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

Knotted wrack (*Ascophyllum nodosum*)

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/1336]. All terms and the MarESA methodology are outlined on the website (https://www.marlin.ac.uk)

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Isolated growth of *Ascophyllum nodosum* on rock.
Photographer: Keith Hiscock

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	Jacqueline Hill & Nicola White	**Refereed by**	Dr Dagmar Stengel
Authority	(Linnaeus) Le Jolis, 1863		
Other common names	-	**Synonyms**	-

Summary

Description

A common large brown seaweed, dominant on sheltered rocky shores. The species has long strap like fronds with large egg-shaped air bladders at regular intervals. The fronds of *Ascophyllum nodosum* are typically between 0.5 and 2m in length. The species often bears tufts of the small reddish-brown filamentous epiphytic algae *Polysiphonia lanosa*. *Ascophyllum nodosum* occurs on the middle of the shore, often with *Fucus vesiculosus*. The species grows slowly and plants can live to be several decades old. Individual fronds can become up to 15 years old before breakage.

Recorded distribution in Britain and Ireland

All coasts of Britain and Ireland.

Global distribution

Global distribution is restricted to the North Atlantic Ocean. Its northern limits are the White Sea in the east and Baffin Island in the west. Southern distributions extend to northern Portugal and New Jersey.

Habitat

The species attaches to rocks and boulders on the middle shore in a range of habitats, from estuaries to relatively exposed coasts. It occupies a similar shore height as *Fucus vesiculosus*. Subtidal populations have been reported, for example in the very clear waters of Rhode Island, USA. However, an intertidal habit is more usual.

Depth range
Not relevant

Identifying features

- Frond narrow without midrib.
- Large swollen egg shaped air bladders at intervals along middle of the frond.
- Reproductive bodies rounded on short stalks.
- Dichotomously branched.

Additional information

Detached forms of *Ascophyllum nodosum* are known from several habitats. *Ascophyllum nodosum* var. *mackayi* is found on very sheltered shores, in sea lochs and is sometimes common on the west coasts of Ireland and Scotland. The frond has extensive dichotomous branching and bears few air bladders. The plants drift in large, spherical masses in sheltered waters. *Ascophyllum nodosum* var. *scorpioides*, which is abundant in New Hampshire (U.S.A.), is often associated with the marsh grass *Spartina alterniflora*. According to Gibb (1957) the major difference between the ecads *mackayi* and *scorpioides* is the proportion of apical to lateral branching. If branching is both 'apical and lateral' the algae would be designated as *mackayi* while if it is 'almost entirely lateral' it would be designated as *scorpioides*. Unattached forms arise when detached fragments of *Ascophyllum nodosum* are deposited onto the shore where they continue to multiply and branch independently of the original fragment (Chock & Mathieson, 1976).

Chock & Mathieson (1979) demonstrated the physiological responses of *Ascophyllum nodosum* and its detached ecad *scorpioides* were similar under varying conditions of light intensity, temperature and salinity.

Ascophyllum nodosum* var. *mackayi
The presence of the ecad in any particular situation depends on the combination of a number of conditions applying at a tide level between high and low water neaps:

- frequent alternation of high and low salinities so a supply of freshwater is of primary importance;
- good shelter from wave action because of the unattached state of the ecad;
- absence of fast moving water, whether caused by freshwater streams or tidal conditions;
- flat, undulating or slightly sloping shore profile where stability is high, and
- substratum type, the porosity of which affects the conditions of salinity and also influences, to some extent, the development of the ecad.

Very sheltered conditions are often found at loch heads on the west coast of Scotland and in these situations the ecad is sometimes present in great abundance. Sheltered or land-locked bays or situations in the lee of small islands are other favourable positions (Gibb, 1957).

Listed by

NIPS

Further information sources

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Biology review

Taxonomy

Phylum	Ochrophyta	Brown and yellow-green seaweeds
Class	Phaeophyceae	
Order	Fucales	
Family	Fucaceae	
Genus	Ascophyllum	
Authority	(Linnaeus) Le Jolis, 1863	
Recent Synonyms	-	

Biology

Typical abundance	High density
Male size range	Up to 2m
Male size at maturity	
Female size range	Large(>50cm)
Female size at maturity	
Growth form	Shrub
Growth rate	5 - 15cm/year
Body flexibility	
Mobility	
Characteristic feeding method	Autotroph
Diet/food source	
Typically feeds on	
Sociability	
Environmental position	Epifloral
Dependency	Independent.
Supports	Substratum epiphytic algae *Polysiphonia lanosa* and ascomycete fungus *Mycosphaerella ascophylli*.
Is the species harmful?	No *Ascophyllum nodosum* is an edible species and alginates from the algae are used in a range of edible products. Also widely used as an animal feed, on its own or as a supplement.

