Speckled sea louse (*Eurydice pulchra*)

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

Georgina Budd

2007-06-28

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/1663]. All terms and the MarESA methodology are outlined on the website (https://www.marlin.ac.uk)

This review can be cited as:
Budd, G.C. 2007. *Eurydice pulchra* Speckled sea louse. In Tyler-Walters H. and Hiscock K. (eds) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. DOI https://dx.doi.org/10.17031/marlinsp.1663.2

(page left blank)

Eurydice pulchra.
Photographer: Marine Ecological Surveys Ltd
Copyright: Marine Ecological Surveys Ltd

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	**Refereed by**	This information is not refereed.
Authority	Leach, 1815		
Other common names	-	**Synonyms**	-

Summary

Description

A small and distinctive 'louse-like' isopod. The body is flattened with an oval outline. It has large eyes, positioned laterally and a long second pair of antennae. It may be pale grey to brown in colour, with black spots covering all surfaces of the body.

Recorded distribution in Britain and Ireland

Widespread on open coast and estuarine sandy beaches, with reduced abundance in south-east England.

Global distribution

Eurydice pulchra is found from Norway and the outer Baltic to the Atlantic coast of Morocco, but not in the Mediterranean (Soika, 1955).

Habitat

Found in the intertidal zone, on fine to medium grained sandy shores. *Eurydice pulchra* occupies a middle shore zone, but its distribution shifts up shore on spring tides and down shore on neap tides.

Depth range

-

Identifying features

- Chitinous body dorso-ventrally flattened, up to 8 mm in length.
- Thorax broader than abdomen giving oval outline.
- Large lateral eyes.
- One pair of short antennae, second pair about two thirds of body length, with 4 segments in basal region.
- All thoracic (pereon) segments except the first, have conspicuous lateral expansions (Coxal plates).
- Coxal plate on 6th thoracic segment, extends sharply backwards.
- Telson (tail piece) is rounded, fringed with long setae, flanked on each side by two short spines.
- Uropods (flat plates) lie on underside of tail piece and conceal pleopods (respiratory plates, that also beat to create a current of water for swimming).
- Pale grey or brown in colour.
- Black spots (chromatophores) on upper and lower surface of body, and along the sides are particularly characteristic.

Additional information

British coastal isopods have been described by Naylor (1972, 1990). A second intertidal species of *Eurydice*, *Eurydice affinis* Hansen, is also found on British shores. It is distinguished from *Eurydice pulchra* by an overall paler appearance, with black spots only on its dorsal surface. In Britain it has a more restricted distribution than *Eurydice pulchra*, from south-west England into North Wales, where it occurs amongst populations of *Eurydice pulchra*.

Listed by

Further information sources

Search on:

NBN WoRMS

Biology review

Taxonomy

Phylum	Arthropoda	Arthropods, joint-legged animals, e.g. insects, crustaceans & spiders
Order	Isopoda	Sea slaters and gribbles
Family	Cirolanidae	
Genus	Eurydice	
Authority	Leach, 1815	
Recent Synonyms	-	

Biology

Typical abundance	
Male size range	<8mm
Male size at maturity	5.0mm
Female size range	5.9mm
Female size at maturity	
Growth form	Articulate
Growth rate	0.3mm/month
Body flexibility	High (greater than 45 degrees)
Mobility	
Characteristic feeding method	Predator, Scavenger
Diet/food source	
Typically feeds on	Other infaunal invertebrates associated with sandy shores and dead organic material.
Sociability	
Environmental position	Infaunal
Dependency	Host for.
Supports	No information found
Is the species harmful?	No

Biology information

Feeding
Eurydice pulchra is a highly predatory carnivore, its mouthparts are adapted for tearing and macerating animal tissue (Naylor, 1972).
Endogenous swimming rhythm
Eurydice pulchra has been shown to have an endogenously controlled circatidal rhythm cycle of swimming that is coupled to a circasemilunar pattern of emergence from the substratum (Alheit & Naylor, 1976; Jones & Naylor, 1970).
On the beach, the animals rely on the cue of increasing water agitation caused by the flood tide to swim from the sand, the endogenous component of the rhythm ensuring that they swim for up to 5-6 hours before reburying in the sand in a restricted zone between mean tide level (MTL) and high water neaps (HWN).

Eurydice pulchra swims mostly at night. Animals emerging from the sand, or washed out by turbulence during the day show photonegative behaviour and immediately bury themselves again.

Habitat preferences

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

Habitat Information

Population densities
Eurydice pulchra populations may occur at densities of 1500 per m^2 or more and, on a South Wales beach studied by Jones (1970b), the population exceeded 4000 per m^2.
Intertidal distribution
Eurydice pulchra lives on the upper half of the shore, generally being most abundant between mean tide level (MTL) and mean high water of neap tides (MHWN). *Eurydice pulchra* relies upon the cue of increasing wave action caused by the flood tide (Jones, 1970b) to initiate swimming from the substratum. It swims in search of food, and buries itself in the sand again as the tide ebbs. As the fortnightly spring tides carry water further up the shore, so *Eurydice pulchra* moves up, and it can be found in the sand right up to the mean high water of spring tides. When the tidal cycles swings again towards neaps, the *Eurydice* population also moves down shore again, and avoids being stranded above the neap high water mark (Fish, 1970).

