An acorn barnacle (*Semibalanus balanoides*)

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

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Group of individuals.
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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	Nicola White	**Refereed by**	Prof. Alan J. Southward
Authority	(Linnaeus, 1767)		
Other common names	-	**Synonyms**	*Balanus balanoides* (Linnaeus, 1767)

Summary

Description

Semibalanus balanoides is the most widespread intertidal barnacle in the British Isles. It may grow up to 15 mm in diameter and has 6 calcified grey-white shell plates. It may be distinguished from other barnacles by the presence of a diamond shaped opercular aperture and a membranous shell base. The barnacle feeds on zooplankton when immersed, by extending the thoracic appendages (cirri). It is a cross fertilizing hermaphrodite and may live for up to 8 years, depending on its position on the shore.

Recorded distribution in Britain and Ireland

All coasts of Britain & Ireland, but sometimes is absent or rare in south-west Cornwall, the Isles of Scilly and south west Ireland.

Global distribution

Recorded in the north-east Atlantic from Spitsbergen to north-west Spain, on the Pacific coast of north America as far south as British Columbia and on the Atlantic coast as far south as Cape Hatteras; but missing from the Biscay coast of France.

Habitat

Semibalanus balanoides is a dominant member of the eulittoral fauna of British rocky shores. It can be found on shores of all exposure and typically occurs in a zone below *Chthamalus montagui*, although the two can overlap. It may extend into the lower reaches of estuaries as it can tolerate salinities down to 20 psu.

Depth range

Not relevant

Identifying features

- Shell wall of 6, grey-white plates.
- Opercular aperture diamond shaped.
- Rostral plate broad.
- Up to 15 mm in diameter.
- Shell base membranous.
- Tissue inside opercular aperture usually white or pinkish-white.

Additional information

No text entered

Listed by

Further information sources

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Biology review

Taxonomy

Order	Sessilia	Sessilia
Family	Archaeobalanidae	
Genus	Semibalanus	
Authority	(Linnaeus, 1767)	
Recent Synonyms	Balanus balanoides (Linnaeus, 1767)	

Biology

Typical abundance	High density
Male size range	Up to 15mm
Male size at maturity	
Female size range	Small(1-2cm)
Female size at maturity	
Growth form	
Growth rate	23 - 160
Body flexibility	
Mobility	
Characteristic feeding method	Active suspension feeder, Passive suspension feeder
Diet/food source	
Typically feeds on	Zooplankton, detritus
Sociability	
Environmental position	Epifaunal
Dependency	Independent.
Supports	Host Several parasites, e.g. gregarinid protozoa, larval digenetic trematodes (metacercariae), and in particular the castrating parasitic cryptoniscid isopod *Hemioniscus balani* (see additional text).
Is the species harmful?	Data deficient

Biology information

Semibalanus balanoides has a membranous base, while *Balanus crenatus* has a calacareous base. *Semibalanus balanoides* is preyed on extensively by the dog whelk *Nucella lapillus* and the shanny *Lipophrys pholis*.

- **Feeding:** *Semibalanus balanoides* feeds by extending thoracic appendages called cirri out from the shell to filter zooplankton or similar sized organic particulates from the water (Rainbow, 1984). In the absence of any current, the barnacle rhythmically beats the cirri. When a current is present *Semibalanus balanoides* holds the cirri fully extended in the current flow (Crisp & Southward, 1961; Southward, 1955). Barnacles feed most during spring and autumn when plankton levels are highest. Little if any feeding takes place during winter, when barnacles rely on stored food reserves. Feeding rate is important in determining the rate of growth. Barnacles feed when they are immersed so barnacles low on the shore are able to feed for a longer time and consequently grow faster than those high on the shore (Barnes & Powell, 1953).