Biology information

- The species is very long lived and has low recruitment. Growth rate is very slow in germlings but increases as the plant ages. During the first year growth takes place at 0.2 cm per year, rising to 1.5 cm per year in the second year (Sundene, 1973). The first air bladder is formed within the first and second years, after which they are produced annually. The holdfasts of *Ascophyllum nodosum* are thought to persist for several decades from which new fronds regenerate.
- Growth is apical. 90% of the apical elongation takes place in the 0 to 5mm zone behind the

apex. Growth rate is maximal in the morning, followed by a continuous decline throughout the day (Strmgren & Nielsen, 1986). In Strangford Lough in Northern Ireland, Stengel & Dring (1997) observed growth to be highly seasonal with low growth rates during November and December, and highest growth rates in late spring and early summer. A decline in growth in mid-summer was observed at all shore levels.
- *Ascophyllum nodosum* repeatedly sloughs its entire outer epidermis, a phenomenon not exhibited by other related seaweeds. (Filion-Myclebust & Norton, 1981). Despite its longevity *Ascophyllum nodosum* is remarkably free of epiphytes even when adjacent plants of other species of fucoid algae are heavily infested. Shedding activity appears to contribute to this difference. The authors frequently observed that when the outer layers are shed, potential epiphytes including spores and germlings of other algae that had settled on the surface were discarded with the epidermis. Only those epiphytes with deeply penetrating rhizoids, such as *Polysiphonia lanosa* (see below), are able to maintain a hold.
- *Polysiphona lanosa* is an obligate epiphyte that occurs primarily on *Ascophyllum nodosum*. The rhizoids of *Polysiphonia lanosa* penetrate the host and obtain some nutrition from *Ascophyllum nodosum*. However, the quantity of carbon obtained is minimal and *Polysiphonia* is pigmented and can photosynthesize itself (Levin & Mathieson, 1991).
- The thalli of *Ascophyllum nodosum* contain an endophytic fungus, the ascomycete *Mycosphaerella ascophylli* Cotton, that penetrates throughout the thallus (Fries, 1988). Garbary & MacDonald (1995) provided experimental evidence for an obligate mutualistic symbiosis where infected thalli were longer, had greater apical diameters and more apical hairs than non-infected thalli. Garbary & London (1995) also suggest that the fungus may protect *Ascophyllum nodosum* from desiccation.

Habitat preferences

Physiographic preferences	Open coast, Strait / sound, Sea loch / Sea lough, Ria / Voe, Estuary
Biological zone preferences	Mid eulittoral, Upper eulittoral
Substratum / habitat preferences	Bedrock, Cobbles, Large to very large boulders, 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	Extremely sheltered, Moderately exposed, Sheltered, Ultra 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 local distribution of *Ascophyllum nodosum* is largely determined by wave exposure. As exposure to wave action increases the number of plants becomes progressively less and they consist increasingly of stumps and short lived shoots. On sheltered shores *Ascophyllum nodosum* may competitively exclude *Fucus vesiculosus*. The species can tolerate salinities down to 15 psu and can tolerate constant immersion but thrives better when exposed to air at low tide.

Life history

Adult characteristics

Reproductive type	Gonochoristic (dioecious)
Reproductive frequency	Annual episodic
Fecundity (number of eggs)	No information
Generation time	5-10 years
Age at maturity	5 years
Season	April - June
Life span	10-20 years

Larval characteristics

Larval/propagule type	-
Larval/juvenile development	Spores (sexual / asexual)
Duration of larval stage	2-10 days
Larval dispersal potential	No information
Larval settlement period	