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	March - August
Life span	1-2 years

Larval characteristics

Larval/propagule type	-
Larval/juvenile development	Ovoviviparous
Duration of larval stage	Not relevant
Larval dispersal potential	100 -1000 m
Larval settlement period	Not relevant

Life history information

Fecundity

The number of eggs carried by females of *Eurydice pulchra* was reported to vary in populations from different localities. In a population from the Dovey Estuary, west Wales, Fish (1970) observed the total number of eggs in any one female to vary between 22 to 54. Jones (1970) found that small females, 4.5 mm body length, carried a minimum of 10 eggs, whilst larger females, 7 mm body length, carried up to 40 eggs. In France, Salvat (1966) reported females of 6.0 mm body length to carry at least 45 eggs.

Reproduction

Fish (1970) and Jones (1970) describe the reproductive cycle of two British populations of *Eurydice pulchra* from an estuarine and open coast location respectively. Some differences concerning the duration of the breeding period, number of eggs carried by females of a particular size were found. The sexes are separate and pair whilst swimming. Development of the embryo occurs within the internal brood pouch (marsupium) of the female, and the incubation period takes 7-8 weeks. Embryonic development is similar to that for other isopods (Forsman, 1944; Kjennerud, 1950; Naylor, 1955b, cited in Fish, 1970), and four distinct stages are recognised, the last stage being a miniature version of the adult. The minimum recorded length of newly emerged juveniles is 1.7 mm and they are able to swim and feed immediately.

Early broods released during July were reported by Jones (1970), to reach maturity before winter within the same year, breed early during the following spring and consequently provide the first broods of that year, before dying in their second autumn after a total lifespan of approximately 15 months. Broods released in August and September, initially grew as rapidly as the early spring brood but did not reach maturity and consequently overwintered as juveniles. overwintering juveniles matured as late as July and themselves produced the late broods of the following year. In contrast, on the west coast of Wales, sexually immature specimens of *Eurydice pulchra* overwintered twice and took 20 months to attain sexual maturity, produced only one brood per year and had a lifespan of about 2 years (Fish, 1970). Furthermore, Salvat (1966) reported a population of *Eurydice pulchra* from Arcachon, France, to have an annual reproductive cycle with sexual maturity being reached within 8 months. It is suspected (Fish, 1970; Jones, 1970; Salvat, 1966), that these variations in reproductive life cycle are related to the significant temperature differences between localities. The effect of temperature being reflected in the duration of the post-hatching growth stages, which are accelerated at higher temperatures.

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	High

During its inactive (non-feeding) phase *Eurydice pulchra* buries infaunally in the uppermost 10 cm of sandy substrata, and the removal of the substratum would also remove the resident population. Intolerance has been assessed to be high. It is likely that the species would re-populate on return to prior conditions, including by immigration, and recovery has been assessed to be very high.

	Intolerance	Recoverability	Sensitivity	Confidence
Smothering	High	High	Moderate	High

Eurydice pulchra would probably be unaffected by an additional covering of sediment of a texture within its preference. In an experiment to determine if *Eurydice pulchra* was selective of substratum particle size, Jones (1970b) observed *Eurydice pulchra* to demonstrate a strong preference for coarse particles (1.0 - 0.5 mm median diameter). It is likely that the grade of the substratum is an important factor determining the zonation and relative geographical distribution of the species. Jones (1970b, Table 6) also observed differences in the speed of burrowing and depth attained by *Eurydice pulchra*, which varied according to particle size. In the finest grades of particles (0.157 - 0.031 mm median diameter (silts, Wentworth scale)), *Eurydice pulchra* made little progress in its attempts at burial, achieving a depth of only 1 cm after 3 hours. Thus if *Eurydice pulchra* experienced difficulty when trying to bury into finer substrata, it is also likely that it would experience difficulty in burying out after smothering by fine particulate matter and would have to rely on displacement by tidal wave action. Furthermore, smothering by fine particulate matter would not only alter the physical properties of the substratum, but also the chemical properties, especially the degree of oxygenation. *Eurydice pulchra* was considered to be intolerant of poorly oxygenated substrata (see oxygenation below), and smaller juveniles may be easily smothered by accretion of fine material. Therefore *Eurydice pulchra* has been assessed to have a high intolerance to smothering by fine particulate matter and viscous materials such as oil, through which burrowing is likely to be hindered and cause changes to the habitat which are outside the species preference. The species is likely to have a high capacity for recovery on return to prior conditions (see additional information below).

	Intolerance	Recoverability	Sensitivity	Confidence
Increase in suspended sediment	Tolerant	Not relevant	Not sensitive	Low

It is unlikely that the swimming and hunting activity of *Eurydice pulchra* would be affected by an increase in the suspended matter in the water column for a period of one month, as it is a regular swimmer in the surf plankton, where the concentration of suspended particles would be expected to be higher and variable according to the strength of wave action. The species has been assessed to be tolerant. The resultant light attenuation effects have been addressed under turbidity, end the effects of rapid settling out of suspended sediment have been addressed under smothering.

