MarLIN

Marine Information Network

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

Sea oak (*Halidrys siliquosa*)

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

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Halidrys siliquosa **in rock pool.**
Photographer: Steve Knight

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 & Paolo Pizzolla	**Refereed by**	Dr Stefan Kraan
Authority	(Linnaeus) Lyngbye, 1819		
Other common names	-	**Synonyms**	-

Summary

Description

A large sturdy brown alga 0.3 -1 m in length (occasionally up to 2 m) rising from a strong, flattened cone shaped holdfast. The main stem is flattened and branches alternately to give a distinctly zigzag appearance. The stem bears a few, flattened ribbon-like 'leafy' fronds. The ends of some branches bear characteristic pod-shaped air bladders (about 0.5 cm wide by 1-4 cm long) that are divided by transverse septa into 10 or 12 compartments. The branches also bear reproductive bodies that appear similar to the bladders but lack the septa. Young plants are olive-green in colour while older specimens are dark brown and leathery. This species is perennial.

Recorded distribution in Britain and Ireland

Widely distributed and fairly common in the Britain and Ireland.

Global distribution

Restricted to the north east Atlantic, and recorded from northern Norway, Scandinavia, the Baltic Sea, Helgoland and the Netherlands south to the Bay of Biscay, north Portugal and the Canary Islands (John *et al*., 2004).

Habitat

A distinctive and common rock pool seaweed from the middle to lower shore (may be found in upper eulittoral but only in rock pools). It may also form a zone in the sublittoral below the lower limit of *Laminaria digitata*. It often supports a range of invertebrate epifauna such as bryozoans, hydroids and ascidians and epiflora such as small red algae, *Ulva* sp. and other fucoids.

Depth range

Intertidal to 4 m

Identifying features

- Flattened cone shaped holdfast.
- Regularly alternately branched.
- Main stem 'zigzag' in appearance.
- Presence of terminal pod-shaped air bladders, resembling seed pods, divided by septa into 10 or 12 compartments.

Additional information

No text entered

Listed by

Further information sources

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Biology review

Taxonomy

Phylum	Ochrophyta	Brown and yellow-green seaweeds
Class	Phaeophyceae	
Order	Fucales	
Family	Sargassaceae	
Genus	Halidrys	
Authority	(Linnaeus) Lyngbye, 1819	
Recent Synonyms	-	

Biology

Typical abundance	See additional information
Male size range	
Male size at maturity	
Female size range	Large(>50cm)
Female size at maturity	
Growth form	Foliose
Growth rate	Up to a maximum of 2cm/month
Body flexibility	High (greater than 45 degrees)
Mobility	
Characteristic feeding method	Autotroph
Diet/food source	
Typically feeds on	
Sociability	
Environmental position	Epilithic
Dependency	Independent.
Supports	Substratum a number of epiphytic algae, hydroids, bryozoans and compound ascidians (Lewis, 1964; see additional information).
Is the species harmful?	No information

Biology information

Although it is typically found in low abundances, *Halidrys siliquosa* can sometimes form beds (S. Kraan, pers. comm.). **Growth rates**
The growth rate of newly germinated *Halidrys siliquosa* (germlings) was found to be dependant on temperature, light intensity and day length. For example:

- germlings grew up to ca 180 µm at 3 °C, up to ca 520 µm at 10 °C and up to ca 860 µm at 20 °C within 30 days of germination (Moss & Sheader, 1973);
- increased light intensity or day length had little effect on slow growth at 4 °C but doubling day length doubled growth rates at 10 °C although doubling total light did not double growth, and

- germlings grew faster but showed abnormal development at 20 °C (Moss & Sheader, 1973).

Moss & Lacey (1963) reported a maximum summer growth rate of 2 cm /month, although this figure was based on a single specimen.

Development

- The main axis develops its characteristic 'zigzag' form within 9 months in culture.
- Young plants (up to 1 year old) composed of 'leafy' branches only, branching in one plane.
- Air vesicles develop at the beginning of the second year of vegetative growth.
- Fertile receptacles develop towards the end of the plants second year i.e. at the end of autumn / start of winter (Moss & Lacey, 1963).

In shallow rock pools or surf affected populations the plants are frequently damaged resulting in a turf-like growth form due to a proliferation of branches from the damaged main axis (Moss & Lacey, 1963).

