A sand digger shrimp (*Bathyporeia pelagica*)

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

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A report from:
The Marine Life Information Network, Marine Biological Association of the United Kingdom.

Please note. This MarESA report is a dated version of the online review. Please refer to the website for the most up-to-date version [https://www.marlin.ac.uk/species/detail/1576]. All terms and the MarESA methodology are outlined on the website (https://www.marlin.ac.uk)

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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	Georgina Budd & Lisa Curtis	**Refereed by**	Dr John Fish
Authority	(Spence Bate, 1856)		
Other common names	-	**Synonyms**	-

Summary

Description

A small crustacean that grows to approximately 6-8 mm in length. Its body is laterally compressed with two pairs of antennae and seven pairs of thoracic limbs. Antenna 1 is shorter than antenna 2, and holds an accessory flagellum. The basal segment of antenna 1 is very large, and rectangular in shape. The remaining segments of antenna 1 are smaller and arise at right angles to the basal segment, a feature known as geniculate, and characteristic of the genus. The body appears semi-transparent to white, with varying degrees of red pigment associated with the abdomen. The eyes are red in colour and easily visible.

Recorded distribution in Britain and Ireland

Found on sandy coasts of Britain and Ireland.

Global distribution

This species has been recorded from the Netherlands and the Channel coast of France.

Habitat

Found in wet, clean, fine to medium sand, from slightly above the mean tide level into the shallow sublittoral; often abundant above mean tide level.

Depth range

-

Identifying features

- The dorsal surface of the fourth segment of the abdomen with a pair of forwardly directed bristles and a pair of backwardly directed spines (J. Fish, pers. comm.).
- The third of three lateral plates (epimeral plates) on either side of abdominal segments 1, 2 and 3 has a tiny posterior tooth together with 4 or 5 groups of spines above the ventral border (J. Fish, pers. comm.).
- In the adult male the posterior tooth is reduced to an uneven border around the postero-ventral corner.
- Distinguished from *Bathyporeia guilliamsoniana* by the large first segment of antenna 1, which has a straight, angular tip.

Additional information

The Gammaridea are difficult to identify and reference should be made to Lincoln (1979) for guidance.

Listed by

Further information sources

Search on:

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Biology review

Taxonomy

Order	Amphipoda	Sand hoppers and skeleton shrimps
Family	Bathyporeiidae	
Genus	Bathyporeia	
Authority	(Spence Bate, 1856)	
Recent Synonyms	-	

Biology

Typical abundance	Moderate density
Male size range	<6mm
Male size at maturity	
Female size range	5mm
Female size at maturity	
Growth form	Articulate
Growth rate	
Body flexibility	High (greater than 45 degrees)
Mobility	
Characteristic feeding method	See additional information
Diet/food source	
Typically feeds on	Organic matter
Sociability	
Environmental position	Infaunal
Dependency	Independent.
Supports	No information
Is the species harmful?	No

Biology information

Characteristic feeding method
Bathyporeia pelagica is an epistrate feeder, individual sand grains are rotated by the mouth parts and organic matter removed, essentially 'sand-licking' (Fish & Fish, 1996).
Pelagic phase
Species of the amphipod genus *Bathyporeia* leave the protection of the sand at night to swim. Such activity is also a feature of certain species of benthic amphipods, particularly of those belonging to the families Haustoriidae, Phoxocephalidae, Oedicerotidae, Calliopiidae, Atylidae and Dexaminidae (Fage, 1933). The swimming activity of *Bathyporeia pelagica* shows both a circatidal and circasemilunar periodicity (Watkin, 1939a; Fincham, 1970a & 1970b; Preece, 1971). *Bathyporeia pelagica* emerges on the early ebb of high tides, and is two or three times more active on night-time tides than during the day. It is likely that endogenous rhythm of *Bathyporeia pelagica* is modulated by temperature, the natural Light/Day cycle (nL/D) and tides acting as exogenous synchronizing factors. This endogenous rhythm will also 'free-run' in animals kept under constant environmental conditions (Fincham, 1970b). However, it is not yet known which exogenous

stimulus is most important in re-phasing the activity cycle to keep in tune with seasonally changing tides and nL/D ratios (Hayward, 1994). It is difficult to state exactly why *Bathyporeia pelagica* has this activity rhythm. Feeding is an unlikely cause since this is conducted whilst buried in the sand. It seems more likely that swimming is connected with the reproductive cycle. Whilst the species swims most nights, a maxima occurs 4-9 days after a new moon when there is less rapid water movement over the beach than at spring tides. As a result mating couplings may be more successful (see reproduction).

