Sea beech (*Delesseria sanguinea*)

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

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Delesseria sanguinea fronds.
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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**	Dr Joanna Jones
Authority	(Hudson) J.V.Lamouroux, 1813		
Other common names	-	**Synonyms**	-

Summary

🏷 Description

A conspicuous crimson seaweed up to 30 cm in length. Blades are oval or lanceolate, leaf like and reminiscent of beech leaves. The membranous lamina has a wavy margin and is supported by a conspicuous midrib with opposite pairs of lateral veins. The irregularly shaped, thickened holdfast (about 0.5 cm in diameter) gives rise to a short cylindrical stipe about 1 cm long. The stipe branches sparingly giving rise to spirally arranged blades (about 1.5 - 4 cm wide). The leaves may be pointed in young specimens. In autumn the membranous lamina is lost so that only the midrib remains. Reproductive bodies (e.g. cystocarp) develop on the naked midrib. Cystocarp are globular, with a membranous border, and form in fairly close formation on a short stalks on female plants. Carpogonia on female plants are fertilised during October but carpospores are not released until February. New fronds may grow before all reproductive structures disappear. Reproductive leaflets also grow on the denuded midrib in male and asexual plants. On the male plants tetrasporangial bladelets appear in November and tetraspores released in January and February [Kain & Bates, 1993]. Very wave battered plants may be confused with *Phycodrys rubens* (q.v.) which has lobed or toothed blades.

📍 Recorded distribution in Britain and Ireland

Recorded from all coasts of the British Isles. However, records from the east coasts are sparse,

presumably due to the lack of suitable substrata.

📍 Global distribution

Recorded from the north eastern coast of Iceland to the Russian coast near Murmansk. Its southern limit is in Sables d'Olonnes, northern France. It is also found in the Baltic.

🖼 Habitat

May be found in deep pools in the lower eulittoral and subtidally to at least 30 m. It is a characteristic member of the understorey flora in *Laminaria hyperborea* (kelp) forests. It may occasionally be epiphytic on *Laminaria hyperborea* stipes.

↓ Depth range

1-30m

🔍 Identifying features

- Bright red, often crimson in colour.
- Margin of lamina wavy but not serrated.
- Similar to beech leaves in appearance.
- Midrib and blade veins conspicuous.
- Usually branched from, or near to, the base of the stipe.

🏛 Additional information

Young specimens may be confused with *Apoglossum ruscifolium* (q.v.) or *Hypoglossum hypoglossoides* (q.v.) although these species lack the conspicuous lateral veins of *Delesseria sanguinea*. Wave eroded (battered) specimens may resemble *Phycodrys rubens*. However, true *Phycodrys rubens* has lobed or toothed blades and reproductive structures are born on mature blades.

✔ Listed by

🔗 Further information sources

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Biology review

☰ Taxonomy

Phylum	Rhodophyta	Red seaweeds
Class	Florideophyceae	
Order	Ceramiales	
Family	Delesseriaceae	
Genus	Delesseria	
Authority	(Hudson) J.V.Lamouroux, 1813	
Recent Synonyms	-	

🌿 Biology

Typical abundance	Moderate density
Male size range	
Male size at maturity	
Female size range	Medium-large(21-50cm)
Female size at maturity	
Growth form	Turf
Growth rate	Insufficient information
Body flexibility	
Mobility	
Characteristic feeding method	Autotroph
Diet/food source	
Typically feeds on	Not relevant
Sociability	
Environmental position	Epifloral
Dependency	Independent.
Supports	No information found
Is the species harmful?	No

🏛 Biology information

Delesseria sanguinea is perennial and exhibits a complex life cycle. This species exhibits a strong seasonal pattern of growth and reproduction. New blades appear in February and grow to full size by May -June becoming increasing battered or torn and the lamina are reduced to midribs by December (Maggs & Hommersand, 1993). Blade weight is maximal in midsummer, growth dropping in June and July and becoming zero in August (Kain, 1984). Small new blades may be formed in darkness, reserves translocated from assimilates stored in the frond ribs and stipes which persist in winter (Luning, 1990; Maggs & Hommersand, 1993). Kain (1987) suggested that new blade growth may result from an increase in irradiance and hence inhibition of reproduction (e.g. due to removal of Laminarian plants from a kelp canopy) which may explain occasional crop of new blades noted in summer. Kain (1987) also suggested that the normal seasonal trigger for new blade production was temperature, probably when temperatures fell to 13 deg C or below. Morphology, salinity and temperature tolerances differ between North Sea and Baltic populations.