Seasonal changes
Moss & Lacey (1963) studied Northumberland populations of *Halidrys siliquosa* and reported:

- rapid growth and elongation of the axis between spring and the end of July;
- proliferation of new 'leafy' branches in spring, reaching a maximum in June -July;
- production of air bladders from Sept -November and again in Feb to peak in April that was highly variable, and
- development of receptacles starting in July, becoming fertile in November and releasing gametes from December to March, after which the receptacles disintegrate.

In appears, therefore, that growth and development follows a seasonal cycle of allocation of energy towards growth in spring, followed by allocation to reproduction later in the year. However, Wernberg *et al.* (2001) did not detect any significant seasonal change in biomass in the Limfjord, Denmark, due to high monthly variation in biomass, although the specimens they examined were small. They did not detect any seasonal change in thallus height or percentage cover.

Epiphytes
Halidrys siliquosa has been reported to support a number of epiphytic species, depending on location, including microflora (e.g. bacteria, blue green algae, diatoms and juvenile larger algae), *Ulothrix* and *Ceramium* sp., hydroids (e.g. *Laomedea flexuosa* and *Obelia* spp.), bryozoans (e.g. *Scrupocellaria* spp.), and ascidians (e.g. *Apilidium* spp. and *Botrylloides leachi*). However, *Halidrys siliquosa* was considered to be relatively clear of epiphytes due to its ability to shed the outer layer of epidermal cell walls, together with adherent epiphytes (Moss, 1982; Lobban & Harrison, 1997).

Habitat preferences

Physiographic preferences	Open coast, Strait / sound, Sea loch / Sea lough, Ria / Voe, Enclosed coast / Embayment

Biological zone preferences	Lower eulittoral, Mid eulittoral, Sublittoral fringe, Upper infralittoral
Substratum / habitat preferences	Bedrock, Cobbles, Large to very large boulders, Rockpools, Small boulders
Tidal strength preferences	Moderately Strong 1 to 3 knots (0.5-1.5 m/sec.), Very Weak (negligible), Weak < 1 knot (<0.5 m/sec.)
Wave exposure preferences	Exposed, Moderately exposed, Sheltered, Very sheltered
Salinity preferences	Full (30-40 psu), Variable (18-40 psu)
Depth range	Intertidal to 4 m
Other preferences	No text entered
Migration Pattern	Non-migratory / resident

Habitat Information

On wave sheltered shores *Halidrys siliquosa* occur in the sublittoral and rock pools at low water. However, on wave exposed sites *Halidrys siliquosa* may also be found in deep high shore rock pools sheltered from the sun (Moss & Lacey, 1963). It is in such rock pools where the very weak water flow rate is likely to occur.

Life history

Adult characteristics

Reproductive type	Permanent (synchronous) hermaphrodite
Reproductive frequency	Annual episodic
Fecundity (number of eggs)	>1,000,000
Generation time	1-2 years
Age at maturity	2 years
Season	December - March
Life span	Insufficient information

Larval characteristics

Larval/propagule type	-
Larval/juvenile development	Spores (sexual / asexual)
Duration of larval stage	< 1 day
Larval dispersal potential	See additional information
Larval settlement period	Insufficient information

Life history information

Fucales, such as *Halidrys siliquosa*, have a single vegetative sporophyte stage, the diploid thallus that bears specialized reproductive bodies (meiosporangia) in the receptacles, in which the gametes are formed. Female gametes are large and immotile (oogonia) while the male gametes are small and motile (antheridia) (van den Hoek *et al.*, 1995).
In *Halidrys siliquosa*, gametes are formed shortly before liberation from the receptacles. Female

oogonia (80 -100μm in size) and male antheridia are shed simultaneously, so that fertilization may occur during or before liberation. Well developed zygotes were observed 12hrs after fertilization. Zygotes probably sink rapidly (especially if they cluster together), are covered in adhesive mucus and stick to the substratum. Further development is delayed for 5 or more days, after which 2-4 rhizoids develop and fix the zygote to the substratum. The early zygote wall is shed and the germling develops further (Moss & Sheader, 1973; Hardy & Moss, 1978).