Habitat preferences

Physiographic preferences	Strait / sound, Estuary, Enclosed coast / Embayment
Biological zone preferences	Lower eulittoral, Mid eulittoral, Sublittoral fringe, Upper eulittoral
Substratum / habitat preferences	Fine clean sand
Tidal strength preferences	
Wave exposure preferences	Moderately exposed, Sheltered
Salinity preferences	Full (30-40 psu)
Depth range	
Other preferences	No text entered
Migration Pattern	Non-migratory / resident

Habitat Information

Salinity tolerance
Bathyporeia pelagica is an intertidal species restricted to the lower half of the tidal range by its intolerance to changes in salinity. In experimental studies, Preece (1970) found that *Bathyporeia pilosa* had a wider salinity tolerance than *Bathyporeia pelagica*. In both species, gravid females and juvenile males tolerated hyposaline conditions (3.6psu & 10.8psu) better than mature males, and that an increase in temperature (5°C to 15 °C) lowered the tolerance to hyposaline conditions. The differences in salinity tolerance between the species are considered to be important in determining their vertical distribution on the shore. Field studies (Watkin, 1942; Fish & Preece, 1970) have shown that *Bathyporeia pilosa* extends into areas where salinity fluctuations are pronounced, whilst *Bathyporeia pelagica* occurs in areas of higher and more stable salinity.
Changes in distribution
Vertical migration into the tidal waters occurs on most nights of the year. However, the species retain their zonation closely when swimming in the tidal waters, which suggests that the time they remain in the water is short or that several cyclical migrations are made (Watkin, 1939a). Seasonal changes in vertical distribution and abundance are considered to be influenced by salinity-temperature fluctuations acting in association with maturation. For instance, Fish & Preece (1970) observed the disappearance of *Bathyporeia pelagica* from their sampling site at Ynyslas, west Wales in March 1967 and specimens were not recorded again until October. In subsequent years the disappearance of *Bathyporeia pelagica* was sudden and characterized by the movement of a large proportion of the population to the lowest levels of the shore.

Life history

Adult characteristics

Reproductive type	Gonochoristic (dioecious)
Reproductive frequency	Annual episodic
Fecundity (number of eggs)	See additional information
Generation time	See additional information
Age at maturity	See additional information
Season	Spring - Autumn
Life span	1 year

Larval characteristics

Larval/propagule type	-
Larval/juvenile development	Ovoviviparous
Duration of larval stage	Not relevant
Larval dispersal potential	10 -100 m
Larval settlement period	Insufficient information

Life history information

Annual reproductive cycle

Fish & Preece (1970) described the reproductive cycle of *Bathyporeia* spp. The sexes are separate and pair whilst swimming, but there is no prolonged precopula behaviour. Mature females of *Bathyporeia pelagica* may produce a sequence of broods. Whilst one set of embryos develop in the brood pouch, oogonia enlarge in the ovary. Development of an egg to the stage when it is released as a juveniles takes about 15 days, and this cycle is thought to be related to the phases of the moon (Watkin, 1939b; Fish, 1975). Females produce up to 15 eggs (J. Fish, pers. comm.). Two reproductive peaks occur in spring and autumn suggesting that the overwintering population matures slowly and reproduces in the spring, and their progeny mature rapidly over 5 months to reproduce in the autumn of the same year. Fish & Preece (1970) found that between November and February the population of *Bathyporeia pelagica* on a sandy beach at Ynyslas, west Wales, consisted entirely of non-reproducing juveniles. Salvat (1967) recorded a similar generation delay for some populations of species on the west coast of France, but in other regions reported reproduction throughout the year. It is likely that temperature may be an important factor. During the breeding season, gravid females are readily identified by the presence of blue eggs in the brood chamber (Fish & Fish, 1996). The ratio of the sexes in *Bathyporeia pelagica* varies throughout the year unlike *Bathyporeia pilosa* where there is a continuous dominance of females in the population (Fish & Preece, 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	Very high	Low	Moderate

Bathyporeia pelagica lives infaunally in the uppermost 3 cm of sandy substrata. The removal of the substratum would also remove the resident population and therefore intolerance has been assessed to be high. Re-population is likely to be rapid (see additional information below).