In the Baltic specimens are smaller than British specimens, with thinner blades. Temperature and salinity tolerances are probably genetically determined (Rietema, 1993).

🖼 Habitat preferences

Physiographic preferences	Strait / sound, Ria / Voe, Enclosed coast / Embayment
Biological zone preferences	Lower eulittoral, Sublittoral fringe, Upper infralittoral
Substratum / habitat preferences	Bedrock, Large to very large boulders, Rockpools, Small boulders
Tidal strength preferences	Moderately Strong 1 to 3 knots (0.5-1.5 m/sec.), Weak < 1 knot (<0.5 m/sec.)
Wave exposure preferences	Exposed, Extremely exposed, Moderately exposed, Very exposed
Salinity preferences	Full (30-40 psu), Reduced (18-30 psu), Variable (18-40 psu)
Depth range	1-30m
Other preferences	No text entered
Migration Pattern	Non-migratory / resident

Habitat Information

-

𝒫 Life history

Adult characteristics

Reproductive type	Oogamous
Reproductive frequency	Annual episodic
Fecundity (number of eggs)	>1,000,000
Generation time	Insufficient information
Age at maturity	Insufficient information
Season	October - December
Life span	5-10 years

Larval characteristics

Larval/propagule type	-
Larval/juvenile development	Spores (sexual / asexual)
Duration of larval stage	Not relevant
Larval dispersal potential	No information
Larval settlement period	Not relevant

🏛 Life history information

Dickinson (1963) suggested a lifespan of 5-6 years but Kain (1984) estimated that 1 in 20

specimens may attain 9 - 16 years of age. All reproductive structures in *Delesseria sanguinea* are born on the mibribs. The typical life cycle of members of the Ceramiales is summarised as follows:

- Male haploid gametophytes release male gametes (spermatia) from spermatangia on male bladelets.
- Female haploid gametophytes produce the female gamete, the carpogonium on female bladelets
- After fusion (fertilization) the carposporophyte develops, enclosed in a stalked cystocarp and releases diploid carpospores.
- Carpospores develop into the tetrasporophyte, a diploid sporophyte stage.
  The sporophyte develops tetrasporangia in which haploid tetraspores are formed by meiosis.
  The tetraspores develop into gametophytes.

The gametophyte and sporophyte stages in the order Ceramiales are isomorphic (Bold & Wynne, 1978). The onset of sexual reproduction is stimulated by daylength, *Delesseria sanguinea* is a short-day plant sensitive to a night-break (Kain, 1991; Kain, 1996]. The male bladelets and spermatangia develop between September - December in the Isle of Man. (Kain, 1993). Cystocarps and tetrasporangia appear from December to March and the carpospores and tetraspores are first released in December. Female carpogonia develop 2-3 months before the carposporophytes (c. September). Tetrasporangia form in response to shorter day length (<10h days) than male and female gametangia (Kain, 1996). In culture male bladelets were stimulated by 11-12h days, spermatangia taking 4 weeks to develop. Spermatangia were inhibited by increased day length in culture. Kain (1987) suggested that the southern limit of *Delesseria sanguinea* may be determined by winter temperatures. Studies in Roscoff and Helgoland showed similar seasonality; new blades formed in April - June at Roscoff, males plants in October - December, cystocarps and tetrasporangia in October - December, the last cystocarps found in April. Juvenile recruitment occurred between February and April/June in both Roscoff and Helgoland (Molenaar & Breeman, 1997).