- **Moulting:** Barnacles need to moult in order to grow. Frequency of moulting is determined by feeding rate and temperature. Moulting does not take place during winter when phytoplankton levels and temperatures are low.
- **Growth**: all barnacle species grow faster in early life and slower in later life. Growth rates recorded in the British Isles are given above (Anderson, 1994; Crisp & Bourget, 1985). Growth rate varies with a variety of biological and environmental factors, including current flow, orientation with respect to current, food supply, wave exposure, shore height, surface contour, and intra- or inter specific competition. Crisp (1960) concluded that un-interrupted current flow was the most important factor affecting growth and that growth was mainly determined by food intake. The influence of current, wave exposure and tidal level out-weighed latitudinal temperature influences in *Semibalanus balanoides* (Crisp & Bourget 1985). Individuals orientated with the rostral end, and hence the cirri, into the current flow gained a slight growth advantage over individuals of different orientation. Individuals that settled in pits grew slower than those on flat surfaces, perhaps since individuals in pits are removed from current flow, although should they out-grow the dimensions of the pits they grew normally (Crisp, 1960; Crisp & Bourget, 1985). At densities above 0.25/cm□ barnacles compete for space, and, as soon as they touch, growth in diameter is replaced by growth in height, so that dry weight and volume continue to increase. However, at densities >1/cm□ growth rate decreases with density. The presence of foliose species, e.g. filamentous algae, hydroids and bryozoans may also reduce growth, presumably due to reduced current flow over and food supply to the barnacles. (Crisp & Bourget, 1985). Growth is also reduced by the energy demands of reproduction and the presence of the cryptoniscid isopod parasite *Hemioniscus balani*.
- **Parasites and epizoites:** the midgut of *Semibalanus balanoides* is parasitised by the Gregarinid protozoan *Pyxinioides balani* while *Epistylis horizontalis* (a peritrich ciliate) lives on the gills and mantle (reviewed by Arvy & Nigrelli, 1969). Protozoan infestation may delay the release of nauplii. Metacercariae (a larval stage in the life cycle of trematodes) occur inside or near the gut of barnacles, e.g. *Maritrema* spp., a possible parasite of the turnstone (*Arenaria intrepes morinella*), terns or gulls, is found in *Semibalanus balanoides* (Rainbow, 1984; Arvy & Nigrelli, 1969). The cryptoniscid isopod *Hemioniscus balani* is a widespread parasite of barnacles, found around the British Isles, including Ireland, north to the Faroes and Oslo Fjord, and south to the Atlantic coast of France, as well as from Labrador to Massachusetts, New Scotland and Friday Harbour in the western Atlantic (Crisp, 1968). *Hemioniscus balani* is protandrous, the males becoming female after invading the host, eventually developing into a bloated, enlarged, star-shaped egg sac. An individual barnacle may contain up to 7 of theses parasites. Heavy infestation inhibits or destroys the gonads resulting in castration of the barnacle. (Rainbow, 1984; Crisp, 1968; Arvy & Nigrelli, 1969). The shell of British barnacles in the mid-shore may appear blackened due to the epizoic lichen *Arthropyrenia sublittoralis* (Rainbow, 1984). The crustose lichen *Pyrenocollema halodytes* can also grow on barnacle plates.

Habitat preferences

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

Biological zone preferences	Lower eulittoral, Mid eulittoral, Upper eulittoral
Substratum / habitat preferences	Artificial (man-made), Bedrock, Cobbles, Large to very large boulders, Pebbles, Small boulders
Tidal strength preferences	Moderately Strong 1 to 3 knots (0.5-1.5 m/sec.), Strong 3 to 6 knots (1.5-3 m/sec.), Very Strong > 6 knots (>3 m/sec.), Weak < 1 knot (<0.5 m/sec.)
Wave exposure preferences	Exposed, Extremely exposed, Extremely sheltered, Moderately exposed, Sheltered, Ultra sheltered, Very exposed, 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