In Northumberland, receptacles began to develop in July, became fertile in November and released gametes from December to March, after which the receptacles disintegrated. Fertile receptacles developed in the plants second year (Moss & Lacey, 1963).

Germlings are capable of growing in the dark for up to 40 days. In addition, germlings maintained in the dark for up to 120 days were able to resume growth when exposed to light, however, after 140 days of darkness germlings died (Moss & Sheader, 1973). The ability to survive darkness, and low light conditions, probably allows the germlings to survive under understory algae, ready to develop should the shading canopy be removed.

Dispersal

Zygotes are large and may form clusters (Hardy & Moss, 1978) and probably sink rapidly. Norton (1992) suggested that turbulent deposition by water flow (zygotes or spores being thrown against the substratum) was the most important force directing propagules to the substratum. Dispersal by spores is probably dependant on the hydrographic regime but is probably localized, e.g. in *Sargassum muticum*. Although some zygotes may settle 1km of more from the parent, most settle within 2m (Norton, 1992). The propagules of most fucales tend to settle near the parent plant (Norton, 1992; Holt *et al.*, 1997). *Halidrys siliquosa* can float if detached, suggesting another potential route for dispersal. Floating plants remain fertile and spores may be released some distance from the point of detachment. However, although some long range dispersal must occur in macroalgae (resulting in colonization of oil rigs and similar structures), Van den Hoek (1987) and Norton (1992) suggested that it is probably ineffective for most species of macroalgae. Wernberg *et al.* (2001) suggested that the lack of long range dispersal success in *Halidrys siliquosa* was responsible for its regional distribution in the north east Atlantic.

Recruitment

Sousa *et al.* (1981) reported that experimental removal of sea urchins significantly increased recruitment in long-lived brown algae. In experimental plots cleared of algae and sea urchins in December, *Halidrys dioica* colonized the plots, in small numbers, within 3-4 months. Plots cleared in August received few , if any recruits, suggesting that recolonization was dependant on zygote availability and therefore the season. *Halidrys dioica* did not colonize plots grazed by urchins in their experiments (Sousa *et al.*, 1981). Svendsen (summary only, 1972) reported that *Halidrys siliquosa* became one of a few dominant algae 3 years after removal of *Laminaria hyperborea* by harvesting on the west coast of Norway. However, this observation may be explained by the growth of small germlings already present due to increased light and space freed by removal of the kelp canopy, as well as by recruitment.

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	Low

Removal of the substratum will result in removal of adults and germlings of *Halidrys siliquosa*. Therefore, an intolerance of high has been recorded. Recoverability has been assessed as high (see additional information below).

	Intolerance	Recoverability	Sensitivity	Confidence
Smothering	Intermediate	High	Low	Low

Adult plants are large and held upright by their air bladders when immersed. Therefore, smothering by 5 cm of sediment is likely to only cover the base of the plant and have little effect. Intertidal rock pool populations may be more intolerant, depending on the depth of the pool. However, young (up to 1 year old) plants do not bear air bladders, and, together with germlings, are likely to be smothered by the sediment, preventing photosynthesis, and potentially kill young plants. Germlings can survive for up to 120 days in the dark (Moss & Sheader, 1973), so may not be affected by smothering for a month (see benchmark), although any resultant anoxic conditions would probably be detrimental. The presence of a layer sediment has been shown to cause stress and considerable mortality in algal propagules, and sediment scour in flowing water may also remove and kill zygotes or germlings (Vadas *et al.*, 1992). Smothering by epiphytes (see general biology) may reduce photosynthesis and increase drag on the thallus increasing its susceptibility to storm damage. Epiphyte communities have been shown to reduce light reaching the plant and decrease the rates of oxygen exchange with the surrounding water. This is especially true in eutrophic conditions, the result being a reduction in photosynthesis and metabolic stress in macrophytes (Sand-Jensen *et al.*, 1985, Phillipart, 1995b) which will presumably affect macroalgae similarly. Nevertheless, *Halidrys siliquosa* is able to shed its outer cell walls in order to reduce surface epiphytes (Moss, 1982). Overall, younger or smaller plants, together with germlings may be killed and recruitment reduced. Therefore, an intolerance of intermediate and a high recoverability has been recorded (see additional information).