Life history information

- **Lifespan.**
  Ascophyllum nodosum fronds can become up to 15 years old before breakage. The holdfasts, from which new fronds regenerate, are observed to exist for much longer so whole plants may live to be several decades old. Sundene (1973) found *Ascophyllum nodosum* needed five years to develop into fertile plants.
- **Time of first gametes.**
  Mainly March and April, sometimes as early as January and February (D. Stengel pers. Comm.).
- *Ascophyllum nodosum* is dioecious and like all other species of fucoids has only a sexual generation. Receptacles are initiated in April and may take one year to become fertile. Thus, receptacles are present on the plant for 12-14 months and ripen in April to June of the following year. Gametes are released from April onwards and the release of gametes is triggered by the exposure of ripe receptacles to air overnight. Fertilization takes place externally and zygotes settle and form a rhizoid within ten days. The receptacles are then shed during June.
- **Recruitment.**
  Recruitment in *Ascophyllum nodosum* is very poor with few germlings found on the shore. The reason for this poor recruitment is unclear, because the species invests the same high level of energy in reproduction as other fucoids and is extremely fertile every year (Printz, 1959). However, the reproductive period lasts about two months, much shorter than for other fucoids. Printz (1959) suggests that it must be assumed that some special combination of climatic or environmental conditions is needed for an effective recolonization of *Ascophyllum nodosum*. The slow growth rate of germlings, which increases the chance of their being covered by diatoms or grazed by *Littorina*, may also help to explain the scarcity of germlings (Baardseth, 1970).

- ***Ascophyllum nodosum* var. *mackayi***
  In Europe, direct reproduction of the ecad *mackayi* is vegetative and sexual reproduction gives rise to attached *Ascophyllum nodosum*. The formation of receptacles on intermediate ecad stages appears to be a frequent phenomenon, although abnormalities in receptacle shape and position usually accompany this (South & Hill, 1970). Sexual reproduction of intermediate and advanced forms of ecad *mackayi* in Newfoundland is relatively rare (South & Hill, 1970).

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	High

Ascophyllum nodosum is permanently attached to the substratum so would be removed upon substratum loss. The species has poor recruitment rates and is slow growing, limiting recovery (Holt *et al*., 1997). The lack of recovery of *Ascophyllum nodosum* from harvesting is well documented. For example, in their work on fucoid recolonization of cleared areas at Port Erin, Knight and Parke (1950) observed that even eight years after the original clearance there was still no sign of the establishment of an *Ascophyllum nodosum* population. The species is extremely fertile every year and Printz (1959) suggests it must be assumed that some special combination of climatic or environmental conditions is needed for an effective recolonization.

	Intolerance	Recoverability	Sensitivity	Confidence
Smothering	High	Low	High	Moderate

If smothering occurred while the tide was out, the whole plant would be covered in sediment preventing photosynthesis and damaging the plant. If smothering occurred while the plant was immersed, fewer surfaces would be covered allowing some surfaces to be unaffected. Recovery is slow in *Ascophyllum nodosum* due to its slow growth rate and poor recruitment (Holt *et al*., 1997).

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

Siltation may cover some surfaces of the plant, reducing photosynthesis rates which may reduce growth rates. However, the species naturally occurs in places of high siltation, such as estuaries and very sheltered areas, so is likely to be tolerant of this factor. Upon return to normal conditions the photosynthesis rate would quickly return to normal.

Decrease in suspended sediment

	Intolerance	Recoverability	Sensitivity	Confidence
Dessication	Intermediate	Moderate	Moderate	Moderate

Ascophyllum nodosum regularly becomes exposed to air during tidal cycles and so is tolerant of some desiccation. Brinkhuis *et al*. (1976) concluded that productivity is affected by desiccation, but only when water loss exceeds 50%. Stengel & Dring (1997) found that growth was lowest in those plants highest up the shore. In transplantation experiments Stengel & Dring (1997) found that 80% of plants moved from the lower shore to the upper shore died within 3 months, whereas all transplants from the upper to the lower shore and all controls survived. However, the photosynthetic and growth rates of those plants that survived on the upper shore had acclimated to the new conditions, but whether the plants survived or not seemed to be determined by thallus morphology which may be genetically fixed. An increase in desiccation at the level of the benchmark, equivalent to a change in position of one vertical biological zone on the shore, will kill a large proportion of plants at the upper end of the populations range depressing the upper limit. Other species, which are better able to tolerate desiccation are likely to competitively displace *Ascophyllum nodosum*. However, some plants are likely to be able to acclimate to the new conditions and survive so intolerance is assessed as intermediate. Conversely, a decrease in the level of desiccation may result in the upper limit of the species extending further up the shore. Recovery would be slow due to the slow growth rate and poor recruitment of the species (Holt *et al*., 1997).

Increase in emergence regime High Low High Moderate

Ascophyllum nodosum is normally exposed to air for no more than a few hours (Lüning, 1990). An increase in the period of emersion would subject the species to greater desiccation and nutrient stress, leading to a depression in the upper limit of the species distribution on the shore. A reduction in the period of emersion may result in the species being competitively displaced by faster growing species and may allow the upper limit of the population of *Ascophyllum nodosum* to extend up the shore. Recovery would be slow due to the slow growth rate and poor recruitment of the species (Holt *et al*., 1997).