In the 1950s the species was extremely rare in south-west Cornwall, and the far west of south County Cork (Crisp & Southward, 1958; Southward & Crisp, 1954; Southward, 1967). Since 1962, as sea temperatures decreased, its range spread westwards apparently from Lyme Bay (Southward, 1967). In 1998 it was found at Porthleven, although the population has declined recently (Southward, pers. comm.). Southward (1998) found that the record for the Azores by Nilsson-Cantell, in the Fauna of Scandinavia, was an error. *Semibalanus balanoides* is a boreo-arctic (i.e. northern) species. Its northern limits are closely paralleled by the summer limits of pack ice while its southern limits are controlled by high temperatures which prevent final maturation of gametes. The mean monthly sea temperature must fall below 7.2 °C in order for the barnacles to breed. *Semibalanus balanoides* is dominant in the eastern and northern regions of the British Isles. In the south west it gives way to chthamalid barnacles and it is sometimes absent or rare in south west Cornwall, south west Ireland and the Isles of Scilly. *Semibalanus balanoides* is less abundant on shores occupied by fucoid algae, because seaweeds prevent establishment of barnacle larvae or remove settled larvae by 'sweeping' across the rock (see reproduction). On shores exposed to strong wave action the upper limit of the barnacles distribution is raised because the shore is kept moist by spray. *Semibalanus balanoides* has a lower tolerance to desiccation than the chthamalid species due to a greater permeability of the shell plates. It is sometimes found sublittorally.

Life history

Adult characteristics

Reproductive type	Permanent (synchronous) hermaphrodite
Reproductive frequency	Annual episodic
Fecundity (number of eggs)	1,000-10,000
Generation time	1-2 years
Age at maturity	1 year
Season	November - December
Life span	5-10 years

Larval characteristics

Larval/propagule type	-
Larval/juvenile development	Lecithotrophic
Duration of larval stage	1-2 months
Larval dispersal potential	Greater than 10 km
Larval settlement period	Insufficient information

Life history information

Reproduction: Reproduction in barnacles is discussed in detail by Rainbow (1984), Barnes (1989), Klepal (1990), Barnes (1992), Anderson (1994) and the references therein. Key points follow.

- *Semibalanus balanoides* is an obligate cross-fertilising hermaphrodite.
- The barnacle penis is substantially longer than the body and is capable of searching an area around the adult to find a receptive 'functional female'.
- Copulation takes place in the UK from November to early December and although an individual 'functional male' may inseminate a single 'functional female' up to 6-8 times (dispensing all its seminal fluid), insemination by more than one functional male is required to successfully fertilise all the eggs. Up to 6 concurrent penetrations may occur (Rainbow, 1984; Anderson, 1994).
- After copulation the penis degenerates and is re-grown during summer ready for the following November. Penis and gonad development in the population is highly synchronous, and probably controlled by light and temperature regime since gonad maturation is inhibited by 15 °C or greater and a light period greater than 12h/day (Barnes, 1992).
- Fertilised embryos are held in two egg sacs and incubated in the mantle cavity overwinter, during which the barnacle does not moult (anecdysis).
- Nauplii larvae are released from the barnacle between February and April, in synchronisation with the spring algal bloom. Hatching takes place later in the north and east of Britain.
- Synchronisation with the spring algal bloom is enabled by the release of a hatching substance, which is secreted by adult barnacles following ingestion of phytoplankton (Barnes 1957; Crisp 1956; reviewed by Clare, 1995). Hatching substance is released into the mantle cavity by the adult and has been identified as an eicosanoid, which may function by stimulating the release of embryonic dopamine (Clare, 1995). In response, the nauplii twitch repeatedly until they break free of the egg membrane and are released. The hatching factor is probably a complex mixture of hydroxy fatty acids, analogous to sex pheromones in insects (see Clare, 1995).
- 'Spawning' of nauplii in response to the spring phytoplankton bloom ensures that larvae grow and develop under optimum conditions when food supply is at its highest and have time to develop and lay down food reserves prior to settlement.
- Nauplii larvae are planktotrophic and develop in the surface waters for about two months. They pass through six nauplii stages before eventually developing into a cyprid larva. Cyprid larvae are specialised for settlement (see general biology). Peak settlement occurs in April to May in the west and May to June in the east and north of Britain.
- *Semibalanus balanoides* produces one brood per year of 5000 -10,000 eggs/ brood in mature adults but varies with age and location e.g. at Port Erin, Isle of Man fecundities of 2500-4000 eggs/ brood (max. 13,000) were reported while 400-8000 eggs / 1.5mg oven

dried body weight were recorded in Scotland (Barnes, 1989).

