The tall sea pen (*Funiculina quadrangularis*)

MarLIN – Marine Life Information Network
Biology and Sensitivity Key Information 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/1154]. All terms and the MarESA methodology are outlined on the website (https://www.marlin.ac.uk)

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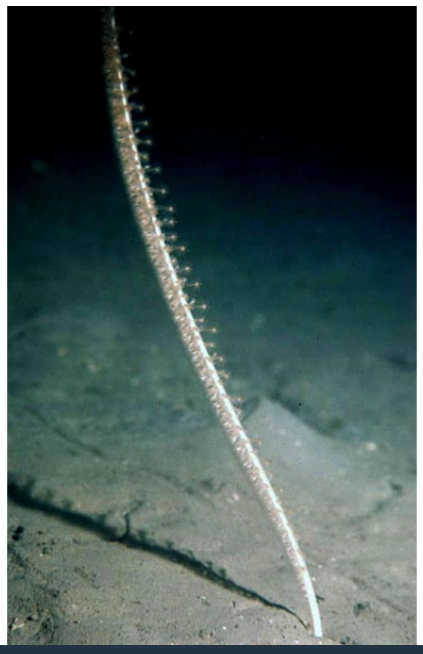

Funiculina quadrangularis, **tall sea pen.**
Photographer: Bernard Picton

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	Olwen Ager	**Refereed by**	This information is not refereed.
Authority	(Pallas, 1766)		
Other common names	-	**Synonyms**	-

Summary

Description

A tall, narrow sea pen, which can exceed 2 metres in height. It has a calcareous white axis, square in section. The polyps are irregularly arranged along the axis or tend to form oblique rows. They are white or pale pink in colour.

Recorded distribution in Britain and Ireland

West and north coasts of Ireland and Scotland.

Global distribution

Funiculina quadrangularis occurs in the North Atlantic and Mediterranean. It has been recorded in New Zealand (Manuel, 1988) and Japan (Fujita & Ohta, 1988).

Habitat

Found in muddy substrata on sheltered coasts, especially in sea lochs. Sublittoral to deep offshore water.

Depth range

20-2000m

Identifying features

- Axis white, diagnostically box like in section.
- Lower quarter of stem forms a smooth peduncle, upper one third is curved.
- Autozooids irregularly arranged on rachis or in short oblique rows, retractile within toothed calyces.
- Autozooids often pink.

Additional information

-none-

Listed by

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Further information sources

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Biology review

Taxonomy

Phylum	Cnidaria	Sea anemones, corals, sea firs & jellyfish
Class	Anthozoa	Sea anemones, soft & cup corals, sea pens & sea pansies
Order	Pennatulacea	
Family	Funiculinidae	
Genus	Funiculina	
Authority	(Pallas, 1766)	
Recent Synonyms	-	

Biology

Typical abundance	Moderate density
Male size range	1.5-2.1m
Male size at maturity	
Female size range	Large(>50cm)
Female size at maturity	
Growth form	Pinnate
Growth rate	
Body flexibility	Low (10-45 degrees)
Mobility	
Characteristic feeding method	Passive suspension feeder
Diet/food source	
Typically feeds on	Plankton and organic particles
Sociability	
Environmental position	Epibenthic
Dependency	No information found.
Supports	Substratum the brittlestar *Asteronyx loveni* and the isopod crustacean *Astacilla longicornis* .
Is the species harmful?	No information

Biology information

Flexibility

Eno *et al.* (1996) found that the tall sea pen bends away from lobster creels dropped on of them in a passive response to the pressure wave travelling ahead of the pot. However, the axial rod of this sea pen is brittle, making the species vulnerable to physical disturbance (Greathead *et al.*, 2007).

Associated species

The deep-water brittlestar, *Asteronyx loveni*, which has been recorded sporadically from the west coast of Scotland (Hughes, 1998b), is known to use its arms to cling to *Funiculina quadrangularis* (Fujita & Ohta, 1988).

