Bladder wrack (*Fucus vesiculosus*)

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/1330]. All terms and the MarESA methodology are outlined on the website (https://www.marlin.ac.uk)

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Fucus vesiculosus **(on left) with** ***Ascophyllum nodosum*****.**
Photographer: Sue Scott

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	Nicola White	**Refereed by**	Dr Stefan Kraan
Authority	Linnaeus, 1753		
Other common names	-	**Synonyms**	-

Summary

Description

The bladder wrack *Fucus vesiculosus* is a large brown algae, common on the middle shore. It can be found in high densities living for about 4-5 years (S. Kraan, pers. comm.). Under sheltered conditions, the fronds have been known to grow up to 2 m in Maine, America (Wippelhauser, 1996).

Recorded distribution in Britain and Ireland

All coasts of Britain and Ireland.

Global distribution

See additional information.

Habitat

The species is found intertidally on rocky shores in a wide range of exposures. It is common on the mid shore often with *Ascophyllum nodosum*, below *Fucus spiralis* and in a zone further up the shore from *Fucus serratus*.

Depth range

Not relevant

Identifying features

- Frond with prominent midrib and almost spherical air bladders.
- Air bladders usually paired but may be absent in very small plants.
- Margin of frond smooth.
- Dichotomously branched.
- The species may be confused with *Fucus spiralis* with which it hybridizes.
- A bladderless form occurs on more wave exposed shores (S. Kraan, pers. comm.).

Additional information

-none-

Listed by

Further information sources

Search on:

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Biology review

Taxonomy

Phylum	Ochrophyta	Brown and yellow-green seaweeds
Class	Phaeophyceae	
Order	Fucales	
Family	Fucaceae	
Genus	Fucus	
Authority	Linnaeus, 1753	
Recent Synonyms	-	

Biology

Typical abundance	High density
Male size range	Up to 1.5m
Male size at maturity	15-20cm
Female size range	15-20cm
Female size at maturity	
Growth form	Foliose
Growth rate	0.48cm/week
Body flexibility	
Mobility	
Characteristic feeding method	Autotroph
Diet/food source	
Typically feeds on	
Sociability	
Environmental position	Epifloral
Dependency	Independent.
Supports	None
Is the species harmful?	No

Biology information

Air bladders or vesicles are produced annually to make the frond float upwards when immersed, except at highly exposed coasts where no air bladders are produced (S. Kraan, pers. comm.). *Fucus vesiculosus* supports few colonial organisms, but provides substratum and shelter for the tube worm *Spirorbis spirorbis*, herbivorous isopods, such as *Idotea*, and surface grazing snails, such as *Littorina obtusata*.

Growth Rate

The growth rate of fucoids is known to vary both geographically and seasonally (Lehvo *et al*., 2001). Relative growth rate can vary from 0.05-0.14 cm/day depending on temperature and light conditions (S. Kraan, pers. comm.). The increase in growth rate for *Fucus vesiculosus* at 10, 12.5 and 15 °C was found to be, on average, 280% higher than it was at 7 °C (Strömgren, 1977). In the northern Baltic, the highest relative growth rate of vegetative branches for *Fucus vesiculosus* was observed in the summer (up to 0.7% / day) compared to winter growth (less than 0.3% / day). In Sweden, growth rates of 0.7-0.8 cm / week were reported over the summer months of June and August (Carlson, 1991).

Growth rate can also vary with exposure. In Scotland, *Fucus vesiculosus* at Sgeir Bhuidhe, a very exposed site, grew about 0.31 cm / week whereas plants at Ascophyllum Rock grew an average of 0.68 cm / week (Knight & Parke, 1950). The proportion of energy allocated between vegetative and reproductive growth also varies throughout the year. In the northern Baltic, reproductive branches experienced a peak in growth rate in mid April where the relative growth rate was almost 0.1% / day (Lehvo *et al*., 2001).