	Intolerance	Recoverability	Sensitivity	Confidence
Smothering	Intermediate	High	Low	Moderate

Within amphipod crustaceans the most efficient adaptations of body form for a sand burrowing mode of life have occurred (Maurer *et al.*, 1986). *Bathyporeia pelagica* would probably be unaffected by an additional covering of a sediment of a texture within its habitat preference (fine - medium sand, 0.125-0.5 mm median diameter, Wentworth scale), although there may be an energetic cost incurred by the additional burrowing activity required to attain a near-surface position for feeding and to swim. However, Maurer *et al.*, (1986) observed curtailment of burrowing activity and reduced survivorship in another burrowing amphipod, *Parahaustorius longimerus* (Haustoriidae), when exposed to 'exotic' sediments with a greater silt/clay content. Therefore, *Bathyporeia pelagica* is likely to be more intolerant of smothering by both coarser and finer particles and viscous materials such as oil, through which burrowing is likely to be hindered. Consequently, the intolerance of *Bathyporeia pelagica* to smothering has been assessed to be intermediate. The species is likely to have a high capacity for recovery (see additional information, below).

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

Bathyporeia pelagica is an infaunal species whose feeding is not reliant upon a supply of suspended material, and it is unlikely that its swimming activity would be affected by an increase in the suspended matter in the water column, as it is a regular swimmer in the surf plankton, where the concentration of suspended particles would be expected to be higher (Fincham, 1970a). Furthermore, during the winter, when the species often extends its distribution into the mouths of estuaries, *Bathyporeia pelagica* may encounter concentrations of suspended sediment measurable in grams per litre (benchmark is mg/l) (Cole *et al.*, 1999). However, in turn, as a result of increased suspended sediment, the quantity of material deposited on the substratum surface is likely to increase on the ebb tide. *Bathyporeia pelagica* appears to have a habitat preference for substrata of fine to medium sand with a silt/clay content of <5% (Fish & Fish, 1978). Increased deposition of finer particles may result in changes of the sediment composition, certainly of the surface layers, and could have a smothering effect on the infaunal population (see smothering). However, the effects of accretion of material are addressed under smothering (see above), and as *Bathyporeia pelagica* is a constituent of the surf plankton, intolerance has been assessed as low. The species is likely to have a very high capacity for recovery (see additional information, below).

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

Bathyporeia pelagica is an infaunal species whose feeding is not reliant upon a supply of suspended material. A reduced concentration of suspended matter may be indicative of an alteration of shore topography, resulting in the reduced deposition of material and habitat loss for the species. However, for the period of one month effects are not likely to be significant, and intolerance has been assessed to be low. The species is likely to have an immediate capacity for recovery and re-population (see additional information, below).

Dessication Tolerant Not relevant Not sensitive Moderate

Desiccation is unlikely to prove a lethal factor to a species of an established beach fauna since the risk of drying up follows a regular pattern to which the species have evolved e.g. the development of physiological adaptations to withstand the risk of desiccation (Eltringham, 1971). *Bathyporeia pelagica* is an intertidal species, whose distribution typically extends from above mean tide level (MTL), into the shallow sublittoral on beaches of clean medium to fine sand. Medium to fine-grained sand remains damp throughout the tidal cycle (Connor *et al.* 1997b) and its uppermost distribution on the shore is apparently primarily determined by its intolerance to reduced salinity (Preece, 1970). It is also a mobile species able to migrate from intolerable environmental fluctuations. If *Bathyporeia pelagica* were exposed to a change in desiccation equivalent to a change in position of one vertical zone on the shore, its environmental position and physiology are likely to protect it from the effects of desiccation and *Bathyporeia pelagica* has been assessed not to be intolerant of the benchmark change in desiccation.

Increase in emergence regime Low Very high Very Low Moderate

Bathyporeia pelagica is an intertidal species, found from slightly above the mean tide level (MTL) into the shallow sublittoral, consequently it experiences regular periods of emersion. During periods of emergence, birds such as the ringed plover, *Charadrius hiaticula* and grey plover,*Pluvialis squatarola*, exploit populations of intertidal animals. An additional hour of emergence would allow the birds to feed for longer and the viability of the population of *Bathyporeia pelagica* may be reduced. Intolerance has been assessed to be low, and recovery expected to be very high (see additional information, below).