- Reproduction may be affected by temperature, latitude, light, feeding, age, size, crowding, seaweed cover and pollution. High shore *Semibalanus balanoides* breed first and low shore specimens last (up to 12 days difference)(Barnes, 1989). Fertilization is prevented by temperatures above 10 °C and continuous light. Differences in breeding times with latitude are probably mediated by temperature and day length, e.g. in Spitzbergen fertilization occurs 2-3 months earlier than in the UK. Increased crowding or seaweed cover may decrease feeding and reduce fecundity.
- Barnacles grow rapidly in the first season after settlement. Newly metamorphosed larvae are very squat and only form the adult shape at 3 mm. *Semibalanus balanoides* may become sexually mature in the first year after settlement although this is often delayed until 2 years of age (Anderson, 1994).
- The lifespan of *Semibalanus balanoides* varies with the position on the shore. Barnacles low on the shore typically die in their third year, whereas those from near the mean level of high water neaps may live for five or six years.

Recruitment: Settlement and subsequent recruitment is highly variable.

- Jenkins *et al.* (2000) reported variation in settlement and recruitment at all spatial scales studied (10s, 1000s of metres and 100s of km) in Sweden, the Isle of Man, southwest Ireland and southwest England and between 2 years, 1997 and 1998. Substantial variation in settlement and recruitment occurred between sites, but was not consistent between the two years studied. Variation in settlement explained 29 -99% of variation in recruitment across all sites, although not all variation in recruitment was explained by settlement at all sites. They also observed significant variation between replicate samples within sites in 1997. Recruitment was lower in southwest England than southwest Ireland even with similar settlement due to variation in post settlement mortality.
- Settlement density may also be influenced by onshore or offshore winds, resulting in irregular and sharp peaks of settlement, e.g. north Yorkshire or north west Scotland coasts (Kendall *et al.*, 1985). Settlement density may be directly related to orientation of the shore to the prevailing winds. Settlement was enhanced by onshore winds in the Isle of Man (Hawkins & Hartnoll, 1982) but offshore winds and calm seas in Anglesey (Rainbow, 1984). Hawkins & Hartnoll, (1982) and Jenkins *et al.* (2000) suggested that failure to recruit in any one year is probably less likely when progeny are produced locally and disperse over short distances, whereas where dispersal is wide the chance of larvae encountering adult habitat is subject to varying hydrographic conditions, especially in offshore islands where isolation may exacerbate loss of larvae due to offshore transport.
- In poor years settlement occurred mainly in the later part of the season suggesting either that early larvae failed or were lost (Kendall *et al.*, 1985), or that the phytoplankton bloom, and so release and development of larvae, was late.
- Macroalgae canopies inhibit cyprid settlement and sweeping of algal fronds or bulldozing by grazing limpets may cause high post-settlement mortality, up 82-97% under *Fucus serratus* canopy (Jenkins *et al.*, 1999). *Fucus serratus* was found to inhibit settlement more than *Fucus spiralis* (which has a less dense canopy) and *Ascophyllum nodosum* (which floats upright in the water column). However, the long-term survival of spat reaching >6mm under the canopy was enhanced, especially high on the shore due to reduced risk of desiccation under the canopy (Jenkins *et al.*, 1999).
- The cyprids are capable of settling above their usual zone on the shore but their upper limit (below *Chthamalus montagui*) is maintained by their lower tolerance to temperature and desiccation when compared to chthamalids. Mortality in early life is highly variable,

e.g. Kendall *et al.* (1985) noted that under highly desiccating conditions 70% of a single days input of barnacle spat to the upper shore died within 24 hrs, but overall, in 48 hrs in 1978 mortality was 13% however, in 1980, when intertidal was exposed to 27 °C, 48hr survival was reduced to 30%.

- Long-term monitoring of intertidal barnacle populations in southwest England demonstrated a correlation between the relative abundance of *Semibalanus balanoides* to *Chthamalus* spp. And the planktonic ecosystem and sea temperatures over a 40 year period (1954-1987) (Southward, 1991; Southward *et al.*, 1995). *Semibalanus balanoides* increased in abundance in cooler years and *Chthamalus* spp. In warmer years, possibly due to the increased survival of *Semibalanus balanoides* spat at lower temperatures and reduced desiccation (Kendall *et al.* 1985). At increased temperatures *Chthamalus* spp. Are likely to produce more and earlier broods of larvae, and compete more effectively with *Semibalanus balanoides* which will suffer increased mortality at high to mid shore (Southward *et al.*, 1995).