Sensitivity review

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

⚔ Physical Pressures

	Intolerance	Recoverability	Sensitivity	Confidence
Substratum Loss	High	High	Moderate	Moderate

Delesseria sanguinea will be removed with the substratum and it is therefore highly intolerant. There is little information on recruitment or recolonization rates. Kain (1975) examined recolonization of cleared concrete blocks in a subtidal kelp forest. Red algae colonized blocks within 26 weeks in the shallow subtidal (0.8 m) and 33 weeks at 4.4 m. *Delesseria sanguinea* was noted within 41 weeks (8 months) at 4.4m in one group of blocks and within 56-59 days after block clearance in another group of blocks. This recolonization occurred during winter months following spore release and settlement, but not in subsequent samples (Kain, 1975). This suggests that recolonization of *Delesseria sanguinea* in new areas is directly dependent on spore availability. Rhodophyceae have non flagellate, and non-motile spores that stick on contact with the substratum. Norton (1992) noted that algal spore dispersal is probably determined by currents and turbulent deposition. However, red algae produce large numbers of spores that may settle close to the adult especially where currents are reduced by an algal turf or in kelp forests. It is likely that this species could recolonize an area from adjacent populations within a short period of time in ideal conditions but that recolonization from distant populations would probably take longer.

Smothering	Intermediate	High	Low	Moderate

Adults are up to 30 cm in height and will probably survive smothering to a depth of 5 cm by sediment. However, algal spores and propagules are adversely affected by a layer of sediment, which can exclude up to 98 percent of light (Vadas *et al.*, 1992). Germlings and juveniles are likely to be highly intolerant of smothering. A layer of sediment is likely to interfere with settlement and attachment of spores.

Increase in suspended sediment	Low	Immediate	Not sensitive	Moderate

The effects of increased siltation on adults is likely to include smothering (above) or increase turbidity and therefore light attenuation (see below). Within kelp forest, current flows are reduced and siltation is likely to be increased. Therefore, *Delesseria sanguinea* may be tolerant of a level of siltation. Increased siltation may increase sediment scour, especially in winter. Spores, germlings and juveniles are likely to be highly intolerant of sediment scour (Vadas *et al.*, 1992). However, *Delesseria sanguinea* reproduces in winter and increased siltation may interfere with recruitment and long term survival of the population.

Decrease in suspended sediment

Dessication	High	High	Moderate	Low

Delesseria sanguinea is normally subtidal and unlikely to be exposed to desiccation except at extreme low tides or in exposed rock pools. Strong insolation of 20mW per square cm (comparable to mid day on a cloudless December in the UK) causes significant reduction in photosynthesis in only a few hours (1- 4 hrs) (Drew, 1983). A variety of subtidal red algae can

survive aerial exposure for 14 hrs only at humidities of 100 percent (Kain & Norton, 1990). Spores and germlings are highly intolerant of desiccation due to there relatively high surface to area ratios. Subtidal algae are more intolerant of than intertidal algae to desiccation.

Increase in emergence regime   Intermediate   High   Low   Low

Delesseria sanguinea is a subtidal species. Increased emergence will extend tidal influence further down the shore. The extent of the population will be decreased accordingly by depressing its height up the shore as a result of increased desiccation, insolation and competition from intertidal algae. Similarly individuals inhabiting rock pools may be lost.

Decrease in emergence regime

Increase in water flow rate   Intermediate   High   Low   Low

Algae are dependent on water flow for a supply of nutrients and removal of wastes. *Delesseria sanguinea* is found is a wide range of water flow regimes from moderately strong to weak. However, the flow rates experienced within kelp forests will be reduced. Deep growing red algae such as *Delesseria sanguinea* were observed growing in stagnating water in Kiel Bay, western Baltic Sea (Schwenke, 1960; cited in Kinne, 1971). It is likely, therefore, that this species would tolerate decreased water flow. However, an increase to strong or very strong may inhibit settlement of spores and may remove adults or germlings.