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

Increased suspended sediment concentrations will increase turbidity (see below). Suspended sediment settling on algal fronds is likely to reduce photosynthesis, and additional scour by sediment in water flow may adversely affect germling and reduce settlement. *Halidrys siliquosa* occurs in sheltered and very sheltered conditions, in which siltation rates may be high. Therefore, *Halidrys siliquosa* may tolerate suspended sediment and is unlikely to be significantly affected by an increase in suspended sediment concentrations for one month (see benchmark). Hence an intolerance of low has been recorded. Increased suspended sediment may reduce recruitment if it coincided with reproductive season. Recovery is likely to be rapid (see additional information below).

	Intolerance	Recoverability	Sensitivity	Confidence
Decrease in suspended sediment	Tolerant	Not relevant	Not sensitive	Not relevant

A decrease in suspended sediment is unlikely to have any direct affects on *Halidrys siliquosa*, except to decrease turbidity (see below).

Dessication	Intermediate	High	Low	Low

Halidrys siliquosa occurs subtidally, in the sublittoral fringe and is restricted to rockpools in the intertidal. Therefore, it is intolerant of desiccation. It is protected from exposure to desiccation in rockpools and subtidally, however, sublittoral fringe populations may be exposed to the air. Therefore, an increase in desiccation at the benchmark level is likely to adversely effect a proportion of the population and an intolerance of intermediate has been recorded. Recoverability has been assessed as high (see additional information below).

Increase in emergence regime	Intermediate	High	Low	Low

A one hour increase in emergence is likely to expose the upper portion of the population, especially in the sublittoral fringe, to desiccation, increased wave action and an increased range of temperature change. *Halidrys siliquosa* is restricted to rock pools in the intertidal, therefore increased emergence is likely to result in loss of the exposed plants, a loss of a proportion of the population. Hence, intolerance has been assessed as intermediate with recoverability of high (see additional information below).

Decrease in emergence regime	Tolerant*	Not relevant	Not sensitive*	Low

Decreased emergence and hence, increased immersion may allow *Halidrys siliquosa* to colonize further up the shore. Therefore, the population may benefit overall.

Increase in water flow rate	High	High	Moderate	Low

Water flow is important to supply nutrients and oxygen, and water flow has been shown to increase photosynthesis in *Halidrys siliquosa* (Schwenke, 1971). *Halidrys siliquosa* was reported from the 'rapids approaches' in association with *Himanthallia elongata* and *Saccharina latissima* (studied as *Laminaria saccharina*), and may occur in association with *Laminaria digitata* in strongly flowing tidal streams (Lewis, 1964). *Halidrys siliquosa* decreases in abundance with increasing water flow, so that in tidal rapids with current speeds of 2-3m/sec (ca 6 knots), it is replaced by *Laminaria digitata*, *Laminaria hyperborea* and *Saccorhiza polyschides* communities (Lewis, 1964; Schwenke, 1971). An increase in water flow from, for example, weak to strong (see benchmark) it likely to significantly reduce the population within a year, resulting in its replacement by species tolerant of strong water flow. Therefore, an intolerance of high has been recorded with a recoverability of high (see additional information below).

Decrease in water flow rate	Low	Immediate	Not sensitive	

Halidrys siliquosa occurs in moderately strong to weak tidal streams, as well as in rock pools, and is probably tolerant on stagnant water in the short term. Therefore a further decrease in water flow is unlikely to have an adverse effect. Reduced water flow may reduce oxygen and nutrient exchange, therefore an intolerance of low has been recorded. Recoverability will probably be immediate.

Increase in temperature	Tolerant	Not relevant	Not sensitive	Moderate

Lüning (1984, 1990) reported an upper survival temperature of 25 °C after one week exposure in *Halidrys siliquosa*. It did not survive at the higher temperatures studied. Zygote germination and growth are temperature dependant. Moss & Sheader (1973) reported 50-97% germination at 3 and 10 °C, falling considerably to 8 -52% at 20 °C and to zero at 22 °C. Growth increased with temperature up to 20 °C but germlings developed abnormally at 20 °C (Moss & Sheader, 1973).
Halidrys siliquosa is distributed from northern Norway to northern Portugal and also occurs in

rock pools, which may experience a relatively large temperature range. Therefore, it is unlikely to be affected by long term temperature changes within the British Isles. Short term acute change may have adverse effects if the change increased the temperature over 20-25°C, especially if the change coincided with the release of gametes or the germination of zygotes. However, *Halidrys siliquosa* releases gametes and zygotes in the winter months (December to March). Overall, *Halidrys siliquosa* is probably tolerant to changes of temperature in British waters.