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	High

Semibalanus balanoides is permanently attached to the substratum so would be removed upon substratum loss. Bennell (1981) observed that barnacles were removed when the surface rock was scraped off in a barge accident at Amlwch, North Wales. Barnacle populations returned to pre-accident levels within 3 years. However, barnacle recruitment can be very variable because it is dependent on a suite of environmental and biological factors, such as wind direction,(see reproduction) therefore populations may take longer to recover.

	Intolerance	Recoverability	Sensitivity	Confidence
Smothering	Intermediate	High	Low	Low

Smothering would bury barnacles and prevent feeding. It is likely that barnacles can withstand smothering for some period of time because they are able to respire anaerobically, however no studies have been found to confirm this. Recovery rates appear to be variable. Bennell (1981) recorded recovery of *Semibalanus* populations within 3 years on a site cleared of barnacles in North Wales. However barnacle recruitment is dependent on a suite of environmental and biological factors, such as wind direction, therefore populations may take longer to recover.

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

Increased siltation would probably reduce growth rate in *Semibalanus balanoides*. The reduced growth rate of barnacles living on carapaces of *Nephrops norvegicus* compared to barnacles growing on rafts was partly attributed to the increased levels of silt found in the immediate vicinity (Barnes & Bagenal, 1951).

Decrease in suspended sediment

	Intolerance	Recoverability	Sensitivity	Confidence
Dessication	Intermediate	High	Low	Moderate

Desiccation tolerance of *Semibalanus balanoides* varies considerably with the size of the barnacle and its position on the shore. Barnacles of 5 mm diameter have a median lethal time (MLT) of 45 hours at 19 °C, whereas barnacles of 11 mm diameter can withstand 92 hours. The median lethal time occurs when 64 % of the water is lost from the body (Foster, 1971a). Desiccation tolerance increases with shore height and increasing body size. The MLT of high shore specimens was reported to be between 48-98% higher than low shore specimens, depending on size (Ware & Hartnoll, 1996). *Semibalanus balanoides* is prevented from growing higher on the shore due to its desiccation tolerance, therefore an increase in the level of desiccation would cause a depression in the upper limit of the species distribution and increased competition from chthamalid barnacles and so intolerance is considered to be intermediate. A decrease in the level of desiccation may elevate the upper limit of the species distribution on the shore. Recovery rates appear to be variable. Bennell (1981) recorded recovery of *Semibalanus balanoides* populations within 3 years on a site cleared of barnacles in North Wales. However, barnacle recruitment can be very variable because it is dependent on a suite of environmental and biological factors, such as wind direction (see reproduction), therefore populations may take longer to recover.

Increase in emergence regime High High Moderate Moderate

Semibalanus balanoides suffers primarily from desiccation and heat upon exposure to air. As desiccation increases the operculum closes and barnacles respire anaerobically (Barnes *et al.*, 1963). Larger barnacles can withstand longer periods of emergence due to increased desiccation tolerance. Barnacles of 5 mm diameter have a median lethal time of 45 hours at 19 °C, whereas barnacles of 11 mm diameter can withstand 92 hours exposure (Foster, 1971a). *Semibalanus balanoides* is prevented from growing higher on the shore due to poor tolerance of desiccation, therefore an increase in the period of emersion would cause increased competition from chthamalid barnacles and a depression in the upper limit of the species distribution. A decrease in the period of emersion would allow the species to grow further up the shore. Recovery rates appear to be variable. Bennell (1981) recorded recovery of *Semibalanus balanoides* populations within 3 years on a site cleared of barnacles in North Wales. However barnacle recruitment can be very variable because it is dependent on a suite of environmental and biological factors, such as wind direction, therefore populations may take longer to recover.