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

Eurydice pulchra is a regular swimmer in the surf plankton, where the concentration of suspended sediment would be expected to be variable according to wave action. The resultant light attenuation effects have been addressed under turbidity.

Dessication Tolerant* Not relevant Not sensitive High

Should the species be stranded, it is likely to be adversely affected by desiccation. However, 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 behavioural and/or physiological adaptations (Eltringham, 1971). *Eurydice pulchra* is an intertidal species which lives on the upper half of the shore, generally being most abundant between mean tide level (MTL) and mean high water of neap tides (MHWN). It relies upon the cue of increasing wave action caused by the flood tide (Jones, 1970b) to initiate swimming from the substratum. It swims in search of food, and buries itself in the sand again as the tide ebbs. As the fortnightly spring tides carry water further up the shore, so *Eurydice pulchra* moves up, and it can be found in the sand up to the mean high water of spring tides. When the tidal cycles swings again towards neaps, the *Eurydice* population also moves downshore, and avoids being stranded above the neap high water mark (Fish, 1970), the synchronisation with the tide is maintained by its endogenous rhythm (see adult general biology). Therefore the behaviour of *Eurydice pulchra* is likely to prevent it from being exposed to the benchmark change (see benchmark) in desiccation, and it has been assessed to be tolerant.

Increase in emergence regime Intermediate Very high Low Moderate

Eurydice pulchra is an intertidal, infaunal species, that is most abundant between mean tide level (MTL) and mean high water of neap tides (MHWN), 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 (Pienkowski, 1983). An additional hour of emergence may allow the birds to feed for longer and the viability of the population, especially where it occurs in lower abundance, may be reduced. Intolerance has been assessed to be intermediate, and recovery expected to be very high (see additional information below).

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

Eurydice pulchra is an intertidal species, which during periods of immersion swims amongst the surf plankton in order to hunt for food (see general biology). Consequently, an additional hour of immersion may benefit the species and it has been assessed to be not sensitive.

Increase in water flow rate High Very high Low Low

Eurydice pulchra demonstrated a preference for specific grades of sandy substrata (Jones, 1970b) (see smothering above). It is likely that *Eurydice pulchra* would be highly intolerant of an increase of two categories in the water flow rate for the duration of one year, e.g. owing to a straightening of channel flow over the sand flats at an estuary mouth. Although the species may not be directly exposed to the increased current, the effect would probably be to cause a redistribution/reduction of suitable substrata and the species population may become restricted or lost from a location. Re-population of an area is likely on return to prior conditions, and recovery has been assessed to be very high (see additional information below).

Decrease in water flow rate High Very high Low Low

Eurydice pulchra demonstrated a preference for specific grades of sandy substrata (Jones, 1970b) (see smothering above). It is likely that *Eurydice pulchra* would be highly intolerant of a decrease of two categories in the water flow rate for the duration of one year, e.g. channel flow over the sand flats becoming more sinuous, sea defences shielding beaches. Although the species may not directly experience the decreased current, the effect would probably be to cause accretion of finer particulate matter to which the species is intolerant e.g. smothering (see smothering above). Re-population of an area is likely on return to prior conditions, and recovery has been assessed to be very high (see additional information below).

Increase in temperature	Low	High	Low	Moderate

The geographic range of *Eurydice pulchra* extends to the south of Britain and Ireland, suggesting that the species would be tolerant of a long term chronic change in temperature of 2°C. At low tide air temperature becomes critically important to intertidal animals, and on sandy beaches the substratum, from the surface to a depth of several centimetres, can experience large variations in temperature during a single cycle and throughout the year (Hayward, 1994). For instance, Khayrallah & Jones (1978b) reported the temperature range of sand at a depth of 1 cm during neap tides to be from -2°C in February 1973, to a maximum of 25°C in July 1977. Jones (1970b) observed some differences in survival rate in *Eurydice pulchra* in response to extreme temperatures e.g. individuals started dying after 18 hours at 30°C and all specimens died after 12 hours at 38°C (fully aerated seawater). The effects of a temperature increase on the species are not necessarily direct and may be related more to the resultant changes in other factors, especially oxygen (Hayward, 1994; Eltringham, 1971). For infaunal sand dwellers, such as *Eurydice pulchra*, increased temperatures may become stressful through an effect upon oxygen levels, owing to enhanced bacterial growth and utilization of oxygen. However, since *Eurydice pulchra* prefers coarse grained, typically well oxygenated sand, oxygen is unlikely to become limiting in the period between low and high tide. In view of the experiment showing survival at high temperatures, the evidence of high temperatures in the usual habitat of *Eurydice pulchra* and the coarse well oxygenated nature of the sediment, intolerance has been assessed to be low.