Decrease in emergence regime

Increase in water flow rate Intermediate Low High Moderate

An increase in water flow rate may cause plants to be torn off the substratum or the plant with the substratum will be mobilised and may be moved to conditions unsuitable for the growth of the species. However, a certain degree of water flow is required to supply nutrients and remove waste products so a reduction in the water flow below a certain level may have an adverse effect on the species. Recovery would be slow due to the slow growth rate and poor recruitment of the species (Holt *et al*., 1997).

Decrease in water flow rate

Increase in temperature Low Moderate Low Moderate

Intertidal algae, such as *Ascophyllum nodosum*, are regularly exposed to rapid and short-term variations in temperature. Both exposure at low tide or rising tide on a sun-heated shore may involve considerable temperature changes, and during winter the air temperature may be far below freezing point. Growth has been measured between 2.5 and 35°C with an optimum between 10 and 17°C (Strömgren, 1977). In the North Sea *Ascophyllum nodosum* can tolerate a maximum temperature of 28°C and the optimum growth rate is at 15°C (Lüning, 1990). Laboratory experiments in New Hampshire showed that *Ascophyllum nodosum* exhibits a eurythermal response to temperature with a more pronounced optimum occurring during the summer than the winter (Chock & Mathieson, 1979). Overall, summer plants showed a higher rate of net photosynthesis than winter specimens. Therefore, the species is likely to be quite tolerant of a long term change in temperature of 2°C. The species is unlikely to be affected by a short term change of 5°C, as it was not damaged during the unusually hot summer of 1983 when the average temperature was 8.3°C higher than normal (Hawkins & Hartnoll, 1985). However, the species has been found to be damaged by thermal pollution if the water temperature is above 24°C for several weeks (Lobban & Harrison, 1997) and the southern limit of the species distribution is controlled by the maximum summer temperature of about 22°C (Baardseth, 1970). The species can tolerate freezing as it has been observed to survive in a block of ice for several days. However, temperature is important for reproduction in *Ascophyllum nodosum*. David (1943) suggests that temperature could provide the stimulus for gamete release. Studies in Maine, USA (Bacon & Vadas, 1991) and in Norway (Printz, 1959) have shown that gamete release in both countries commences at 6°C and in Maine terminated at about 15°C. Provided the temperature has not exceeded the critical limits it will soon recover on return to normal conditions.

Decrease in temperature

Increase in turbidity	Low	Immediate	Not sensitive	Moderate

Changes in turbidity would alter the light available for photosynthesis during immersion. In laboratory experiments Strömgren & Nielsen (1986) observed that there was a strong correlation between the total radiant energy during the day and the average daily growth rates and Ramus *et al*., (1977) observed reduced growth rates of fucoid algae with depth. However, at low tide, when the plants are emersed, *Ascophyllum nodosum* can continue to photosynthesize as long as the plant has a sufficiently high water content and so will be unaffected during this period. Upon return to previous turbidity levels the photosynthesis rate would return immediately to normal.

Decrease in turbidity

Increase in wave exposure	High	Low	High	Moderate

Ascophyllum nodosum cannot resist very heavy wave action so exposure to wave action is an important factor controlling the distribution of the species. In moving from protected sites to the open sea the number of plants become progressively reduced, and individual plants become increasingly short and stumpy (Baardseth, 1970) and with a higher percentage of injured tissue (Levin & Mathieson, 1991). Thus, the species is only present in sheltered or moderately exposed locations and increased wave exposure causes plants to be torn off the substratum and replaced by *Fucus vesiculosus*. Intolerance to wave exposure is therefore high. In moderately exposed locations all *Ascophyllum nodosum* fronds produce few vegetative laterals, but are prolific reproducers even at an early age. Such an allocation of resources is to be expected in habitats where environmental severity is extreme and life expectancy of fronds is likely to be short (Cousens, 1985). In populations sheltered from wave action reproduction does not occur until they have reached a greater age and size. Recovery is slow due to the poor recruitment and slow growth rate of the species (Holt *et al*., 1997). Wave exposure may also be important in preventing settlement of zygotes and therefore recruitment.

Decrease in wave exposure

Noise	Tolerant	Not relevant	Not sensitive	Not relevant

Seaweeds have no known mechanism for the perception of noise.