Decrease in emergence regime

Increase in water flow rate Low Very high Very Low Low

Semibalanus balanoides can tolerate a wide range of water current rates. However, water flow rate is very important in determining the growth rate and a decrease in water flow would lower growth rates (Crisp, 1960). Barnacles can tolerate very high flow rates so they are unlikely to be washed off the substratum by an increase in the water current. On return to normal current levels the growth rate of the species would be quickly resumed.

Decrease in water flow rate

Increase in temperature Intermediate High Low Moderate

Semibalanus balanoides is pre-eminently a boreal species, adapted to cool environments. Higher temperatures are therefore likely to have more adverse effects on the species than lower temperatures. The lower lethal temperature varies seasonally and regionally. An exceptional tolerance to cold is acquired in December and January and is lost between February and April. The median lethal temperature in January was -17.6 °C in air for 18 hours, whereas animals in June could only withstand -6.0 °C (Crisp & Ritz, 1967). *Semibalanus balanoides* was not affected during the severe winter of 1962-63 in most areas, except the south east coast which suffered 20-100% mortality. (Crisp, 1964). However, recovery was rapid in this instance due to heavy settlement the following June (Crisp, 1964). However, the mean monthly sea temperature must fall below 7.2 °C for the gametes to mature (Barnes, 1958).

Increased temperature is likely to favour chthamalid barnacles rather than *Semibalanus balanoides*, whereas cold years favour survival and abundance of *Semibalanus balanoides* in south west England (Southward *et al.* 1995). Reproduction in *Semibalanus balanoides* is inhibited by temperatures greater than 10 &#176C (Barnes, 1989). Cirral beating rate reaches a maximum at 18 °C in the U.K. (Southward, 1955) and 21 °C at Woods Hole, where summers are warmer (unpublished data, Crisp & Southward). This rate declines until all spontaneous activity ceases at 31 °C and at a temperature of 37 °C a coma is induced (Southward, 1955). It has also been noted that high internal temperatures of approximately 44 °C can cause 50 %

mortality if experienced for more than 45 minutes (Southward, 1958). Therefore, *Semibalanus balanoides* is likely to exhibit 'intermediate' intolerance to temperature change. Recovery rates appear to be variable. Bennell (1981) recorded recovery of *Semibalanus balanoides* populations within 3 years on a site cleared of barnacles in North Wales. However, barnacle recruitment can be very variable because it is dependent on a suite of environmental and biological factors, such as wind direction, therefore populations may take longer to recover.

Decrease in temperature

Increase in turbidity Low Very high Very Low Low

An increase in turbidity could be beneficial for *Semibalanus balanoides* if the suspended particles are composed of organic matter. However, if the suspended particles are entirely composed of sediment, an energetic cost may be imposed because barnacles will be filtering inedible particles. A reduction in light penetration could also reduce growth rate of phytoplankton and so limit zooplankton levels, which form the bulk of barnacles food. On return to normal turbidity levels the growth rate of *Semibalanus balanoides* would quickly resume.

Decrease in turbidity

Increase in wave exposure Low High Low Low

Semibalanus balanoides can tolerate all levels of wave exposure. However, a decrease in the level of wave exposure could cause a shift in the community towards fucoid algae, which prevent barnacle larvae from settling. An increase in wave exposure is unlikely to have an effect because barnacles are found in extremely exposed conditions. On return to normal wave exposure levels barnacle populations would quickly resume.

Decrease in wave exposure

Noise Tolerant Not relevant Not sensitive Not relevant

Barnacles are unlikely to be affected by noise.

Visual Presence Tolerant Not relevant Not sensitive Not relevant

Barnacles are unlikely to be affected by visual presence.

Abrasion & physical disturbance Intermediate High Low Very low

Bally & Griffiths (1989) observed that human trampling had no effect on rocky shores in South Africa, and merely dislodged dead barnacle shells. However, Brosnan & Cumrine (1994) observed that barnacles were crushed and removed by trampling in California. Recovery took place within one year following the cessation of trampling. None of these studies involved *Semibalanus balanoides* but the intolerance may be similar.

Displacement High High Moderate Moderate

Barnacles are permanently attached to substratum and cannot survive if detached. Recovery rates appear to be variable. Bennell (1981) recorded recovery of *Semibalanus* populations within 3 years on a site cleared of barnacles in North Wales. However barnacle recruitment can be very variable because it is dependent on a suite of environmental and biological factors, such as wind direction, therefore populations may take longer to recover.