Decrease in temperature	Low	High	Low	Moderate

The geographic range of *Eurydice pulchra* extends to the north of Britain and Ireland, suggesting that the species would be tolerant of a long term chronic change in temperature of 2°C.
At low tide air temperature becomes critically important to intertidal animals, and on sandy beaches the substratum, from the surface to a depth of several centimetres, can experience large variations in temperature during a single cycle and throughout the year (Hayward, 1994). For instance, Khayrallah & Jones (1978b) reported the temperature range of sand at a depth of 1 cm during neap tides to be from -2°C in February 1973, to a maximum of 25°C in July 1977. In the winter, *Eurydice pulchra* migrates into the sublittoral zone, thus escaping extreme temperatures (Jones, 1970b), a factor perhaps in part responsible the high survival rate of the species after the severe winter of 1962-1963 (Crisp, 1964). Intolerance has been assessed to be low as there is no evidence to suggest that the population would killed by decreased temperatures.

Increase in turbidity	Tolerant*	Not relevant	Not sensitive*	Low

The light attenuating effects of an increase in turbidity may be beneficial to *Eurydice pulchra* during its active feeding phase. In the clearer waters of south-west France, Salvat (1966) noted that the feeding activity of *Eurydice pulchra* was suppressed during daylight. The isopod appeared in greater abundance on the night time tide, possibly as a behavioural mechanism to avoid predation by fish that hunt intertidally by sight. *Eurydice pulchra* has been assessed as tolerant of an increase in turbidity.

Decrease in turbidity	Low	Very high	Very Low	

In British waters *Eurydice pulchra* feeds during high tide, both day and night, relying upon the wave action of the flood tide to wash it out of the sand. A decrease in turbidity, perhaps associated with reduced wave action, may allow fish that hunt by sight to prey upon *Eurydice pulchra* more efficiently. Intolerance has been assessed to be intermediate. Recovery has been assessed to be very high (see additional information below).

Increase in wave exposure	High	Very high	Low	Moderate

Whilst wave action operates indirectly upon small infaunal animals during their inactive phase through its control of particle size and beach oxygenation, wave action also has a direct effect upon them during their active phase (Jones, 1970b). The active feeding phase is initiated as the rising tide reaches the sand in which the isopod is buried (Elmhirst, 1932; Watkin 1942; Salvat, 1966). In trying to confirm that wave action controls the emergence of *Eurydice pulchra*, Jones (1970b) found a direct relationship between the numbers of *Eurydice pulchra* swimming and the height of the waves. The depth of disturbance of sand by a wave is in direct proportion to its height, providing that the slope and the median particle size of the sand remain constant. King (1959) calculated that for a beach with a median grain diameter of 0.23 mm there is an approximate increase of 1 cm depth for every 1 ft of wave height, and that for a beach with a median grain diameter of 0.4 mm the increase of disturbance is about 3 cm depth for every 1 ft of wave height. Since *Eurydice pulchra* relies upon wave action to initiate swimming, it occurs in greatest abundance within the range of deepest penetration by wave action. The beaches populated by *Eurydice pulchra* tend to be moderately exposed in the first instance (see distribution) and the benchmark increase would result in the exposure of *Eurydice pulchra* to very wave exposed conditions. A greater proportion of the population would be washed out as the waves eroded the substratum. Whilst the higher concentration of suspended particulate matter and prey items resulting from the increased turbulence may result in enhanced feeding, ultimately the nature of the substratum would change becoming coarser and forming deposits of gravel or shingle rather than sand, creating conditions outside the species habitat preference. Intolerance has been assessed to be high as the species would probably no longer be found. Recovery has been assessed to be very high, for instance, at Village Bay in St Kilda, an island group far out into the Atlantic west of Britain, an expanse of sandy beach was removed offshore as a result of winter storms to reveal an underlying rocky shore (Scott, 1960). Yet in the following summer the beach was gradually replaced when wave action was less severe. *Eurydice pulchra* was a species reported to be a frequent member of the re-colonizing fauna, its recovery being aided by the ability to survive in the shallow sublittoral zone where substrata may be deposited.

Decrease in wave exposure	High	Very high	Low	Moderate

Whilst wave action operates indirectly upon small infaunal animals during their inactive phase through its control of particle size and beach oxygenation, wave action will also have a direct effect upon the species during their active phase (Jones, 1970b) (see increase in wave exposure for additional information). The beaches populated by *Eurydice pulchra* tend to be moderately exposed in the first instance (see distribution) and the benchmark decrease would decrease exposure to very sheltered conditions. A smaller proportion of the population would be washed from the substratum on each flood tide, consequently limiting feeding activity. Jones (1970b) suggested that reduced wave action resulting in shortened available feeding times, allowed *Eurydice affinis* to compete more successfully with *Eurydice pulchra* on semi-exposed beaches in Britain and Ireland. In addition, the nature of the substratum would change becoming finer with deposits of finer sands and silts (see smothering). Intolerance has been assessed to be high owing to the creation of conditions outside the habitat preference of *Eurydice pulchra*. Recovery has been assessed to be very high on return to prior conditions (see additional information, below).