Decrease in temperature	Tolerant	Not relevant	Not sensitive	Low

Little information concerning the effects of low temperatures on *Halidrys siliquosa* was found. Lüning (1984, 1990) reported that it survived at 0 °C for one week, and Moss & Sheader (1973) reported that the lower limit of germination was not reached at 3 °C but that no gametes were released from fertile receptacles at -4 °C. *Halidrys siliquosa* is protected from ice scour or severe frosts by its subtidal or rock pool habit. Overall, *Halidrys siliquosa* is recorded from northern Norway and is probably tolerant to decreases of temperature likely to occur in British waters.

Increase in turbidity	Intermediate	High	Low	Low

Increased turbidity decreases light penetration and hence decreases photosynthesis, plant growth and reproduction. Moss & Sheader (1973) demonstrated that the growth of germlings was dependent on light intensity but that germlings could survive total darkness for 120 days (see general biology). *Halidrys siliquosa* occurs in sheltered waters that may already be of medium to high turbidity (see benchmark), therefore an additional increase in turbidity may adversely effect the population. A short term increase may not have significant effects. An increase from medium to high turbidity for a year is likely to result in loss of the deepest extent of the population. Therefore, an intolerance of intermediate has been reported. Extreme turbidity for a year is likely to result in loss of macroalgae. Recoverability has been assessed as high (see additional information below).

Decrease in turbidity	Tolerant*	Not relevant	Not sensitive*	Low

Decreased turbidity and hence increased light penetration is likely to benefit all macroalgae present, and may allow the *Halidrys siliquosa* population to extend to greater depths. Moss & Sheader (1973) noted that *Halidrys siliquosa* germlings approached photosynthetic saturation at light intensities about 5 fold those of early sporophytes of *Laminaria hyperborea*, possibly an adaptation to exposure to high light intensities in rock pools. Therefore, the population is likely to benefit from decreased turbidity

Increase in wave exposure	High	High	Moderate	Moderate

Halidrys siliquosa is most abundant on sheltered shores but is found on wave exposed shores where it occurs, primarily in deep mid-shore pools (Lewis, 1964). *Halidrys siliquosa* develops as a short, stunted turf in wave exposed pools (Moss & Lacey, 1963; Lewis, 1964) suggesting that it can tolerate strong water movement (Lewis, 1964). However, with increasing wave exposure *Halidrys siliquosa* / *Saccharina latissima* (studied as *Laminaria saccharina*) communities are replaced by *Laminaria digitata* or *Laminaria hyperborea* communities (Lewis, 1964). Therefore, intolerance of high has been recorded with a recoverability of high (see additional information).

Decrease in wave exposure	Tolerant*	Not relevant	Not sensitive*	Low

Halidrys siliquosa is associated with wave sheltered rocky substrata (Lewis, 1964). A decrease in wave exposure is likely to allow *Halidrys siliquosa* to colonize space and to increase in extent. Therefore, the population may benefit from a decrease in wave exposure.

Noise	Tolerant	Not relevant	Not sensitive	High

Macroalgae are not known to perceive noise of vibration.

Visual Presence	Tolerant	Not relevant	Not sensitive	High

Although macroalgae respond to light, they have no visual perception.

Abrasion & physical disturbance	Intermediate	High	Low	Low

Physical disturbance by a scallop dredge (see benchmark) may damage or remove some individuals. Therefore, an intolerance of intermediate has been recorded. Damaged individuals with intact holdfasts, i.e. not removed, will probably survive.

Displacement	High	High	Moderate	Low

Halidrys siliquosa is permanently attached to the substratum and once removed would not be able to reattach. Therefore, displaced individuals would be lost and an intolerance of high has been recorded. Recoverability has been assessed as high (see additional information below).