Habitat preferences

Physiographic preferences	Open coast, Strait / sound, Sea loch / Sea lough, Ria / Voe, Estuary, Enclosed coast / Embayment
Biological zone preferences	Mid eulittoral, Upper eulittoral
Substratum / habitat preferences	Artificial (man-made), Bedrock, Cobbles, Gravel / shingle, Large to very large boulders, Pebbles, Small boulders
Tidal strength preferences	Moderately Strong 1 to 3 knots (0.5-1.5 m/sec.), Strong 3 to 6 knots (1.5-3 m/sec.), Very Weak (negligible), Weak < 1 knot (<0.5 m/sec.)
Wave exposure preferences	Moderately exposed, Sheltered, Very sheltered
Salinity preferences	Full (30-40 psu), Reduced (18-30 psu), Variable (18-40 psu)
Depth range	Not relevant
Other preferences	No text entered
Migration Pattern	Non-migratory / resident

Habitat Information

The morphology of the plant varies in response to the environmental conditions leading to distinct varieties. Also, the fact that it can hybridize freely with other fucoids leads to the formation of distinct varieties (S. Kraan, pers. comm.). This species can survive in exposed locations, even though it is not a preferred habitat, but survive as a dwarf form (S. Kraan, pers. comm.). Plants from exposed locations usually have no airbladders and are known as *Fucus vesiculosus* forma *evesiculosus* (formally *Fucus vesiculosus* forma *linearis*) which may be mistaken for *Fucus ceranoides*. The loss of airbladders is thought to be because they increase a plants drag, making them more vulnerable to being washed off by waves. Depth is not relevant as the plant is intertidal although it does occur at shallow depths in the Baltic.

Global distribution

Fucus vesiculosus is found in the Baltic Sea, Faroes, Norway (including Spitsbergen), Sweden, Britain, Ireland, the Atlantic coast of France, Spain and Morocco, Madeira, the Azores, Portugal, the North Sea coast of Denmark, Germany, the Netherlands and Belgium and the eastern shores of United States and Canada.

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	Insufficient information
Season	Winter - Summer
Life span	2-5 years

Larval characteristics

Larval/propagule type	-
Larval/juvenile development	Not relevant
Duration of larval stage	No information
Larval dispersal potential	No information
Larval settlement period	Insufficient information

Life history information

The species is highly fecund often bearing more than 1000 receptacles on each plant, which may produce in excess of one million eggs. Development of the receptacles takes three months from initiation until gametes are released. On British Shores, receptacles are initiated around December and may be present on the plant till late summer. In Sweden receptacles were reportedly present from February through to October (Carlson, 1991).
In England, the species has a protracted reproduction period of about six months which varies only slightly in timing between a population at Wembury on the south coast of Devon and one at Port Erin, Isle of Man (Knight & Parke, 1950). Gametes may be produced from mid winter until late summer with a peak of fertility in May and June. According to Berger *et al.* (2001), *Fucus vesiculosus* reproduced in either of two periods in the Baltic, the first period being early summer (May - June) and the second being late autumn (September - November).
Plants are dioecious. Gametes are generally released into the seawater under calm conditions (Mann, 1972; Serrão *et al*., 2000) and the eggs are fertilized externally to produce a zygote. In the Baltic, summer spawning plants produced smaller but more eggs than plants reproducing in late autumn (September - November): egg production was approximately 210,000 eggs / gram frond mass with an egg size of 0.067 mm and 89,000 egg / gram frond mass with an egg size of 0.07 mm for summer and autumn periods respectively (Berger *et al*, 2001). Both periods experienced a similar recruitment success. Eggs are fertilized shortly after being released from the receptacle. On the coast of Maine, sampling on three separate occasions during the reproductive season revealed 100% fertilization on both exposed and sheltered shores (Serrão *et al*., 2000). Fertilization is not considered as a limiting factor in reproduction in this species (Mann, 1972; Serrã0 *et al*., 2000). Zygotes start to develop whenever they settle, even if the substratum is entirely unsuitable. The egg adheres to the rock within hours of settlement and the germling may be visible to the naked eye within a couple of weeks (Knight & Parke, 1950). The zygote is sticky (S. Kraan, pers. comm.) and may adhere firmly enough to resist removal by the next returning tide (Knight & Parke, 1950). Mortality is extremely high in the early stages of germination up to a time when plants are 3 cm in length and this is due mostly to mollusc predation (Knight & Parke 1950). In the Baltic, for example, a total of more than 1000 fertilized eggs per cm^2 were observed on the

sea floor around the females over the two month reproductive season (Serrão *et al*., 2000). By the end of the season, however, the number of germlings growing in the same area was at least an order of magnitude lower.