Noise Tolerant Not relevant Not sensitive Low

Eurydice pulchra may respond 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

Eurydice pulchra is able to detect changes in light. During the day, if disturbed, the species demonstrates photonegative behaviour and immediately buries back into the sand. Furthermore, as a predator it probably has sufficient visual acuity to distinguish between prey items in the surf plankton. However, at the benchmark level, it is unlikely that *Eurydice pulchra* would be sensitive to the visual presence of boats, machinery or humans, and has been assessed to be not sensitive.

Abrasion & physical disturbance Tolerant Not relevant Not sensitive Low

Eurydice pulchra is a small, infaunal but highly mobile species that is regularly washed from the substratum by wave action of the flood tide and re-buries itself on the ebb tide. It is unlikely to be damaged by a passing scallop dredge or similar effect since it can readily avoid the impact and/or pass through the dredge, only to rebury rapidly. Therefore, it has been assessed as tolerant.

Displacement Tolerant Not relevant Not sensitive High

Eurydice pulchra is a mobile species, which is regularly washed from the substratum by wave action of the flood tide and swims in response to its circasemilunar endogenous rhythm, it re-buries itself on the ebb tide. As displacement is a regular feature in the life of *Eurydice pulchra* it has been assessed to be not sensitive to displacement from the substratum.

Chemical Pressures

	Intolerance	Recoverability	Sensitivity	Confidence
Synthetic compound contamination	High	Very high	Low	Moderate

In general, crustaceans are widely reported to be sensitive to synthetic chemicals (Cole *et al.*, 1999). Powell (1979) infers from the known susceptibility of Crustacea to synthetic chemicals and other non-lethal effects, that there would probably also be a deleterious effect on isopod fauna as a direct result of synthetic chemical application.
Following the *Torrey Canyon* tanker oil spill (March, 1967), shore-spraying operations exposed intertidal animals to very high concentrations of the detergent BP 1002 for several hours. Smith (1968) conducted toxicity experiments and found that the concentration required to kill all *Eurydice pulchra* in 24 hours was 10 mg/BP 1002/l at 12°C. At 5 mg/BP 1002/l four out of five specimens survived when transferred to clean water, while all survived at lower concentrations. On Mawgan Porth beach, Cornwall, a concentration of 4 mg/BP 1002/l was found in seawater at either end of the bay on an incoming tide for at least 24 hours after spraying. However, it became apparent that some of the population of *Eurydice pulchra* had survived, despite exposure to lethal concentrations both in the sea water and in the sand, as specimens were collected during May 1967. The species had repopulated the entire beach by August of the same year. Recovery within 4 months may have been aided by the fact that during the summer *Eurydice pulchra* would have spent twice daily periods in almost uncontaminated water.
Other oil dispersing compounds, were found to be toxic to two other species of isopod. Kaim-Malka (1972a, b,c, cited in Powell, 1979) tested the tolerance of *Idotea baltica* and *Sphaeroma*

serratum to various non-ionic detergents (which do not dissociate in solution to any significant degree) ranging from 0.1 to 800 mg/l. The individual detergents affected the two isopods differently: (a) acid-and ester-base detergents, inactive against *Idotea baltica*, were lethal to *Sphaeroma serratum* at concentrations of 10 to 25 mg/l; (b) ether-base detergents were four times more toxic to *Idotea baltica* than to *Sphaeroma serratum*; (c) alcohol-function detergents were twice as toxic to *Sphaeroma serratum* than to *Idotea baltica*; and (d) alkyl-aryl polyoxyethelenes were ten times more toxic to *Idotea baltica* as to *Sphaeroma serratum*. Thus it is apparent that different isopod suborders differ greatly in their susceptibility to synthetic detergent formulas and that this may be related to their physiology (Powell, 1979). Consequently, owing to the diversity of chemicals to which *Eurydice pulchra* may be exposed and the intolerance of crustaceans in general, intolerance has been assessed to be high. Recovery has been assessed to be very high owing to the evidence of Smith (1968) when *Eurydice pulchra* repopulated a shore within 5 months following exposure to a chemical detergent.

Heavy metal contamination	Intermediate	Moderate	Moderate	Moderate

Jones, (1975b; 1973) found that mercury (Hg) and copper (Cu) react synergistically with changes in salinity and temperature, resulting in increased toxicity of the metals to marine and brackish water isopods. In an extensive study of six species of isopod, including *Eurydice pulchra*, Jones (1975) examined mortality caused by Cadmium (Cd) at two temperatures (5 & 10°C), two concentrations (10 and 20 mg/l), and at seven salinities (0.34-34psu). Maximum mortality for *Eurydice pulchra* occurred at the lowest salinities (20.4 & 13.6 psu) at both concentrations and at the higher temperature. At full salinity (34psu) at 5°C, with 10 mg/Cd/l 60% of *Eurydice pulchra* died within 4 days. However, *Eurydice pulchra* was more tolerant of zinc (Zn) at concentrations of 10 and 20 mg/Zn/l, even at the higher temperature of 10°C. Whilst the concentrations of heavy metals used in the work by Jones (1975, 1975b) are higher than those typically occurring in British waters (e.g. Preston (1973) gives values for heavy metal 'hotspots' e.g. Severn Estuary 7.7 µg/Cd/l and 26.6 µg/Zn/l; Tyne-Tees 0.8µg/Cd/l and 11.7 µg/Zn/l), the point was to obtain a comparative study of species over a short time scale. However, Jones (1975) suggested that owing to the accumulative nature of heavy metals, his experiments would provide a reasonable basis for predictions about the comparative effects of various metals at lower environmental concentrations. Intolerance has been assessed to be intermediate owing to the fact that alterations in salinity and temperature influence the effects of heavy metals on the species. The entire population may not be killed but could experience sublethal effects which may reduce the viability of the population. Recovery has been assessed to be moderate owing to the possible persistence of contaminants in the substratum.