Chemical Pressures

	Intolerance	Recoverability	Sensitivity	Confidence
Synthetic compound contamination	Intermediate	High	Low	Very low

No information on the intolerance of *Halidrys siliquosa* to synthetic chemicals was found, however, information on other Fucales was available.
Fucoids are generally quite robust in terms of chemical pollution (Holt *et al.*, 1995, 1997), e.g. *Fucus* sp. seems to thrive in TBT-polluted waters (Bryan & Gibbs, 1991). However, Rosemarin *et al.* (1994) stated that brown algae (Phaeophyta) were extraordinarily highly sensitive to chlorate, such as from pulp mill or brine electrolysis effluents (Holt *et al.*, 1997). In the Baltic, *Fucus vesiculosus* disappeared in the vicinity of pulp mill discharge points and was adversely affected even at immediate and remote distances (Kautsky, 1992). Different life stages of *Fucus serratus* differ in their intolerance to synthetic chemicals. Scalan & Wilkinson (1987) found that spermatozoa and newly fertilized eggs of *Fucus serratus* were the most intolerant of biocides, while adult plants were only just significantly affected at 5ml/l of the biocides Dodigen v181-1, Dodigen v 2861-1 and ML-910. Herbicides (e.g. Diuron and Linuron) in agricultural or urban runoff are likely to be highly toxic to algae (Cole *et al.*, 1999).
Therefore, given the reported intolerance of brown algae to chlorates, and their potential intolerance to biocides and herbicides, an intolerance of intermediate has been recorded albeit at very low confidence. Recoverability has been recorded as high (see additional information below).

Heavy metal contamination	Low	Very high	Very Low	Moderate

Holt *et al.*, (1995, 1997) reported that fucoids and other algae were capable of retaining and concentrating heavy metals, so much so that *Fucus* spp. are used as indicators of heavy metal pollution. Alginates found in fucoids (and in *Halidrys siliquosa*) strip heavy metals and some radionuclides from seawater and store them in inert forms. Hence, adult plants are considered to be relatively tolerant of heavy metal contamination. however, younger stages may be more intolerant. for example iron ore dust interfered with the interaction between eggs and sperm in *Fucus serratus* (Boney, 1980; cited in Bryan, 1984). Bryan (1984) also reported that heavy metals retarded growth in brown algae, and suggested that heavy metal toxicities to seaweeds was in the order of Hg>Cu>Ag>Zn>Zn>Cd>Pb.
Overall, it appears that members of the fucales, and by inference *Halidrys siliquosa* are relatively tolerant of heavy metal pollution and an intolerance of low has been recorded.

Hydrocarbon contamination Low Very high Very Low Low

Halidrys siliquosa is protected from the direct effects of oil spills due to its subtidal habit, although sublittoral fringe and rock pool populations will be more vulnerable. However, plants may be exposed to water soluble components of the oil or oil adsorbed on to particulates.
No information concerning the effects of oil on *Halidrys siliquosa* was found. Holt *et al.* (1997) suggested that fucoids had limited intolerance to oil but noted that studies on long-term exposure were limited. For example, adult *Fucus serratus* plants are tolerant of exposure to spills of crude oil although very young germlings are intolerant of relatively low concentrations of 'water soluble' extractions of crude oils. Exposure of eggs to these extracts (at 1.5 micrograms/ml for 96 hours) interferes with adhesion during settling and at 0.1micrograms/ml) prevented further development (Johnston, 1977). *Fucus vesiculosus* showed limited intolerance to oil. After the *Amoco Cadiz* oil spill *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.
Therefore, it appears that fucoids, and by inference *Halidrys siliquosa*, have a limited intolerance to hydrocarbons and an intolerance of low has been recorded.

Radionuclide contamination Not relevant Not relevant

Ryan *et al* (2003) report on radioactivity levels in various fucoids around Ireland although no specific information was found on either *Halidrys siliquosa* or effects on fucoids in general.

Changes in nutrient levels Tolerant* Not relevant Not sensitive* Moderate

Wernberg *et al.* (2001) reported that the N:P (nitrogen to phosphorus) ratio in Limfjorden *Halidrys siliquosa* was low in summer and high in spring, which suggested that growth was nutrient limited by P in spring and N in summer. Kindig & Littler (1980) exposed *Halidrys dioica* and other algae to 10% untreated sewage effluent in the field, which resulted in increased gross productivity. However, *Halidrys dioica* was found to be absent in the vicinity of a sewage outfall, and Kindig & Littler (1980) concluded that another component of the effluent, other than nutrient, was responsible. Overall, therefore, it would appear that moderate nutrient enrichment at the benchmark level may stimulate growth of *Halidrys* spp. However, excessive enrichment may lead to eutrophication, decreased oxygen levels (see below) and the potential smothering of *Halidrys* sp. by microfloral epiphytes (see smothering).