Chemical Pressures

Intolerance Recoverability Sensitivity Confidence

Synthetic compound contamination Intermediate Moderate Moderate Moderate

Barnacles have a low resilience to chemicals such as dispersants, dependant on the concentration and type of chemical involved (Holt *et al.*, 1995) . They are less intolerant than some species (e.g. *Patella vulgata*) to dispersants (Southward & Southward, 1978). Most *Semibalanus balanoides* were killed in areas treated with dispersants (Smith, 1968). Holt *et al.* (1995) concluded that barnacles are fairly sensitive to chemical pollution. However, the barnacle population suffered indirectly as a result of the mass mortality of grazers. The resultant bloom of algae, and growth of fucoids, within 6 months, grew over and killed surviving barnacles (Hawkins & Southward, 1992). Recovery rates appear to be variable. Bennell (1981) recorded recovery of *Semibalanus balanoides* populations within 3 years on a site cleared of barnacles in North Wales. However barnacle recruitment can be very variable because it is dependent on a suite of environmental and biological factors, such as wind direction, therefore populations may take longer to recover. Hawkins & Southward (1992) suggested that the communities on shores heavily treated with dispersants had taken 5-8 years to recover, while some had not recovered after 10 years, and (if limpets and barnacle densities are used as criteria) 15 years may be a more realistic estimate for community recovery. Where oil had gone largely untreated recovery was almost complete within 3 years (Hawkins & Southward, 1992).

Heavy metal contamination Low High Low Moderate

Barnacles accumulate heavy metals and store them as insoluble granules. Clarke (1947) investigated the intolerance of *Semibalanus balanoides* to copper, mercury, zinc and silver. He found that 90 percent of barnacles died when held in 0.35 mg/l Cu carbonate for two days. Zinc, mercury and silver killed 90 percent of barnacles in two days at concentrations of 32 mg/l, 1 mg/l and 0.4 mg/l respectively. Pyefinch & Mott (1948) recorded median lethal concentrations of 0.32 mg/l copper and 0.36 mg/l mercury over 24 hours for this species. Barnacles may tolerate fairly high level of heavy metals in nature, for example they are found in Dulas Bay, Anglesey, where copper reaches concentrations of 24.5 µg/l, due to acid mine waste (Foster *et al.*, 1978).

Hydrocarbon contamination Intermediate Moderate Moderate Low

Littoral barnacles have a high resistance to oil (Holt *et al.*, 1995). However, after the *Torrey Canyon* oil spill, some mortality of barnacles was caused by the oil although most had been able to form a hole in the covering of oil and were 'in good order' (Smith, 1968). Significant reductions in densities of *Semibalanus balanoides* were observed after the *Exxon Valdez* oil spill (1989) , especially at high and mid shore (Highsmith *et al.*, 1996). Although barnacles survived on most shores, up to 98 % reduction in barnacle cover resulted from treatment by hot-water washing. However, recovery on most rocky shores was reported to have progressed considerably by July 1992 (Houghton, *et al.* 1996). Experimentally, *Semibalanus balanoides* has been found to tolerate exposure to the water-accommodated fraction of diesel oil at 129.4 µg/l for two years (Bokn *et al.*, 1993). Recovery rates appear to be variable. They depend on the level of settlement and the survival rate of spat, both of which vary with a suite of environmental and biological factors. Lightly oiled shores have been observed to take 7 to 9 years to reach the previous normal state and more heavily oiled shores take longer (Holt *et al.*, 1995).

Radionuclide contamination Not relevant Not relevant

Insufficient information.

Changes in nutrient levels Intermediate High Low Low

Little data exists on the effects of increased nutrients on barnacles. A slight increase in nutrient levels could be beneficial for barnacles by promoting the growth of phytoplankton levels and therefore increasing zooplankton levels. However, Holt *et al.* (1995) predict that smothering by ephemeral green algae is a possibility under eutrophic conditions. Recovery rates appear to be variable. Bennell (1981) recorded recovery of *Semibalanus* populations within 3 years on a site cleared of barnacles in North Wales. However barnacle recruitment can be very variable because it is dependent on a suite of environmental and biological factors, such as wind direction, therefore populations may take longer to recover.