Hydrocarbon contamination	Intermediate	Moderate	Moderate	Moderate

Toxic effects:
A proportion of the population of *Eurydice pulchra* on Mawgan Porth beach, Cornwall, was reported to survive the oil pollution caused by the *Torrey Canyon* tanker spill. In addition the population was observed to have recovered by the summer of the same year (Smith, 1968) (see synthetic chemicals above). However, evaluation of hydrocarbon toxicity impacts alone from the *Torrey Canyon* spill are nearly impossible owing to the quantity of dispersants used (at a ratio of 10,000 tons of dispersant to 14, 000 tons of oil) to disperse the oil (Suchanek, 1993).
Physical effects:
The crude oil from the *Torrey Canyon* washed into the sandy bays of Cornwall in drifts between 3-6 cm thick. Some sank into the sand, creating sticky layers, through which *Eurydice pulchra* would not be able to burrow (see smothering, above). Such areas of oil contaminated sand

were scooped up and dumped inland (see substratum removal). Wave action also frequently buried untreated layers of brown oil a few centimetres under the surface and deeper, and the development of grey layers in the sand became an abnormal and conspicuous feature of oil contaminated beaches (Smith, 1968). The beaches populated by *Eurydice pulchra* are clean with a very low content of organic detritus, and, being generally devoid of silt, the sands are mobile and well aerated. The presence of a grey sulphide layer following oil contamination suggests that the interstitial oxygen concentration became limiting owing to oxidisation by bacteria. *Eurydice pulchra* is likely to be intolerant of a decrease in oxygenation of the substratum (see oxygenation, below). However, large individuals of *Eurydice pulchra* were also found at Sennen, Cornwall, during August of 1967, despite markedly grey layers in the sand below them (Smith, 1968). The intolerance of *Eurydice pulchra* to hydrocarbon contamination has been assessed to be intermediate owing to evidence for the reduced abundance of the species and the additive but indirect effects arising from the type of clean up operations that might be employed on a sandy shore following an oil spill.

Radionuclide contamination		Not relevant		Not relevant

Insufficient information.

Changes in nutrient levels	High	Moderate	Moderate	High

The sandy shore environment inhabited by *Eurydice pulchra* has a characteristically low level of organic matter. Enhanced levels of organic matter would usually increase the secondary production of the shore, and on sandy shores organic enrichment may be revealed by a shift in species composition towards polychaetes and oligochaetes (Pearson & Rosenberg, 1978). However, the effects of organic enrichment are usually seen earlier and more obviously in meiofaunal populations. From survey work by Read *et al.* (1983) it may be inferred that *Eurydice pulchra* had a high intolerance to organic enrichment in the Firth of Forth, as it became established on the beaches of Seafield East and Portobello, only after the introduction of a new sewage treatment scheme for Edinburgh, which reduced the suspended solids content of the liquid effluent by 60%. Recovery has been assessed to be moderate owing to the fact that partial recovery occurred within five years, the pollution community was reduced to isolated patches and gradually replaced by species previously found, in the ten year period after the opening of the sewage works.

Increase in salinity	Low	High	Low	Low

Salinities higher than those of natural seawater are less common, although they can occur in surface pools of interstitial water on sand and mud flats in summer owing to surface evaporation. However as a burrower *Eurydice pulchra* is probably sufficiently mobile to avoid increased surface salinities resulting from evaporation and intolerance has been assessed to be low.

Decrease in salinity	Intermediate	Very high	Low	High

Jones (1970b) conducted salinity tolerance experiments with *Eurydice pulchra* and found that to some extent the species was euryhaline, tolerating a reduced salinity of 17psu for up to 5 days before death. Therefore, the species is likely to be highly intolerant of an acute change in salinity of two categories, from full salinity to low salinity (< 18psu) for the period of a week. However, an intolerance assessment of intermediate has been made owing to the fact that *Eurydice pulchra* is a mobile species and may avoid conditions outside its tolerance by migration e.g. Salvat (1966) observed the abundance of *Eurydice* spp. to decline where a freshwater stream crossed a beach in France. Recovery has been assessed to be very high (see additional information, below).