Habitat preferences

Physiographic preferences	Open coast, Sea loch / Sea lough
Biological zone preferences	Lower circalittoral, Upper circalittoral
Substratum / habitat preferences	Mud, Muddy sand
Tidal strength preferences	Very Weak (negligible), Weak < 1 knot (<0.5 m/sec.)
Wave exposure preferences	Extremely sheltered, Sheltered, Ultra sheltered, Very sheltered
Salinity preferences	Full (30-40 psu)
Depth range	20-2000m
Other preferences	No text entered
Migration Pattern	Non-migratory / resident

Habitat Information

Although previously recorded only within sea lochs, a recent study by Greathead *et al.* (2007) found the species distribution to include the outer mouths of sea lochs, and areas of open water such as North and South Minch, and the Cuillin Sound where water depth exceeds 100 m.
This sea pen has been recorded in high abundance in Loch Sunart, Loch Teacuis, Loch Duich and Loch a'Chairn Bhain from the mainland and in Loch Seaforth on Lewis.

Life history

Adult characteristics

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

Larval characteristics

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

Life history information

- Sexes in sea pens are separate; each colony of polyps are either male or female.
- Hughes (1998a) suggests, using the information from other species of seapen, that *Funiculina quadrangularis* may follow a similar pattern of patchy recruitment, slow growth

and a long lifespan. Isolated populations are likely to be self-seeding, and hence susceptible to local extinction if their environments are disrupted (Hughes, 1998).

- Birkeland (1974) found the lifespan of *Ptilosarcus gurneyi* to be 15 years, reaching sexual maturity between the ages of 5 and 6 this may be similar in *Funiculina quadrangularis*. It was estimated by Wilson *et al*. (2002), that larger specimens of a tall sea pen (*Halipteris willemoesi*) in the Bering Sea were 44 years old, with a growth rate of 3.6 - 6.1 cm per year.
- The developmental mechanism for *Funiculina quadrangularis* is unknown, however large size of larvae in many sea pens is indicative of lecithotrophic larva. Sea pen fecundity is high, and varies between 30,000-200,000 ocytes per colony (Edwards & Moore, 2008) Another British sea pen, *Pennatula phosphorea*, spawns in summer (July-August), with each polyp releasing approximately 50 ocytes, having a fecundity of 40,000 ocytes per colony for medium to large specimens (Edwards & Moore, 2008).

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	Low	High	Moderate

As *Funiculina quadrangularis* lives in the substratum, substratum loss will lead to loss of the population. Therefore, intolerance has been recorded as high.
A recoverability of low has been recorded, thus sensitivity is assessed as high (see additional information below).

Smothering	Low	Immediate	Not sensitive	Moderate

Smothering would be expected to be caused by high levels of siltation. *Funiculina quadrangularis* is very tall and would protrude above the sediment, therefore an intolerance of low as been recorded. Recoverability would be expected to be immediate, therefore the species is assessed as not sensitive.

Increase in suspended sediment	Low	Immediate	Not sensitive	Moderate

The effect of an increased deposit of fine silt is unclear but it is possible that feeding structures may become clogged (Jones *et al*., 2000). Kinnear *et al*. (1996) found that mud particles adhering to *Funiculina quadrangularis* were quickly removed due to large amounts of mucus produced. Also, an increase in suspended sediment may provide an increase in food availiabity for *Funiculina quadrangularis*. Therefore an intolerance of low has been recorded. Recovery on return to normal conditions is likely to be immediate, therefore the species is assessed as not sensitive.

Decrease in suspended sediment	Low	Immediate		

The effects of a decrease in suspended sediment levels are unclear. It is possible that this factor may reduce the amount of particulate matter available as food for *Funiculina quadrangularis*, which may affect viability but is unlikely to be fatal at the level of the benchmark. Therefore an intolerance of low has been recorded. Recovery on return to normal conditions is likely to be immediate, therefore the species is assessed as not sensitive.