Decrease in water flow rate

Increase in temperature   Low   Immediate   Not sensitive   Moderate

There is some evidence to suggest that blade growth in *Delesseria sanguinea* is delayed until ambient sea temperatures fall below 13 °C, although blade growth is likely to be intrinsically linked to gametangia development (see Kain, 1987). *Delesseria sanguinea* is tolerant of 23 deg C for a week (Lüning, 1984) but dies rapidly at 25 deg C. North Sea and Baltic specimens grew between 0-20 deg C, survived at 23 deg C but died at 25 deg C rapidly (Rietema, 1993). Rietema (1993) reported temperature differences in temperature tolerance between North Sea and Baltic specimens. Lüning (1990) reports optimal growth in *Delesseria sanguinea* between 10 - 15 deg C and optimal photosynthesis at 20 deg C. However, the upper limit of temperature tolerance is reduced by lowered salinity in Baltic specimens (Kinne, 1970; Kain & Norton, 1990). At low salinity photosynthesis is restricted to a narrow range of temperatures in adult thalli whereas juvenile thalli have a wider response range (Lobban & Harrison, 1997; fig 6.27). It is likely therefore that within the subtidal an increase in temperature of 2 deg C in the long term will have limited effect on survival, although it may affect initiation of new growth at the southern limits of the population. An increase of 5 deg C in the short term may affect survival if the ambient temperature is increased above 23 deg C.

Decrease in temperature

Increase in turbidity   Tolerant   Not relevant   Not sensitive   Moderate

Temperate, sub-tidal red algae are characterised by high rates of photosynthetic saturation, high maximum rates of photosynthesis and rapid growth. Reproduction in some species, triggered by short days, during winter when growth of other algae is limited, increased wave action results in loss of algae and most space is available for recolonization (Kain & Norton, 1990). Red algae possess only trace amounts of chlorophyll a (Lüning & Schmitz, 1988). Their main photosynthetic pigments are phycobiliproteins, which absorb optimally in the green light of deeper coastal waters. Photosynthesis in *Delesseria sanguinea* is inhibited by high light levels >200 µmol/m⌷/s, roughly equivalent to very clear shallow water in summer (Kain & Norton,

1990; Figure 15-2). However, in turbid coastal waters, where green light prevails, photosynthetic effectiveness increases with depth in red algae rich in phycoerythrin such as *Delesseria sanguinea* (Lüning, 1990). *Delesseria sanguinea* can grow in darkness using energy reserves stored in the stipe or lower regions of the frond ribs (Lüning, 1990). Increased turbidity would decrease the light levels at depth and may reduce the effective day length and induce reproduction earlier than in less turbid areas (Kain & Norton, 1990). *Delesseria sanguinea* is adapted to grow at depth or in the shade of other plants. Long term (years) decreased turbidity may restrict its downward extent. Short term changes may affect growth and reproduction, however, as a perennial, the adults will probably survive.

Decrease in turbidity

Increase in wave exposure   Tolerant   Not relevant   Not sensitive   Moderate

Delesseria sanguinea occurs on coasts with a wide range of wave exposures, from very exposed to very sheltered and are therefore unlikely to be intolerant of changes in wave action. The plants are sheltered from the worst effects of wave action by depth or dominant kelps.

Decrease in wave exposure

Noise   Tolerant   Not relevant   Not sensitive   Not relevant

Plants have no known sound or vibration receptors

Visual Presence   Tolerant   Not relevant   Not sensitive   Not relevant

Marine algae have no known response to visual stimuli.

Abrasion & physical disturbance   Intermediate   High   Low   Very low

Little information is available on the effects of abrasion on sub tidal red algae. However, the growth form of *Delesseria sanguinea* suggests that its lamina would probably be damaged by passing fishing gear, such as a scallop dredge (see benchmark). Although, its lamina is flexible a proportion of the population is likely to be torn off and lost. Specimens attached to cobbles or boulders may be removed (see substratum loss above). Therefore, an intolerance of intermediate has been recorded.