Increase in salinity	Low	High	Low	Moderate

Semibalanus balanoides can tolerate salinities between 12 and 50 psu, below this cirral activity ceases (Foster, 1970). Barnacles can survive periodic emersion in freshwater, e.g. from rainfall or fresh water run off, by closing their opercular valves (Foster, 1971b). They can also withstand large changes in salinity over moderately long periods of time by falling into a "salt sleep". In this state motor activity ceases and respiration falls, enabling animals to survive in freshwater for three weeks (Barnes, 1953). Recovery rates appear to be variable. Bennell (1981) recorded recovery of *Semibalanus* populations within 3 years on a site cleared of barnacles in North Wales. However barnacle recruitment can be very variable because it is dependent on a suite of environmental and biological factors, such as wind direction, therefore populations may take longer to recover.

Decrease in salinity

Changes in oxygenation	Intermediate	High	Low	Moderate

Semibalanus balanoides can respire anaerobically, so it can tolerate some reduction in oxygen concentration (Newell, 1979). When placed in wet nitrogen, where oxygen stress is maximal and desiccation stress is low, *Semibalanus balanoides* has a mean survival time of 5 days (Barnes *et al.*, 1963). Most barnacles can probably survive low levels of oxygen for a week so intolerance is recorded as intermediate.

Biological Pressures

	Intolerance	Recoverability	Sensitivity	Confidence
Introduction of microbial pathogens/parasites	Intermediate	High	Low	High

Barnacles are parasitised by a variety of organisms and, in particular, the cryptoniscid isopod *Hemioniscus balani* (see general biology). Heavy infestation can cause castration of the barnacle. Levels of infestation within a population vary. Once infected recovery of an individual barnacle is unlikely.

Introduction of non-native species	Intermediate	High	Low	Low

The Australasian barnacle *Elminius modestus* was introduced to British waters on ships during the second world war. The species does well in estuaries and bays, where it can displace *Semibalanus balanoides* and *Chthamalus montagui*. The native species are not displaced completely because they out-compete *Elminius* on exposed shores (Raffaelli & Hawkins, 1996).

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

Not relevant.

Extraction of other species	Intermediate	High	Low	Not relevant

Collection of intertidal algae could damage barnacles by abrasion from trampling. Recovery rates appear to be variable. Bennell (1981) recorded recovery of *Semibalanus* populations within 3 years on a site cleared of barnacles in North Wales. However barnacle recruitment is dependent on a suite of environmental and biological factors, such as wind direction, therefore populations may take longer to recover.

Additional information

Semibalanus balanoides may be infected by the isopod *Hermioniscus balani*. Crisp (1960) recorded that 1.7 percent of barnacles were infected by the isopod and that infected barnacles had no egg masses and grew nearly 40 percent less than uninfected barnacles. King *et al.*, (1993) similarly recorded that 7 percent of brooding *Semibalanus balanoides* were infected by the isopod.

Importance review

Policy/legislation

- no data -

Status

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

Non-native

Native	-		
Origin	-	Date Arrived	-

Importance information

Semibalanus balanoides is a dominant member of the intertidal fauna of rocky shores. On semi-exposed shores patches of *Semibalanus balanoides* may alternate with patches of fucoid seaweeds and limpets. Clumps of *Fucus* fronds can establish on moderately exposed shores, in the absence of heavy limpet grazing. The fronds sweep across the rock surface dislodging barnacle larvae and they provide damp conditions in which juvenile limpets and dogwhelks aggregate. The clumps of fronds eventually disappear through ageing and following this the limpets and dogwhelks disperse due to the loss of shelter. Barnacles can then settle successfully in the remaining gaps.
The definitive early studies of barnacles (Cirripedes) were conducted by Charles Darwin. He devoted 8 years (1846-1854) to a careful study of the Cirripedes that probably had considerable influence on the development of his theories of natural selection, published in 1859, for which he is more famous (Southward, 1983; Crisp, 1983).

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