, and habitat diversity through the formation of 'urchin barrens' (see Birkett *et al*., 1998b and EIR.LhypR Key Information review for discussion).
- The roe of *Echinus* was eaten in many parts of England (Pennant 1777 cited in Nichols 1981) and may continue today locally. References to use in Roman times may refer to *Paracentrotus lividus* (Nichols 1981). There is little evidence of medicinal use of *Echinus* although other species may have been used in the past.
- Mainly sold as a curio, ornament or occasionally as a receptacle and was collected by divers around the UK for the curio trade. It was the object of a specific fishery in Cornwall in the 1980s. Nichols (1981) pointed out that although most divers missed small specimens within kelp beds, population densities should not be allowed to fall below 0.2 per metre to conserve the species in the UK.
- The possibility of a sea urchin fishery in Shetland for the Japanese market has been investigated recently (Penfold *et al.* 1996).
- Sea urchin development has been well studied (MacBride 1914) and echinoids form an important research organism in embryology, developmental biology, evolution, biochemistry and molecular biology studies.

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