Displacement   High   High   Moderate   Moderate

If *Delesseria sanguinea* is removed from the substratum it can not reattach itself and it is therefore highly intolerant. Kain (1975) examined recolonization of cleared concrete blocks in a subtidal kelp forest. Red algae colonized blocks within 26 weeks in the shallow subtidal (0.8 m) and 33 weeks at 4.4 m. *Delesseria sanguinea* was noted within 41 weeks (8 months) at 4.4 m in one group of blocks and within 56-59 days in blocks cleared at two monthly intervals during winter months, but not in subsequent samples (Kain, 1975). This suggests that *Delesseria sanguinea* can recolonize areas, but is directly dependent on its reproductive season and spore availability. Rhodophyceae have non flagellate, and non-motile spores that stick on contact with the substratum. Norton (1992) noted that algal spore dispersal is probably determined by currents and turbulent deposition. However, red algae produce large numbers of spores that may settle close to the adult especially where currents are reduced by an algal turf or in kelp forests. It is likely that this species could recolonize an area from adjacent populations within a short period of time in ideal conditions but that recolonization from distant populations would probably take longer.

⚗ Chemical Pressures

     Intolerance   Recoverability   Sensitivity   Confidence

Synthetic compound contamination   `High`   `High`   `Moderate`   `High`

O'Brien & Dixon (1976) suggested that red algae were the most sensitive group of algae to oil or dispersant contamination, possibly due to the susceptibility of phycoerythrins to destruction, and that the filamentous forms were the most sensitive. However, most evidence relates to dispersants. O'Brien & Dixon (1976) also report that red algae are effective indicators of detergent damage since they undergo colour changes when exposed to relatively low concentration of detergent. Smith (1968) reported that 10 ppm of the detergent BP 1002 killed the majority of specimens in 24hrs in toxicity tests. However, the effects take several days to manifest; when killed the lamina turn bright orange. Heavy mortality of *Delesseria sanguinea* occurred down to 12 m after the 'Torrey Canyon' oil spill (probably due to a mixture of wave action and dispersant application). Laboratory studies of the effects of oil and dispersants on several red algae species, including *Delesseria sanguinea* (Grandy, 1984; cited in Holt *et al.*, 1995) concluded that they were all sensitive to oil/ dispersant mixtures, with little differences between adults, sporelings, diploid or haploid life stages. Cole *et al.* (1999) suggested that herbicides , such as simazina and atrazine were very toxic to macrophytes. Hoare & Hiscock (1974) noted that *Delesseria sanguinea* was excluded from Amlwch Bay, Anglesey by acidified halogenated effluent discharge. Holt *et al.* (1995) concluded that *Delesseria sanguinea* is probably generally sensitive to chemical contamination.

Heavy metal contamination   `Low`   `Very high`   `Very Low`   `Low`

Bryan (1984) suggested that the general order for heavy metal toxicity in seaweeds is: Organic Hg > inorganic Hg > Cu > Ag > Zn > Cd > Pb. Cole *et al.* (1999) reported that Hg was very toxic to macrophytes. The sub-lethal effects of Hg (organic and inorganic) on *Plumaria elegans* sporeling were reported by Boney (1971), for example 100 percent growth inhibition was caused by 1 ppm Hg in his study. However, little information concerning the effects of heavy metals on *Delesseria sanguinea* was found. Heavy metals have the potential to accumulate in plant tissue, therefore it may take some time for tissue levels to fall before recovery can begin.

Hydrocarbon contamination   `High`   `High`   `Moderate`   `High`

Delesseria sanguinea is unlikely to become smothered by oil due to its subtidal position. However, O'Brien & Dixon (1976) suggested that red algae were the most sensitive group to oil or dispersant contamination, possibly due to the susceptibility of phycoerythrins to destruction, and that the filamentous forms were the most intolerant. Heavy mortality of *Delesseria sanguinea* occurred down to 12 m after the 'Torrey Canyon' oil spill, although it was unclear how much of the effect was due to oil rather than dispersant contamination. Laboratory studies of the effects of oil and dispersants on several red algae species, including *Delesseria sanguinea* (Grandy, 1984; cited in Holt *et al.*, 1995) concluded that they were all sensitive to oil/ dispersant mixtures, with little differences between adults, sporelings, diploid or haploid life stages. Holt *et al.* (1995) concluded that *Delesseria sanguinea* is probably generally sensitive to chemical contamination.