Increase in salinity Low Very high Very Low Very low

No information on salinity tolerance was found. However, *Halidrys siliquosa* occurs in rock pools, which may experience considerable fluctuations in salinity due to evaporation on hot days. Therefore, *Halidrys siliquosa* is probably tolerant of fluctuations in salinity, both increases and decreases, and an intolerance of low has been recorded.

Decrease in salinity Low Very high Very Low

No information on salinity tolerance was found. However, *Halidrys siliquosa* occurs in rock pools, which may experience considerable decline in salinity due to freshwater influence during rain. Therefore, *Halidrys siliquosa* is probably tolerant of fluctuations in salinity, both increases and decreases, and an intolerance of low has been recorded.

Changes in oxygenation Not relevant Not relevant

Little information on the effects of oxygen depletion on macroalgae was found. Kinne (1972) reports that reduced oxygen concentrations inhibit both photosynthesis and respiration. The effects of decreased oxygen concentration equivalent to the benchmark would be greatest during dark when the macroalgae are dependant on respiration.

Biological Pressures

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

Halidrys siliquosa supports a number of epiphytic species, which use it as a substratum but are not parasitic on the plant. No information on diseases was found.

	Intolerance	Recoverability	Sensitivity	Confidence
Introduction of non-native species	High	High	Moderate	High

Halidrys siliquosa has been reported to be displaced as the dominant species in rock pools by the non-native *Sargassum muticum* on the south coast of England (Eno *et al.*, 1997). Staehr *et al.* (2000) reported that an increase in the abundance of *Sargassum muticum* in Limfjorden, Denmark had resulted in a significant decline of the cover of large brown algae, especially *Saccharina latissima* (studied as *Laminaria saccharina*), *Halidrys siliquosa*, *Codium fragile* and *Fucus vesiculosus*.
Therefore, *Sargassum muticum* appears to able to completely replace or significantly reduce the extent of *Halidrys siliquosa*, and other algae, and an intolerance of high has been recorded. Recoverability has been assessed as high (see additional information below).

	Intolerance	Recoverability	Sensitivity	Confidence
Extraction of this species	Not relevant	Not relevant	Not relevant	Not relevant

No evidence of the extraction or harvesting of *Halidrys siliquosa* was found.

	Intolerance	Recoverability	Sensitivity	Confidence
Extraction of other species	Tolerant*	Not relevant	Not sensitive*	Low

Svendsen (1972; summary only) reported that *Halidrys siliquosa* became one of the dominant macroalgae, 3 years after kelp harvesting in Norway. This suggests that removal of other algae species that compete with *Halidrys siliquosa* for space and light would be beneficial.

Additional information

Recoverability

Little information concerning recruitment in *Halidrys siliquosa* was found. The congeneric *%Halidrys dioica%* was shown to recruit to cleared areas within 3-4 months in the absence of sea urchins on the California coast (Sousa *et al.*, 1981). Similarly, *Halidrys siliquosa* became a dominant algae in 3 years after the removal of kelps in Norway (summary only, Svendsen, 1972). Several fucoids have been shown to recolonize cleared areas readily, especially in the absence of grazers (Holt *et al.*, 1995, 1997). For example, *Fucus* dominated areas may take 1-3 years to recolonize in British waters (Holt *et al.*, 1995).
Overall, *Halidrys siliquosa* is highly fecund and widespread in British waters. If a population is damaged or reduced in abundance it is likely that local recruitment will be good, especially in the winter months and prior abundance may return within a few years. Should the population be destroyed, then recruitment from the surrounding area and subsequent growth may take longer, possibly up to 5 years.

Importance review

Policy/legislation

- no data -

Status

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

Non-native

Native	-		
Origin	-	**Date Arrived**	Not relevant

Importance information

Halidrys siliquosa provides substratum for a number of epiphytic species (see general biology).

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