	Intolerance	Recoverability	Sensitivity	Confidence
Changes in oxygenation	High	High	Moderate	Low

Brafield (1964) concluded that the most significant factor influencing the oxygenation is the drainage of the beach which, in turn, is determined by the slope and particle size. Oxygen depletion becomes a severe problem at all states of the tide on only the finest grained beaches and as a general rule, if the percentage of particles of less than 0.25 mm in 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.
Jones (1970b) investigated the oxygen requirements of *Eurydice pulchra*. Its respiration rate was high in comparison with some other isopods, although not excessive when the small size and high activity rates of the species was taken into consideration. Jones (1970b) concluded that since the preferred habitat of *Eurydice pulchra* is generally well oxygenated, owing to the low percentage of fine sand, absence of silts and organic matter, that in normal conditions oxygenation had little influence upon its distribution. Thus it is unlikely that the species would be able to tolerate conditions of hypoxia for a week and intolerance has been assessed to be high. Recovery has been assessed to be high (see additional information below).

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 was found.

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

Eurydice pulchra is not a species targeted for extraction.

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

No other species are extracted from the habitat of *Eurydice pulchra*.

Additional information

Recoverability

Eurydice pulchra is likely to have a high capacity, and even very high in some instances, for recovery from many factors of disturbance. It is a widespread and abundant species, occurring at densities of up to and over 1500 per m^2 so it is probably likely that a proportion of the population may survive an impact. In addition the population structure consists of three distinct overlapping cohorts which reach maturity at different stages (see reproduction and longevity). Furthermore, as a swimmer in the high tide surf plankton the species has the potential for migration and Elmhirst (1931) showed that during the winter, populations of *Eurydice pulchra* often migrate downshore into the shallow water below low water springs in order to seek shelter from disturbance.

Importance review

Policy/legislation

- no data -

Status

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

Non-native

Native	-		
Origin	-	**Date Arrived**	-

Importance information

Eurydice pulchra, *Bathyporeia pelagica* and various polychaetes such as *Arenicola marina*, form an important component of the diet of shore birds such as the ringed plover, *Charadrius hiaticula*, and the grey plover, *Pluvialis squatarola*. The plovers detect and catch their 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, in order to make them visible (Pienkowski, 1983).

Bibliography

Alheit, J. & Naylor, E., 1976. Behavioural basis of intertidal zonation in *Eurydice pulchra* Leach. *Journal of Experimental Marine Biology and Ecology*, **23**, 135-144.

Brafield, A.E., 1964. The oxygen content of interstitial water in sandy shores. *Journal of Animal Ecology*, **33**, 97-116.

Cole, S., Codling, I.D., Parr, W. & Zabel, T., 1999. Guidelines for managing water quality impacts within UK European Marine sites. *Natura 2000 report prepared for the UK Marine SACs Project.* 441 pp., Swindon: Water Research Council on behalf of EN, SNH, CCW, JNCC, SAMS and EHS. [UK Marine SACs Project.], http://www.ukmarinesac.org.uk/

Elmhirst, R., 1932. Quantitative studies between tidemarks. *Glasgow Naturalist*, **10**, 56-62.

Eltringham, S.K., 1971. *Life in mud and sand*. London: The English Universities Press Ltd.

Fish, J.D. & Fish, S., 1996. *A student's guide to the seashore.* Cambridge: Cambridge University Press.

Fish, S., 1970. The biology of *Eurydice pulchra* (Crustacea: Isopoda). *Journal of the Marine Biological Association of the United Kingdom*, **50**, 753-768.

Hayward, P., Nelson-Smith, T. & Shields, C. 1996. *Collins pocket guide. Sea shore of Britain and northern Europe.* London: HarperCollins.

Hayward, P.J. & Ryland, J.S. (ed.) 1995b. *Handbook of the marine fauna of North-West Europe.* Oxford: Oxford University Press.

Hayward, P.J. 1994. *Animals of sandy shores.* Slough, England: The Richmond Publishing Co. Ltd. [Naturalists' Handbook 21.]

Howson, C.M. & Picton, B.E., 1997. *The species directory of the marine fauna and flora of the British Isles and surrounding seas.* Belfast: Ulster Museum. [Ulster Museum publication, no. 276.]

Jones, D.A. & Naylor, E., 1970. The swimming rhythm of the sand beach isopod *Eurydice pulchra*. *Journal of Experimental Marine Biology and Ecology*, **4**, 188-199.

Jones, D.A., 1970. Population densities and breeding in *Eurydice pulchra* and *Eurydice affinis* in Britain. *Journal of the Marine Biological Association of the United Kingdom*, **50**, 635-655.

Jones, D.A., 1970b. Factors affecting the distribution of the intertidal isopods *Eurydice pulchra* Leach and *E. affinis* Hansen in Britain. *Journal of Animal Ecology*, **39**, 455-472.

Jones, M.B. & Naylor, E., 1967. The distribution of *Eurydice* (Crustacea: Isopoda) in British waters, including *E. affinis* new to Britain. *Journal of the Marine Biological Association of the United Kingdom*, **47**, 373-382.

Jones, M.B., 1973. Influence of salinity and temperature on the toxicity of mercury to marine and brackish water isopods (Crustacea). *Estuarine and Coastal Marine Science*, **1**, 425-431.