The timing of reproduction in this species can, to a certain extent, be influenced by wave exposure and reproduction is sometimes initiated earlier in sheltered condition (Knight & Parke, 1950). In Finland, the amount of energy proportioned to reproduction was significantly higher on exposed sites than sheltered localities (Bäck *et al*, 1991).

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	Intermediate	High	Low	Moderate

Fucus vesiculosus attaches permanently to the substratum, and would therefore be removed upon substratum loss. However, this factor is not thought to lead to the mass mortality of the population (S. Kraan, pers. comm.) and therefore intolerance has been assessed as intermediate. Recovery would be high due to the high fecundity of the species and it's widespread distribution. *Fucus vesiculosus* recruits readily to cleared areas of the shore and full recovery takes 1-3 years (Holt *et al.*, 1997).

	Intolerance	Recoverability	Sensitivity	Confidence
Smothering	High	High	Moderate	Low

If smothering occurs while the tide is out all surfaces of the plant will be covered in sediment, preventing photosynthesis. If smothering occurs while the plant is immersed fewer surfaces will be covered, allowing photosynthesis to continue. Germlings will be smothered and die. Recovery should be high due to the high fecundity of the species and it's widespread distribution. *Fucus vesiculosus* recruits readily to cleared areas of the shore and full recovery takes 1-3 years.

	Intolerance	Recoverability	Sensitivity	Confidence
Increase in suspended sediment	Low	Immediate	Not sensitive	Low

Siltation may cover some of the fronds and so reduce light available for photosynthesis and lower growth rates. Once silt is removed the growth rate should rapidly recover.

Decrease in suspended sediment

	Intolerance	Recoverability	Sensitivity	Confidence
Dessication	Intermediate	High	Low	Moderate

Fucus vesiculosus can tolerate desiccation until the water content is reduced to 30%. If desiccation occurs beyond this level, irreversible damage occurs. The plants at the top of the range probably live at the upper limit of their physiological tolerance and therefore are likely to be unable to tolerate increased desiccation and would be displaced by more physiologically tolerant species. However, individuals at the lower limit of the species distributional range would probably survive so intolerance is reported to be intermediate. Decreased levels of desiccation may result in the species colonizing further up the shore. Recovery would be rapid due to the high fecundity of the species, its widespread distribution and capacity for dispersal.*Fucus vesiculosus* recruits readily to cleared areas of the shore although full recovery may take 1-3 years.

	Intolerance	Recoverability	Sensitivity	Confidence
Increase in emergence regime	Intermediate	High	Low	Moderate

The primary effect of emersion upon algae would be desiccation. Emersion for just 4 hours on a sunny day can reduce the water content of *Fucus vesiculosus* to just 30 percent. This is the critical water content for the alga and water loss beyond this would cause irreversible damage. The species cannot tolerate increased emersion. Increases in the period of emersion would cause plants to die at the upper limit of the species. *Fucus vesiculosus* survives readily in fully submerged conditions where lowered salinity reduces the range of competing organisms. However, a reduction in the period of emersion under fully saline conditions may result in the plants at the bottom of the species distribution on the shore being out-competed by algae that normally grow further down the shore and the upper limit of the species distribution may extend up the shore. Recovery would be high due to the high fecundity of the species, its widespread distribution and capacity for dispersal.*Fucus vesiculosus* recruits readily to cleared areas of the shore although full recovery may take 1-3 years.

Decrease in emergence regime

Increase in water flow rate Intermediate High Low Low

Increase in water flow rate may cause some of the plants to be torn off the substratum or the plants with substratum to be mobilized. The presence of air bladders increases the species drag making it more vulnerable to being removed. Recovery would be high due to the high fecundity of the species and its widespread distribution and capacity for dispersal.*Fucus vesiculosus* recruits readily to cleared areas of the shore although full recovery may take 1-3 years.

Decrease in water flow rate

Increase in temperature Tolerant Not relevant Not sensitive High

Fucus vesiculosus can withstand a wide range of temperatures. Plants have been found to tolerate -30°C in Maine for several weeks and temperatures as high as 30°C (Lüning, 1990). However, at the former temperature, intercellular and extracellular ice crystals form which would cause some damage to the plant (S. Kraan, pers. comm.). The species is well within its temperature range in the UK so would not be affected by a change of 5°C. The species showed no sign of damage during the extremely hot summer of 1983, when the average temperature was 8°C hotter than normal (Hawkins & Hartnoll, 1985).