Dessication	Not relevant	Not relevant	Not relevant	Not relevant

Funiculina quadrangularis is a sub-tidal species and is therefore likely to be highly intolerant of desiccation. However, the species is found in the circalittoral zone (below 20 m) where desiccation is unlikely to occur, so not relevant has been recorded.

Increase in emergence regime	Not relevant	Not relevant	Not relevant	Not relevant

Funiculina quadrangularis is a sub-tidal species and is therefore likely to be highly intolerant of emergence. However, the species is found in the circalittoral zone (below 20 m) where any emergence is highly unlikely to occur, so not relevant has been recorded.

Decrease in emergence regime	Not relevant	Not relevant	Not relevant	Not relevant

Funiculina quadrangularis is a sub-tidal species and is therefore likely to be highly intolerant of

emergence. However, the species is found in the circalittoral zone (below 20 m) where any emergence is highly unlikely to occur, so not relevant has been recorded.

Increase in water flow rate High Low High Moderate

Areas where *Funiculina quadrangularis* is found tend to be physically sheltered with low or very low water flow rates. No information was found about effects of increased water flow rate on *Funiculina quadrangularis*. However, experiments on another sea pen (*Virgularia mirabilis*) showed that, as water flow increased, the polyps faced away from the current to face downstream. Increasing current led to the stalk bending over and the pinnae becoming pushed together, which may result in feeding inhibition. Eventually the sea pen withdrew into the sediment (Hiscock, 1983). Furthermore, *Funiculina quadrangularis* is large with a short peduncle and increased flow may drag the sea pen out of the sediment. If feeding was inhibited, or if the sea pen was displaced for an excessive amount of time, survival and distribution of *Funiculina quadrangularis* may be affected (Hiscock, 1983). Therefore intolerance has been recorded as high.
A recoverability of low has been recorded, resulting in a high sensitivity recording (see additional information below).

Decrease in water flow rate Intermediate Moderate Moderate Moderate

Areas where *Funiculina quadrangularis* is found tend to be physically sheltered with low or very low water flow rates, however, as this sea pen is a suspension feeder a decrease in water flow rate may effect feeding. Therefore an intolerance of intermediate has been recorded.
A recoverability of moderate has been recorded, hence sensitivity is moderate (see additional information below).

Increase in temperature Intermediate Moderate Moderate Low

No information was found of the upper or lower thermal limits of *Funiculina quadrangularis*. *Funiculina quadrangularis* occurs in thermally stable conditions, with annual temperature variation between 5 - 15°C (Jones *et al.*, 2001). This species is subtidal where wide variations in temperature are not common, so may be intolerant of short term changes in temperature. Therefore intolerance has been recorded as intermediate.
A recoverability of moderate has been recorded, and sensitivity is moderate (see additional information below). Also in the event of climate change, if larval dispersal is poor, colonization of suitable habitats at different latitudes is unlikely.

Decrease in temperature Intermediate Moderate Moderate Low

No information was found of the upper or lower thermal limits of *Funiculina quadrangularis*. *Funiculina quadrangularis* occurs in thermally stable conditions, with annual temperature variation between 5 - 15 (Jones *et al.*, 2001). This species is subtidal where wide variations in temperature are not common, so may be intolerant of short term changes in temperature. Therefore intolerance has been recorded as intermediate.
A recoverability of moderate has been recorded, and sensitivity is moderate (see additional information below).

Increase in turbidity Not sensitive

No information could be found about the sensitivity of *Funiculina quadrangularis* to light. Another sea pen *Virgularia mirabilis*, was not found to be sensitive to light (Hoare & Wilson, 1977).

Decrease in turbidity Moderate

No information could be found about the intolerance of *Funiculina quadrangularis* to light.

Another sea pen *Virgularia mirabilis* was found to be insensitive to light (Hoare & Wilson, 1977).

Increase in wave exposure High Low High Moderate

Funiculina quadrangularis is found in areas with little or no wave exposure. *Virgularia mirabilis* was found to be smaller and less common where wave exposure increased (Hoare & Wilson, 1977). It is likely that an increase in exposure ranking of 2 or more would kill *Funiculina quadrangularis*. Therefore, an intolerance of high has been recorded.
A recoverability of low has been recorded, resulting in a high sensitivity assessment (see additional information below).