Visual Presence	Tolerant	Not relevant	Not sensitive	Not relevant

Seaweeds have no known mechanism for visual perception.

Abrasion & physical disturbance	High	Low	High	Moderate

Abrasion may damage the fronds and kill germlings of seaweeds. *Ascophyllum nodosum* is particularly intolerant of abrasion from trampling (Holt *et al*., 1997). It is also likely to be removed if shores are mechanically cleaned following oil spills. Recovery would be slow due to the slow growth rate and poor recruitment of the species.

Displacement	High	Low	High	Moderate

Ascophyllum nodosum is normally permanently attached to the substratum and cannot re-establish itself if detached. Only the unattached forms, such as *Ascophyllum nodosum* var. *mackaii*, can tolerate displacement. Recovery would be slow due to the slow growth rate and poor recruitment of the species. The lack of recovery of *Ascophyllum nodosum* from harvesting is well documented. For example, in their work on fucoid recolonization of cleared areas at Port Erin, Knight and Parke (1950) observed that even eight years after the original clearance there was still no sign of the establishment of an *Ascophyllum nodosum* population. The species is extremely fertile every year and Printz (1959) suggests it must be assumed that some special combination of climatic or environmental conditions is needed for an effective recolonization.

Chemical Pressures

	Intolerance	Recoverability	Sensitivity	Confidence
Synthetic compound contamination	Intermediate	Low	High	Low

The disappearance of *Ascophyllum nodosum* from Oslofjord has been attributed to the reduced ability of germlings to recruit at highly polluted sites (Sjoetun & Lein, 1993). However, Hoare & Hiscock (1974) observed that *Ascophyllum nodosum* was found within 100m of an acidified, halogenated effluent discharge, although plants had abnormal and retarded growth. Recovery is slow due to the low growth rate and poor recruitment levels of this species (Holt *et al.*, 1997).

Heavy metal contamination	Low	High	Low	Moderate

The disappearance of *Ascophyllum nodosum* from Oslofjord has been attributed to an increase in pollution and copper at concentrations of 1039nM (66µg/L) have been found to inhibit the growth of *Ascophyllum nodosum* (Str&#246mgren, 1979a). However, adult plants appear to be fairly robust in the face of heavy metal pollution (Holt *et al*., 1997) and so intolerance is reported to be low. For example, the species penetrates into the metal polluted middle reaches of Restronguet Creek in the Fal estuary system where concentrations of both copper and zinc are in the region of 1000-2000µg/g in the sediment and 10-100µg/l in seawater (Bryan & Gibbs, 1983). Although *Ascophyllum nodosum* accumulates copper this can be removed because the species naturally sheds its epidermis at regular intervals (Stengel & Dring, 2000). Earlier life stages of *Ascophyllum nodosum* are probably more sensitive than adult plants. Therefore on return to normal conditions growth rates should gradually return to normal.

Hydrocarbon contamination	Low	Moderate	Low	Moderate

Experimental studies have found that long-term exposure to low levels of diesel reduces the growth rate in *Ascophyllum nodosum*. For example, in mesocosm experiments, Bokn (1987) observed growth inhibition at a diesel concentration of 130 ppb and that inhibition stops when the oil is removed. Thus, a limited amount of oil pollution need not be detrimental to a population with good recruitment (Sjoetun & Lein, 1993). However, *Ascophyllum nodosum* generally has poor recruitment so populations may take a long time to recover and hydrocarbon contamination may also prevent fertilization and germination and hence recruitment. If plants are heavily oiled the fronds can become severely overweighted by oil and be broken by waves. This may be no more detrimental than a severe storm if a few blades are lost, but the loss of too many blades can be harmful (Lobban & Harrison, 1997).

Radionuclide contamination				Not relevant

Insufficient information.

Changes in nutrient levels	Intermediate	High	Low	Moderate

Ascophyllum nodosum, like several other intertidal algae, is able to accumulate nitrogen in its tissues in response to seasonal availability. A reduction in the level of nutrients could reduce growth rates in *Ascophyllum nodosum*. A slight increase in nutrients may enhance growth rates but high nutrient concentrations could lead to the overgrowth of the algae by ephemeral green algae. *Ascophyllum nodosum* plants, when transplanted into sewage-stressed areas have become heavily infested with epiphytes and frequently overgrown by *Ulva* species and there are reports of a decline in populations of the species in the North Atlantic as a result of increased eutrophication (Fletcher, 1996). On return to normal nutrient levels the growth rate would be quickly restored.