Decrease in temperature

Increase in turbidity Low Immediate Not sensitive Moderate

Increased turbidity may reduce plant growth rates by reducing light available for photosynthesis. The compensation point for photosynthesis for *Fucus vesiculosus* was found to be ca. 25 µmol /m /sec along the Gulf of Finland. Below this point, the alga must rely on internal energy reserves to survive. A reduction in turbidity at the level at the benchmark level should have no effect. Once turbidity is restored to normal, the growth rate of the species would be quickly restored.

Decrease in turbidity

Increase in wave exposure Intermediate High Low Moderate

Fucoids may be torn off the substratum by increased wave action. As exposure increases the fucoid population would become dominated by small juvenile plants. An increase in wave action beyond this would lead to dominance of the community by grazers and barnacles at the expense of fucoids. A reduction in wave action would have little effect as the species is naturally found in sheltered conditions. Recovery would be high upon return to sheltered conditions due to the high fecundity of the species and its widespread distribution and capacity for dispersal.*Fucus vesiculosus* recruits readily to cleared areas of the shore and full recovery takes 1-3 years (Holt *et al.*, 1997).

Decrease in wave exposure

Noise	Tolerant	Not relevant	Not sensitive	Not relevant

Seaweeds have no known mechanism for perception of noise.

Visual Presence	Tolerant	Not relevant	Not sensitive	Not relevant

Seaweeds have no known mechanism of visual perception.

Abrasion & physical disturbance	Intermediate	High	Low	Moderate

Abrasion may cause damage to the fronds and germlings of *Fucus vesiculosus*. Abrasion may be caused by human trampling which can have a significant impact on shores, reducing the cover of fucoids (Holt *et al.*, 1997). Recovery would be high upon return to normal conditions due to the high fecundity of the species and its widespread distribution and capacity for dispersal. *Fucus vesiculosus* recruits readily to cleared areas of the shore and full recovery takes 1-3 years.

Displacement	High	High	Moderate	Moderate

Fucus vesiculosus is permanently attached to the substratum and would not be able to re-attach itself if removed. Recovery would be high upon return to normal conditions due to the high fecundity of the species and its widespread distribution and capacity for dispersal.*Fucus vesiculosus* recruits readily to cleared areas of the shore although full recovery may take 1-3 years (Holt *et al.*, 1997).

Chemical Pressures

	Intolerance	Recoverability	Sensitivity	Confidence
Synthetic compound contamination	Intermediate	High	Low	Low

Fucoids are generally quite robust in terms of chemical pollution (Holt *et al.*, 1997). However, *Fucus vesiculosus* is extraordinarily highly intolerant of chlorate, such as from pulp mill effluents. In the Baltic, the species has disappeared in the vicinity of pulp mill discharge points and is affected even at immediate and remote distances (Kautsky, 1992). Recovery would be high upon return to normal conditions due to the high fecundity of the species, its widespread distribution and capacity for dispersal.*Fucus vesiculosus* recruits readily to cleared areas of the shore although full recovery may take 1-3 years (Holt *et al.*, 1997).

Heavy metal contamination	Low	High	Low	Moderate

Fucoids accumulate heavy metals and may be used as indicators to monitor these. It is generally accepted that adult plants are relatively tolerant of heavy metal pollution (Holt *et al.*, 1997). However, local variation exists in the tolerance to copper. Plants from highly copper polluted areas can be very tolerant, while those from unpolluted areas suffer significantly reduced growth rates at 25 micrograms per litre.

Hydrocarbon contamination	Low	High	Low	High

Fucus vesiculosus shows limited intolerance to oil. After the Amoco Cadiz oil spill it was observed that *Fucus vesiculosus* suffered very little (Floc'h & Diouris, 1980). Indeed, *Fucus vesiculosus*, may increase significantly in abundance on a shore where grazing gastropods have been killed by oil. However, very heavy fouling could reduce light available for photosynthesis and in Norway a heavy oil spill reduced fucoid cover. Recovery occurred within two years in moderately exposed conditions and four years in shelter (Holt *et al.*, 1997).