Decrease in wave exposure Not relevant Not relevant Not relevant Not relevant

Funiculina quadrangularis is found in areas with little or no wave exposure so it is unlikely that a decrease in wave exposure would occur. Therefore, not relevant has been recorded.

Noise Tolerant Not relevant Not sensitive Very low

Funiculina quadrangularis probably has a very limited if any ability for detection of noise vibrations, therefore tolerant has been recorded, and the species is assessed as not sensitive.

Visual Presence Tolerant Not relevant Not sensitive Very low

Funiculina quadrangularis probably has a very limited if any ability for visual perception, and is not known to be sensitive to light (Greathead *et al.*, 2007). It is unlikely the sea pen will be sensitive to visual presence. Therefore tolerant has been recorded, and the species is assessed as not sensitive.

Abrasion & physical disturbance High Moderate Moderate Moderate

Sea pens project above the surface of the seabed and so are likely to be vulnerable to physical disturbance (Eno *et al.*, 2001). Eno *et al.* (1996) dropped creels onto sea pens. They were seen to bend away in response to the pressure wave travelling ahead of the dropping creel, therefore reducing the chance the top of the sea pen would be struck causing fracture of the colony. Kinnear *et al.* (1996) conducted creel dragging experiments. The majority of *Funiculina quadrangularis* that were displaced from the sediment recovered after 72 hours. However, fishing gear such as a scallop dredge (see benchmark) or, more likely for this species, a *Nephrops* trawl, is likely to have a more severe impact. Sea pens are likely to be particularly vulnerable to damage from trawls, and have been reported as numerous in bycatch from otter trawls in the Bering sea (Brodeur 2001; Wilson *et al.*, 2002). It is possible that the apparent absence of *Funiculina quadrangularis* from many open coast *Nephrops* grounds may be a consequence of its susceptibility to trawl damage (Connor, pers. comm. in Hughes, 1998a). For example when the sea pen *Halipteris willemoesi* becomes entangled in prawn trapping gear, 50% of sea pen colonies are damaged (Troffe *et al.*, 2005).
A damaged sea pen appeared to remain fully functional but if, as seems likely, the axis is broken, the sea pen will be unable to remain erect and will most likely die. Therefore, intolerance has been recorded as high. A recoverability of moderate has been recorded, resulting in a moderate sensitivity value (see additional information below).

Displacement Low Immediate Not sensitive Moderate

Funiculina quadrangularis can not retract into the sediment so it is likely to be removed from the seabed by the action of fishing gear. Removal experiments by Kinnear *et al.* (1996) showed when a sea pen was displaced it could reburrow as long as its foot remains in contact with the mud. Therefore, intolerance has been recorded as low. Recovery would take less that 72 hrs, so recoverability is recorded as immediate, yielding a sensitivity value of not sensitive.

Chemical Pressures

	Intolerance	Recoverability	Sensitivity	Confidence
Synthetic compound contamination				Not relevant

Insufficient information.

Heavy metal contamination				Not relevant

Insufficient information.

Hydrocarbon contamination				Not relevant

Insufficient information.

Radionuclide contamination	Low	High	Low	Low

No information was found for *Funiculina quadrangularis* in relation to intolerance to radionuclides. However another species, *Virgularia mirabilis*, occurred in high density (10/m) at a sampling station immediately offshore from the Sellafield outfall pipeline in the Irish Sea (Hughes & Atkinson, 1997). Bottom sediments in this area contains particles of long half life radionuclides from liquid effluent, so intolerance has been recorded as low. Recovery is likely to be high, therefore the species is assessed as low sensitivity.