Radionuclide contamination   `Not relevant`   `Not relevant`

Insufficient information

Changes in nutrient levels   `Low`   Immediate   `Not sensitive` `Low`

Kain (1984) noted that growth of blades continued into July and August. *Delesseria sanguinea* can grow new blades in darkness by drawing on reserves held in frond midrib and stipe (Lüning, 1990), suggesting that nutrients are subject to 'luxury' accumulation in the winter months. *Delesseria sanguinea* is likely to tolerate low nutrient levels, during spring and summer.

An increase in abundance of red algae, including *Delesseria sanguinea*, was associated with eutrophication in the Skagerrak area, Sweden, especially in areas with the most wave exposure or water exchange (Johansson *et al.*, 1998). However, where eutrophication resulted in high siltation rates, the delicate foliose red algae such as *Delesseria sanguinea* were replaced by tougher, erect red algae (Johansson *et al.*, 1998). High nutrient levels and eutrophication may result in increased siltation and turbidity (see above). Although increased nutrients may stimulate growth, this species may be out competed by green algae and epiphytes at the upper reaches of its range where light is less limiting.

Increase in salinity　　　　Low　　　Immediate　　　Not sensitive　　High

Salinity and temperature affect photosynthesis. At low salinities photosynthesis in adults occurs in a restricted temperature range, although juvenile thalli photosynthesise across a wider range of temperatures (Lehnberg, 1978; cited in Lobban & Harrison, 1997). Rietema (1993) examined ecotypic differences between North Sea and Baltic populations of *Delesseria sanguinea*. Optimal growth occurred in Baltic specimens at 19 -23 psu and North Sea specimens at 33 psu. North Sea specimens died at 7.5 - 11 psu. Optimal photosynthesis occurred at full salinity, even in specimens collected from 15 psu (Lehnberg, 1978; cited in Lobban & Harrison, 1997). Increased salinity at 40 psu drastically reduced photosynthesis in Baltic specimens (Kinne, 1971). *Delesseria sanguinea* is likely to tolerate reduced salinity, although growth and reproduction may be reduced in low salinity environments when compared to full salinity.

Decrease in salinity

Changes in oxygenation　　　　High　　　High　　　Moderate　　Moderate

The effects of deoxygenation in plants has been little studied. Since plants produce oxygen they may be considered relatively insensitive. However, a study of the effects of anaerobiosis (no oxygen) on some marine algae concluded that *Delesseria sanguinea* was very intolerant of anaerobic conditions; at 15 deg C death occurs within 24hrs and no recovery takes place although specimens survived at 5 deg C. (Hammer, 1972).

🐛 Biological Pressures

	Intolerance	Recoverability	Sensitivity	Confidence
Introduction of microbial pathogens/parasites				Not relevant
Introduction of non-native species	Not relevant	Not relevant	Not relevant	Not relevant
Extraction of this species	Not relevant	Not relevant	Not relevant	Not relevant
Extraction of other species	Tolerant*	Not relevant	Not sensitive*	Low

Introduction of microbial pathogens/parasites

No reference to diseases of red algae was found in the literature.

Introduction of non-native species

No non-native species were identified that compete with *Delesseria sanguinea*.

Extraction of this species

This species has been collected, by the French company GoËmar for cosmetic purposes, although knowledge of this trend continuing is unknown. Additionally sheep, on North Ronaldsay of the Orkneys have been known to graze on this species of algae.

Extraction of other species

Extraction or harvesting of kelp will increased light penetration and is likely to enhance growth. Kain (1975) showed that red algae recolonized cleared concrete blocks, in kelp forest in the Isle of Man; *Delesseria sanguinea* colonizing within 56-59 days. This suggests that extraction of kelp may encourage growth of this species in the short term until the kelp

species dominate again.

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
Delesseria sanguinea is used in the cosmetics industry for its anticoagulant properties and vitamin K content; the active principle being termed delesserine (Guiry & Blunden, 1991).

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