Decrease in emergence regime Tolerant Not relevant Not sensitive Moderate

Bathyporeia pelagica is an intertidal species that experiences regular periods of immersion and emersion. Its distribution extends into the shallow sublittoral where it remains immersed on all but the lowest spring tides. Therefore *Bathyporeia pelagica* has been assessed to be tolerant of a decrease in emergence.

Increase in water flow rate High High Moderate Low

An increase of two categories in the water flow rate for the duration of one year would probably result in the winnowing away of the finest fraction of sand, leaving a coarser surface layer. *Bathyporeia pilosa*, a closely related species to *Bathyporeia pelagica* (Fish & Fish, 1996), avoided burrowing into substrata with particles > 500µm median diameter (Khayrallah & Jones, 1978a). Thus it is likely that *Bathyporeia pelagica* would become exposed to conditions outside its habitat preference and would probably no longer be found at such a location. Intolerance has been assessed to be high. Recovery has been assessed to be high owing to the species distribution and reproductive pattern (see additional information below), although following return to prior conditions, it may take many months for the deposition of a substratum suitable for colonization by the species e.g. Scott (1960) witnessed the deposition of a sandy beach to take 5 months following its near complete removal during storms.

Decrease in water flow rate High High Moderate Low

A decrease of two categories in the water flow rate for the duration of one year would, in the absence of wave action determining grain size, favour the deposition of finer sand, silts and clays. *Bathyporeia pelagica* demonstrated a habitat preference for clean, medium to fine grained sands with a minimum silt/clay content. Accumulation of finer sediments over the period of a year would alter not only the physical properties of the substratum, but also the chemical properties, especially the degree of oxygenation. *Bathyporeia pelagica* is probably intolerant of poorly oxygenated substrata, and smaller juveniles may be easily smothered by accretion of fine material. Again, assuming that tidal flow rate exerts an influence on sedimentation, *Bathyporeia pelagica* would become exposed to conditions outside its habitat preference and would probably no longer be found at such a location. Intolerance has been assessed to be high. Recovery has been assessed to be high owing to the species distribution and reproductive pattern (see additional information below), although following return to prior conditions, it may take many months for the substratum to obtain characteristics favourable for colonization by the species.

Increase in temperature	Low	High	Low	Moderate

Hayward (1994) states that seawater temperatures vary little between day and night, and seasonal variations tend to be slow and gradual, allowing animals to respond through behavioural changes. However, at low tide air temperature becomes critically important to intertidal animals, and on sandy beaches the habitat, from the surface to a depth of several centimetres, can experience large variations in temperature during a single tidal cycle (Hayward, 1994). For instance, Khayrallah & Jones (1978b) reported the temperature range of sand at a depth of 1 cm during neap tide periods, to be from -2°C in February 1973 to a maximum of 25°C in July 1977. The effects of increased temperature are not necessarily direct, and may be related more to the resultant changes in other factors, especially oxygen (Eltringham, 1971; Hayward, 1994). For interstitial sand dwellers such as *Bathyporeia pelagica*, increased temperatures may be deleterious through an effect on oxygen levels. In the surface layer of the substratum, higher temperatures promote bacterial growth, especially on beaches with a higher organic content e.g. decaying seaweed, so that the interstitial water is rapidly depleted of oxygen for the period before it is replenished by the flood tide. An intolerance assessment of low has been made owing to the fact that the deleterious effects of high temperature upon a species are not necessarily direct, but rather related to the exacerbated influences of other factors e.g. depleted oxygen or salinity change.

Decrease in temperature	Low	High	Low	Moderate

Hayward (1994) states that seawater temperatures vary little between day and night, and seasonal variations tend to be slow and gradual, allowing animals to respond through behavioural changes. However, at low tide air temperature becomes critically important to intertidal animals, and on sandy beaches the habitat, from the surface to a depth of several centimetres, can experience large variations in temperature during a single tidal cycle (Hayward, 1994). For instance, Khayrallah & Jones (1978b) reported the temperature range of sand at a depth of 1 cm during neap tide periods, to be from -2°C in February 1973 to a maximum of 25°C in July 1977, but freezing of sediment was only encountered once in the three year period of study. The effect of an unusually cold winter on the interstitial fauna is a simple physical one, in which body fluids freeze, causing cell and tissue damage. However, whilst low temperature are likely to be physically damaging to interstitial animals, Crisp (1964) reported that other interstitial species of amphipod and isopods seemed to be unharmed by the severe winter of 1962-1963 and intolerance has been assessed to be low.