Changes in nutrient levels	Intermediate	High	Low	Moderate

A low level of nutrient enrichment is likely to be beneficial to *Funiculina quadrangularis*. However, because the distribution of the species is limited to relatively small areas within semi-enclosed water bodies, organic encrichment is expected to have adverse effects (Hughes, 1998). Jones *et al.* (2000) found *Funiculina quadrangularis* absent from de-oxygenated areas which are characterised by nutrient enrichment resulting in a hypoxic bacterial community. Salmon farming has been identified as the greatest source of organic pollution in Scottish sea lochs (Hiscock *et al.*, 2005). Therefore intolerance has been recorded as intermediate. Recovery is recorded as high, hence a low sensitivity value.

Increase in salinity	Not relevant	Not relevant	Not relevant	Not relevant

Funiculina quadrangularis is found in fully saline conditions and it is unlikely that it would be exposed to hypersaline conditions, therefore, not relevant has been recorded.

Decrease in salinity	High	Low	Not relevant	

Funiculina quadrangularis is found only in fully saline conditions so it is likely that the sea pen would be intolerant of a decrease in salinity. Therefore an intolerance of high has been recorded.
A recoverability of low has been recorded, hence sensitivity is high (see additional information below).

Changes in oxygenation	Intermediate	Moderate	Moderate	Low

Funiculina quadrangularis is found in sea lochs where stratification of the water column is likely to occur during warm temperatures so it may be able to tolerate some reduction in oxygenation. However, Jones *et al.* (2000) found the sea pen absent from de-oxygenated areas which are characterised by nutrient enrichment resulting in a hypoxic bacterial community. Therefore intolerance has been recorded as intermediate.
A recoverability of moderate has been recorded, hence sensitivity is moderate (see additional information below).

Biological Pressures

	Intolerance	Recoverability	Sensitivity	Confidence
Introduction of microbial pathogens/parasites				Not relevant

No information was found on diseases of *Funiculina quadrangularis*.

Introduction of non-native species				Not relevant

Insufficient information

Extraction of this species	Not relevant	Not relevant	Not relevant	Not relevant

Funiculina quadrangularis is unlikely to be subject to extraction, therefore, this factor has been assessed as not relevant. This sea pen can not retract into the sea bed which may mean it can be extracted through dredging activity.

Extraction of other species	High	Low	High	Low

Trawling for the Norway lobster (*Nephrops norvegicus*) in the open sea and more accessible sea lochs may have removed populations of *Funiculina quadrangularis*. Large quantities of *Funiculina quadrangularis* axis have been observed below Dunstaffnage pier, presumably discarded bycatch (Hiscock, pers comm.). Other species of sea pen have also been recorded as numerous bycatch in trawls from the Bering sea (Brodeur 2001; Wilson *et al*., 2002). It is likely that physical disturbance from demersal fishing activities poses the greatest threat to *Funiculina quadrangularis*, (Greathead *et al*., 2007), and due to the fragmented distribution and possibly limited larval dispersal, recovery if unlikely (Hughes, 1998a).
In the isolated sea lochs where *Funiculina quadrangularis* is found, creeling for lobsters traditionally occurs. Studies indicate that this has a less damaging effect than trawling as the sea pen has the ability to right itself if hit by a creel pot (Eno *et al*., 1996). Nevertheless, due to its potential vulnerability to trawling, an intolerance of high has been recorded. A recoverability of low has been recorded, so sensitivity is high (see additional information below).

Additional information

There have been no long term studies of British sea pen populations so assessment of intolerance and recoverability is based on the available information for other species of sea pen. However, *Funiculina quadrangularis* is the most sensitive of the British Sea pens (Hughes, 1998; Greathead *et al*., 2007).

Recoverability

There is very little information on life cycles and population dynamics of British sea pens. From the limited information on other species Hughes (1998) suggested a pattern of patchy recruitment, slow growth and a long life span. Recoverability would depend on recolonization from other populations. Larval settlement is likely to be limited and patchy in space and time, with possibly no recruitment for several consecutive years.

Importance review

Policy/legislation

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

Status

National (GB) importance	Not rare/scarce	**Global red list (IUCN) category**	-

Non-native

Native	-		
Origin	-	**Date Arrived**	-

Importance information

-none-

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