Increase in salinity	Low	High	Low	Moderate

Ascophyllum nodosum is euryhaline with a salinity tolerance of about 15 to 37 psu (Baardseth, 1970). The species can also withstand periodic emersion in freshwater (Baardseth, 1970) and frequently inhabits estuaries where salinity is variable. Doty & Newhouse (1954) reported *Ascophyllum nodosum* from estuarine waters with a maximum salinity of 17.3psu and a minimum of 0psu. Further evidence is provided by Chock & Mathieson (1979) who found *Ascophyllum nodosum* plants in the laboratory exhibited net photosynthesis at salinities from 0 to 40 psu although the long term effects within this range were not evaluated. Intolerance to salinity changes is therefore assessed at low. Once salinity levels have returned to normal the seaweed will rapidly recover.

Decrease in salinity				
Changes in oxygenation				Not relevant

There is insufficient information to make an assessment.

Biological Pressures

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

Although bacteria and fungi are associated with *Ascophyllum nodosum* no information could be found on any disease causing microbes. Nematodes have been associated with small, round galls, usually located near the air vesicles in *Ascophyllum nodosum* (Barton, 1892).

Introduction of non-native species		Not relevant		Not relevant

Insufficient information

Extraction of this species	Intermediate	Low	High	High

Harvesting of *Ascophyllum nodosum* will severely affect the population if the whole plant is removed. If stumps 10-20cm high are left the plants will re-sprout and harvesting is possible in 3 to 6 years (Baardseth, 1970). Where the whole plant is removed recovery is slow due to the slow growth rate and poor recruitment of *Ascophyllum nodosum*. In their work on fucoid recolonization of cleared areas at Port Erin, Knight and Parke (1950) observed that even eight years after the original clearance there was still no sign of the establishment of an *Ascophyllum nodosum* population. Even in an area where many plants remained after harvesting no repopulation was seen for several years (Printz, 1959). The species is extremely fertile every year and Printz (1959) suggests it must be assumed that some special combination of climatic or environmental conditions is needed for an effective recolonization. Recovery of the population to original abundance and biomass is therefore, likely to take a very long time.

Extraction of other species	Tolerant	Not relevant	Not sensitive	Not relevant

There are no other species that are required as a host or prey for *Ascophyllum nodosum*.

Additional information

Importance review

Policy/legislation

Northern Ireland Priority Species ☑

Status

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

Non-native

Native	-		
Origin	-	**Date Arrived**	-

Importance information

- *Ascophyllum nodosum* ecad *mackayi* occurs only in specific conditions. Its habitat is, therefore rare, and the beds small. The UK populations are also important in an international context. Therefore, *Ascophyllum nodosum* ecad *mackayi* beds are protected under Schedule 8 of the Wildlife & Countryside Act (1981) and included in the UK Biodiversity Action Plan.
- *Ascophyllum nodosum* is harvested in Ireland and Scotland for use in alginates, fertilisers and for the manufacture of seaweed meal for animal and human consumption. Around 32,000 t is harvested per year. The species is also harvested in Europe, Canada and the north-west Atlantic. Poor resource management and over-exploitation have led to severely depleted populations in many regions. These factors, together with the long-recognised shortage of sporelings (David, 1943) and the failure of the species to recolonize denuded areas for decades, illustrate the need to have good management strategies and reseeding techniques.
- The ecological effects of harvesting have been noted by Boaden & Dring (1980) who concluded that harvesting has a significant and persistent effect on shore ecology. Even several years after small scale cutting shore cover was reduced and there were significant decreases in the cover of other species like *Cladophora*, *Halichondria* and *Balanus crenatus*. Under boulder diversity of species had also declined by one-third per boulder.
- Production rates of *Ascophyllum nodosum* in Nova Scotia were estimated to be between 0.61 and 2.82 kg/m (Cousens, 1984). Westlake (1963) estimated an annual production in south west Nova Scotia of 2.0 - 2.6 kg/m for a standing crop of 8kg/m by assuming recovery from harvesting takes 3-4 years.
- The fronds of *Ascophyllum nodosum* are narrow, flexible and slimy, offering a poor support for most encrusting animals. The species is unattractive to most intertidal species with the exception of *Clava multicornis*, *Bowerbankia imbricata* and on sheltered shores *Spirorbis spirorbis*. It also supports the red alga *Polysiphonia lanosa*, which penetrates the fronds with root-like fibres.

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