Increase in turbidity	Tolerant	Not relevant	Not sensitive	Low

Bathyporeia pelagica is infaunal and is not likely to be affected by the light attenuating effects caused by an increase in turbidity.

Decrease in turbidity Tolerant Not relevant Not sensitive Low

Bathyporeia pelagica is infaunal and is not likely to be directly affected by increased light penetration of the water column caused by a decrease in turbidity.

Increase in wave exposure High High Moderate Low

The strength of wave action determines the topography, slope and width of the intertidal. An increase in wave exposure would alter the shore through increased erosion (which may not be compensated for by deposition) and leave a coarser substratum. Intolerance has been assessed to be high owing the potential loss of habitat and the alteration in the nature of the sediment outside the habitat preference of the species. Re-population is likely on return to prior conditions and recoverability has been assessed to be high (see additional information below).

Decrease in wave exposure High High Moderate Low

The hydrodynamic regime has a significant effect on the distribution of sediments of different particle sizes and the slope of the shore. Decreases in wave exposure in relatively sheltered locations, may cause accretion of finer sands and even silt and clays. *Bathyporeia pelagica* demonstrates a habitat preference for clean, medium to fine grained sands with a minimum silt/clay content. Accumulation of finer sediments over the period of a year would alter not only the physical properties of the substratum, but also the chemical properties, especially the degree of oxygenation. *Bathyporeia pelagica* has been assessed to be intolerant of poorly oxygenated substrata, and smaller juveniles may be easily smothered by accretion of fine material. An intolerance assessment of high has been made. On return to prior conditions re-population is likely and recovery has been assessed to be high (see additional information below).

Noise Tolerant Not relevant Not sensitive Low

Bathyporeia pelagica may respond, e.g. wriggle, to vibrations caused by noise, but it is unlikely to be directly sensitive to noise at the benchmark level.

Visual Presence Tolerant Not relevant Not sensitive Low

Bathyporeia pelagica is able to detect changes in light, which influences its endogenous swimming activity, but it is unlikely to have any visual acuity and has been assessed not to be sensitive to this factor.

Abrasion & physical disturbance Tolerant Not relevant Not sensitive Low

Bathyporeia pelagica is infaunal and highly mobile so that is unlikely to be damaged by abrasion caused by the passing scallop dredge. Therefore, it has been assessed as tolerant.

Displacement Tolerant Not relevant Not sensitive High

Bathyporeia pelagica is a mobile species, which leaves the protection of the substratum regularly owing to its endogenous swimming rhythm and buries back into the substratum before low tide (see adult general biology). As displacement is a regular feature in the life of *Bathyporeia pelagica*, it has been assessed to be not sensitive to displacement from the substratum.

Chemical Pressures

Intolerance Recoverability Sensitivity Confidence

Synthetic compound contamination High Moderate Moderate Very low

In general, crustaceans are widely reported to be intolerant of synthetic chemicals (Cole *et al.*, 1999) and intolerance to some specific chemicals has been observed in amphipods. Gammaridean amphipods have been reported to be intolerant of TBT with 10 day LC_{50} values of 1-48ng/l (Meador *et al.*, 1993). Intolerance has been assessed to be high (in the absence of information to the contrary for this species) and recovery moderate owing to the possible persistence of contaminants in the substratum.

Heavy metal contamination Intermediate Moderate Moderate Moderate

For most metals, toxicity to crustaceans increases with decreased salinity and elevated temperature, consequently marine species living within their normal salinity range may be less susceptible to heavy metal pollution than those living in salinities near the lower limit of their salinity tolerance (McLusky *et al.*, 1986).
High concentrations of mercury (Hg) in sediments have been reported by many authors (cited in Khayrallah, 1985). This is a feature which may be of direct importance for epistrate feeders such as *Bathyporeia pelagica* and of indirect importance for its fish and shorebird predators. Khayrallah (1985) investigated the effects of salinity and temperature on the toxicity of two mercuric compounds to *Bathyporeia pilosa*, which is closely related, and has a similar life-cycle to *Bathyporeia pelagica* (Fish & Fish, 1996). Khayrallah (1985) found the organic form (C_2H_5HgCl) to be more toxic than the inorganic form (HgCl) of mercury. The toxicity of both forms of Hg to *Bathyporeia pilosa*, was directly related to increasing concentration (range 0.04-0.75 mg/Hg/l (no sediment)) and temperature (1-20°C), and inversely related to salinity (10 & 20 psu) and age (adults were more tolerant than juveniles). The survival rate of *Bathyporeia pilosa* was found to be dependent on both the salinity and temperature of the medium, the effect being most pronounced in inorganic concentrations of Hg <0.09 mg/Hg /l, suggesting that the lower concentrations of Hg become important only under conditions of stress caused by some other factor. *Bathyporeia pelagica* is intolerant of salinity changes unlike *Bathyporeia pilosa*, so it is possible that *Bathyporeia pelagica* would be more intolerant of sub-lethal concentrations of both organic and inorganic mercury. Recovery is likely to be moderate owing to the possible persistence of contaminants in the substratum.