Radionuclide contamination		Not relevant		Not relevant

Brown algae readily accumulate radionuclides and have been routinely used in temperate latitudes as biomonitors of radionuclide pollution (van der Ben & Bonotto, 1991; Fowler, 1979, cited in Boisson *et al*.,1997). In the Irish Sea, much higher activities of alpha and gamma radionuclides were observed at sites in close proximity to Sellafield compared to other sites on the coast (Thompson *et al*., 1982). Temperature has been shown to affect the uptake of some radionuclides and their subsequent bioaccumulation in *Fucus vesiculosus* (Boisson *et al*., 1997). More importantly, any contaminants bioaccumulated in the alga can enter the food chain through, for example, grazers such as sea urchins. In 2003 the Radiological Protection Institute of Ireland produced a study focussing on assessing radioactivity exposure to the public and monitoring radioactivity in the marine environment of the Irish Sea (Ryan *et al*., 2003). In *Fucus vesiculosus*, activity concentration of the artificial radionuclide caesium-137 was found to have fallen dramatically since 1983 with concentrations ranging from 1.2-5.8 Bq/kg in 2000/2001. Concentrations of technitium-99 averaged between 264-3905 Bq/kg over the same period and concentrations were shown to have been declining since 1998 (Ryan *et al*., 2003). However, the actual effects of radionuclide accumulation in the alga are not well documented and accordingly, insufficient information has been suggested for this section.

Changes in nutrient levels	Intermediate	High	Low	Moderate

Nutrients are essential for algal growth and are often a limiting factor. When plants grow in high densities they are usually competing for nutrients. Increased nutrients may lead to eutrophication, overgrowth by green algae and reduced oxygen levels. However, fucoids appear relatively resistant to sewage and they grow within 20m of an outfall discharging sewage from the Isle of Man (Holt *et al*., 1997).

Increase in salinity	Low	High	Low	Low

Fucus vesiculosus tolerates a wide range of salinities, as evidenced by it's penetration into the Baltic. Being an intertidal species it must withstand occasional conditions of hyposalinity during precipitation and hypersalinity during sunny or windy periods. In the UK, the species tolerates salinity down to 11 psu, below which it is replaced by *Fucus ceranoides* (Suryono & Hardy, 1997). The growth of germlings at 35 ‰ was found to be greatly reduced compared to growth at 31 ‰. Recovery would be high upon return to normal salinity conditions due to the high fecundity of the species and its widespread distribution and capacity for dispersal. *Fucus vesiculosus* recruits readily to cleared areas of the shore although full recovery may take 1-3 years (Holt *et al*., 1997).

Decrease in salinity

Changes in oxygenation		Not relevant		Not relevant

Insufficient information

Biological Pressures

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

Insufficient information

Introduction of non-native species		Not relevant		Not relevant

Insufficient information

Extraction of this species	Intermediate	High	Low	Not relevant

Over harvesting could occur on easily accessible shores if harvesting of *Fucus vesiculosus* increased significantly. Provided the plant is not removed entirely the algae can regenerate from the remaining stem. Recovery would be high due to the high fecundity of the species and its widespread distribution and capacity for dispersal. *Fucus vesiculosus* recruits readily to cleared areas of the shore although full recovery may take 1-3 years.

Extraction of other species	Not relevant	Not relevant

Insufficient information

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

Morrissey *et al* (2001) listed many uses for *Fucus vesiculosus* including fertilizer, bodycare products, such as shower gels and body creams, and health supplements (kelp tablets). When used in hot seawater baths or steamed the plants are said to release certain substances that promote good skin, lower blood pressure and ease arthritic and rheumatic pains (Morrissey *et al*, 2001). The boiled broth can also be used as a health drink (Guiry & Blunden, 1991). Only a small amount of the available *Fucus vesiculosus* resource is reported to be used and is hand cut or collected as drift (Morrissey *et al*, 2001).

Fucus vesiculosus is important for promoting biodiversity as it provides substrate and shelter for various species including the tube worm *Spirorbis spirorbis*, herbivorous isopods, such as *Idotea*, and surface grazing snails, such as *Littorina obtusata*.

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