Jones, M.B., 1975. Synergistic effects of salinity, temperature and heavy metals on mortality and osmoregulation in marine and estuarine isopods (Crustacea). *Marine Biology*, **30**, 13-20.

Jones, M.B., 1975b. Effects of copper on the survival and osmoregulation in marine and brackish water isopods (Crustacea). In *Proceedings of the 9th European Marine Biological Symposium* (ed. H. Barnes), 419-431. Scotland: University of Aberdeen Press.

King, C.A.M., 1959. *Beaches and coasts*. London.

Naylor, E., 1972. *British marine isopods.* London: Academic Press. [Synopses of the British Fauna, no. 3.]

Naylor, E., 1990. Isopoda. In *The Marine Fauna of the British Isles and North-west Europe*, (eds. P.J. Hayward & J.S. Ryland), Vol. 1, Ch.6., Oxford, Clarendon Press.

Pearson, T.H. & Rosenberg, R., 1978. Macrobenthic succession in relation to organic enrichment and pollution of the marine environment. *Oceanography and Marine Biology: an Annual Review*, **16**, 229-311.

Pienkowski, M.W., 1983. Surface activity of some intertidal invertebrates in relation to temperature and the foraging behaviour of their shorebird predators. *Marine Ecology Progress Series*, **11**, 141-150.

Powell, C.E., 1979. Isopods other than cyathura (Arthropoda: Crustacea: Isopoda). In *Pollution ecology of estuarine invertebrates* (ed. C.W. Hart & S.L.H. Fuller), 325-338. New York: Academic Press.

Preston, A., 1973. Heavy metals in British Waters. *Nature*, **242**, 95-97.

Read, P.A., Anderson, K.J., Matthews, J.E., Watson, P.G., Halliday, M.C. & Shiells, G.M., 1983. Effects of pollution on the benthos of the Firth of Forth. *Marine Pollution Bulletin*, **14**, 12-16.

Salvat, B., 1966. *Eurydice pulchra* (Leach 1815), *Eurydice affinis* (Hansen 1905) Isopodes Cirolanidae, taxonomie, éthologie, écologie, répartition verticale et cycle reproducteur. *Acta Societé Linnean. Bordeaux*, **103** (A), 1-77.

Scott, A., 1960. The fauna of the sandy beach, Village Bay, St. Kilda. A dynamical relationship. *Oikos*, **11**, 153-160.

Smith, J.E. (ed.), 1968. 'Torrey Canyon'. *Pollution and marine life.* Cambridge: Cambridge University Press.

Soika, G.A., 1955. Ethologie, ecologie, systematique et biogeographie des *Eurydice*. *Vie et Milieu*, **6**, 38-52.

Suchanek, T.H., 1993. Oil impacts on marine invertebrate populations and communities. *American Zoologist*, **33**, 510-523.

Watkin, E.E., 1942. The macrofauna of the intertidal sand of Kames Bay, Millport, Buteshire. *Transactions of the Royal Society Edinburgh*, **60**, 543-561.

Datasets

Bristol Regional Environmental Records Centre, 2017. BRERC species records recorded over 15 years ago. Occurrence dataset: https://doi.org/10.15468/h1ln5p accessed via GBIF.org on 2018-09-25.

Environmental Records Information Centre North East, 2018. ERIC NE Combined dataset to 2017. Occurrence dataset: http://www.ericnortheast.org.uk/home.html accessed via NBNAtlas.org on 2018-09-38

Fenwick, 2018. Aphotomarine. Occurrence dataset http://www.aphotomarine.com/index.html Accessed via NBNAtlas.org on 2018-10-01

Fife Nature Records Centre, 2018. St Andrews BioBlitz 2014. Occurrence dataset: https://doi.org/10.15468/erweal accessed via GBIF.org on 2018-09-27.

Lancashire Environment Record Network, 2018. LERN Records. Occurrence dataset: https://doi.org/10.15468/esxc9a accessed via GBIF.org on 2018-10-01.

Manx Biological Recording Partnership, 2017. Isle of Man wildlife records from 01/01/2000 to 13/02/2017. Occurrence dataset: https://doi.org/10.15468/mopwow accessed via GBIF.org on 2018-10-01.

Merseyside BioBank., 2018. Merseyside BioBank (unverified). Occurrence dataset: https://doi.org/10.15468/iou2ld accessed via GBIF.org on 2018-10-01.

NBN (National Biodiversity Network) Atlas. Available from: https://www.nbnatlas.org.

OBIS (Ocean Biogeographic Information System), 2019. Global map of species distribution using gridded data. Available from: Ocean Biogeographic Information System. www.iobis.org. Accessed: 2019-03-21

South East Wales Biodiversity Records Centre, 2018. SEWBReC Myriapods, Isopods, and allied species (South East Wales). Occurrence dataset: https://doi.org/10.15468/rvxsqs accessed via GBIF.org on 2018-10-02.

South East Wales Biodiversity Records Centre, 2018. Dr Mary Gillham Archive Project. Occurance dataset: http://www.sewbrec.org.uk/ accessed via NBNAtlas.org on 2018-10-02