Hydrocarbon contamination High Moderate Moderate Very low

Amphipods have been reported to be sensitive to oil (Suchanek, 1993). After the *Amoco Cadiz* oil spill there was a reduction in both the number of amphipod species and the number of individuals (Cabioch *et al.*, 1978). Initially significant mortality would be expected, attributable to toxicity and the effects of smothering, therefore intolerance has been assessed to be high. Often populations do not return to pre-spill abundances for 5 or more years, which is most likely related to the persistence of oil within sediments (Southward, 1982), and recovery has been assessed to be moderate.

Radionuclide contamination Not relevant Not relevant

Insufficient information.

Changes in nutrient levels High Moderate Moderate Low

The sandy shore environment favoured by *Bathyporeia pelagica* has a characteristically low level of organic matter. As an epistrate feeder, *Bathyporeia pelagica* feeds upon the film of diatoms and bacteria adhering to individual sand particles. Nutrient enrichment would enhance the growth of episammic diatoms and bacteria as nutrients are probably limiting. A flourishing population of bacteria would utilize oxygen for the oxidization of the resulting organic matter, possibly causing hypoxia. *Bathyporeia pelagica* has been assessed to be intolerant of hypoxic conditions (see oxygenation below). Intolerance has been assessed to be high owing to the fact that an increase in nutrient levels would probably result in the species being exposed to conditions outside its habitat preferences. Recovery has been assessed to be moderate owing to the length of time it may take to return to prior conditions. For instance the normal fauna of clean sandy beaches had only partially recovered after three years after the opening of a sewage works and resultant reduction in organic enrichment in the Firth of Forth (Read *et al.*, 1983).

Increase in salinity High High Moderate Very low

Salinities higher than those of natural seawater are uncommon, although they could occur in surface pools of interstitial water on sand and mud flats in summer owing to surface evaporation. *Bathyporeia pelagica* is a stenohaline species and would be intolerant of exposure to hypersaline conditions, especially in conditions of elevated temperature. However, owing to the relatively well drained nature of the substratum populated by *Bathyporeia pelagica*, pooling of surface water is unlikely. In addition the species can, to some extent, avoid the factor by burrowing deeper into the sediment where changes of salinity are buffered. Therefore, intolerance has been assessed to be low. Recovery has been assessed to be high because it is unlikely that the entire population would be affected, e.g. individuals may burrow deeper into the sediment, and would rapidly attain a pre-impact population following reproduction.

Decrease in salinity Low Immediate Not sensitive High

Bathyporeia pelagica is an intertidal species restricted to the lower half of the tidal range by its intolerance to reduced salinity (Preece, 1970). An intolerance assessment of high would have been given except for the fact that as a mobile species *Bathyporeia pelagica* is able to migrate and avoid conditions of depressed salinity.
Salvat (1967), Fish & Preece (1970), Ladle (1975) and Fish & Fish (1978) have reported both the re-distribution of populations down the shore during spring and summer on open coasts, and the migration of *Bathyporeia pelagica* from sandy estuarine beaches to sites on the open coast. These authors recorded *Bathyporeia pelagica* in the sandy flats at the mouths of estuaries (west Wales and Northumberland) from September through to April, after which time the species disappeared, a pattern which was observed in each subsequent year. Fish & Fish (1978) concluded that the migration pattern was controlled by the combined effects of salinity and temperature, the species being better able to tolerate conditions of reduced salinity at cooler temperatures. Furthermore, although the extent of penetration by *Bathyporeia pelagica* into estuarine sandflats is ultimately limited by its salinity tolerance, populations that do so, are able to exploit the food resources, whether qualitative or quantitative, of the estuary. Fish & Fish (1978) found that in the population of *Bathyporeia pelagica* that over-wintered in the Dovey Estuary, the reproductive output was greater and specimens were larger. An intolerance assessment of low has been made, owing to the lack of evidence for mortalities arising from reduced salinities in the field and that the species is able to migrate. Recovery has been assessed to be immediate because it is unlikely that the entire population would be affected, e.g. individuals may burrow deeper into the sediment or may migrate seawards and would probably rapidly attain a pre-impact population owing to migration and reproduction.

Changes in oxygenation High High Moderate Very low

Brafield (1964) concluded that the most significant factor influencing the oxygenation was the drainage of the beach which, in turn, is controlled by the slope and the particle size. Oxygen depletion becomes a severe problem at all states of the tide on only the very finest grained beaches, and as a general rule, if the percentage of particles of less than 0.25 mm median diameter exceeds 10% of a sand, then the oxygen concentration of its interstitial water will be less than 20% of the air saturation level, and will drop rapidly during low tide periods. Oxygen depletion, variations in salinity and pH result in steep gradients of faunal change through the upper layers of the substrata. The infauna are generally restricted to the uppermost layers, where the interstitial water contains sufficient oxygen for the fauna, and for the oxidization of the organic waste products of the infauna and allochthonous detritus. Laboratory studies by Khayrallah (1977) on *Bathyporeia pilosa*, which is closely related, and has a similar life-cycle to *Bathyporeia pelagica* (Fish & Fish, 1996), revealed *Bathyporeia pilosa* to have a relatively poor resistance to conditions of hypoxia in comparison to other interstitial animals. It was also susceptible to hydrogen sulphide, supporting the conclusion that aerated deposits are a fundamental requirement of *Bathyporeia pilosa* and also probably *Bathyporeia pelagica*. It is likely, therefore, that *Bathyporeia pelagica* would be unable to endure hypoxic conditions for a week, that may result from smothering by impermeable/viscous materials, and intolerance has been assessed to be high.

Biological Pressures

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

No information concerning infestation or disease related mortalities was found.

	Intolerance	Recoverability	Sensitivity	Confidence
Introduction of non-native species		Not relevant		Not relevant

No information concerning non-native species that might affect abundance or survival of *Bathyporeia pelagica* was found.

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

Bathyporeia pelagica is not a species targeted for extraction.

	Intolerance	Recoverability	Sensitivity	Confidence
Extraction of other species	Intermediate	Very high	Low	Moderate

The cockle, *Cerastoderma edule*, is found in both muddy and clean sands, although it is frequently more abundant in the former. Specimens of marketable size may be harvested more efficiently using mechanical methods, such as tractor-powered harvesters and suction dredgers than by traditional methods. Ferns *et al*., (2000) examined the effects of a tractor-towed cockle harvester on the benthic invertebrates and predators of intertidal plots of muddy and clean sand. Harvesting resulted in the loss of a significant proportion of the most common invertebrates from both areas. In the muddy sand, the population of a similar species, *Bathyporeia pilosa* remained significantly depleted for more than 50 days, whilst the population in clean sand recovered more quickly. It is therefore likely that *Bathyporeia pelagica* would be similarly affected by the mechanical extraction of marketable shellfish in locations where populations co-occur. Intolerance has been assessed to be intermediate owing to the likelihood of a proportion of the population being killed and the reduced abundance of the remaining population. Recovery has been assessed to be very high owing to the likelihood of migration from other areas on the shore.

Additional information

Recoverability

Bathyporeia pelagica is likely to have a high to very high capacity for recovery from many factors of disturbance. It is a widespread and common species which produces two generations within a year.

In addition, as a mobile species, *Bathyporeia pelagica* has demonstrated an ability to avoid environmental fluctuations e.g. reduced salinity and increasing temperature, to which it is intolerant by migration (Fish & Fish, 1978; Ladle, 1975; Fish & Preece, 1970).

Importance review

Policy/legislation

- no data -

Status

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

Non-native

Native	-		
Origin	-	**Date Arrived**	-

Importance information

Bathyporeia pelagica, *Eurydice pulchra* and various polychaetes such as *Arenicola marina*, form an important component of the diet of shore birds such as ringed, *Charadrius hiaticula* and grey plovers,*Pluvialis squatarola*. The plovers detect and catch prey by watching for, and exploiting the brief periods of surface activity. When such activity is low the birds use foot-vibration to stimulate movement of these animals, making them visible (Pienkowski, 1983).

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