An opossum shrimp (*Neomysis integer*)

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

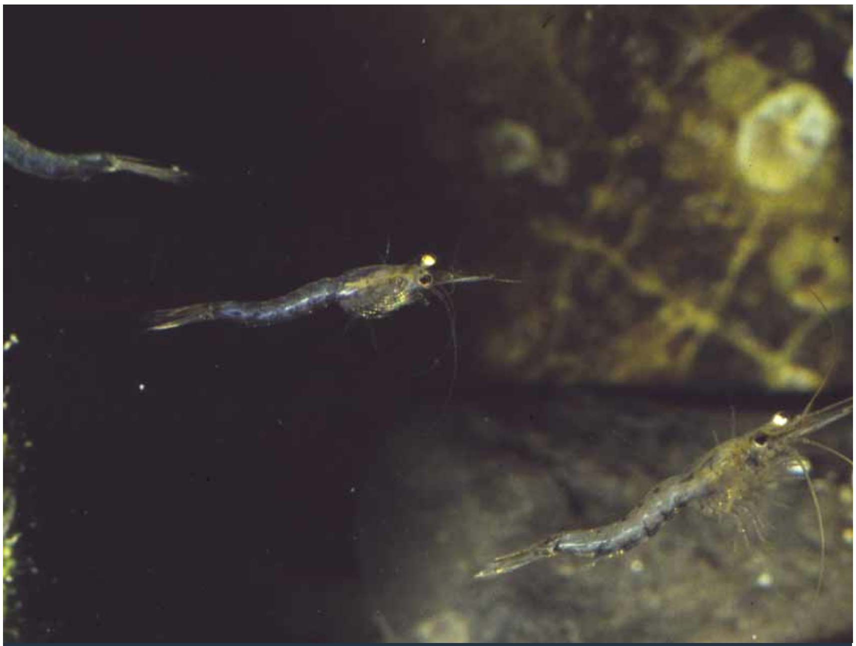
Georgina Budd

2008-04-24

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/1691]. 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. 2008. *Neomysis integer* An opossum shrimp. 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.1691.2



***Neomysis integer*.**
Photographer: Marco Faasse
Copyright: Marco Faasse

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, 1814)		
Other common names	-	**Synonyms**	-

Summary

Description

A slender, free-swimming, shrimp that grows up to 17 mm in length. Its body is almost transparent, with occasional brown pigmentation. The species has a well developed carapace, which protects the large stalked eyes, head and thorax. The rostrum of the head is distinctly pointed but short. Its antennae are conspicuous and biramous (having an inner and outer extension), the outer extension (exopod) of the second pair of antennae, takes the form of a flattened plate, known as the antennal scale. The antennal scale is bordered along its margin with setae and is an important diagnostic characteristic. Thoracic limbs are well developed and also biramous, the outer set have a distinctly feathery appearance. Abdominal limbs are less developed and finger-like, with the exception of the last pair which are biramous and flattened, and form the tail fan (uropods).

Recorded distribution in Britain and Ireland

Records indicate *Neomysis integer* to have a widespread, but patchy distribution on all British and Irish coasts in locations of lowered salinity, usually estuaries or brackish water enclosures.

Global distribution

Distributed from Artic Norway to the Atlantic coast of Spain.

Habitat

Neomysis integer is the dominant mysid shrimp in the upper reaches of estuaries. It is also found in non-tidal lagoons, isolated bodies of nearly freshwater, and in high shore hypersaline pools, but is rare in fully marine habitats.

Depth range
5 - 10 m

Identifying features

- Body almost transparent; up to 17 mm in length.
- Large eyes on stalks.
- Well developed carapace with distinctly pointed but short rostrum.
- Two pairs of conspicuous antennae, both biramous.
- First pair of antennae are long. Outer limb of second antenna, forms antennal scale, which is very long and narrow, tapering to a point.
- Thoracic appendages all biramous, the outer limbs (exopods) are fringed (appear feather like).
- Abdominal appendages (pleopods) also biramous. Male pleopods are small, the 4th pair are elongated with a terminal pair of barbed setae.
- The telson (tail blade) is long, triangular in outline with narrow truncated tip; short spines around margin.

Additional information
The species seems to be particularly susceptible to injury, causing atypical morphology which may lead to misidentification (Hayward & Ryland, 1995). Synonyms of *Mysis* or *Neomysis vulgaris* were in use in the early and continental literature, though Tattersall & Tattersall (1951) considered the specific *integer* (Leach) to have priority (Parker, 1979).

Listed by

Further information sources

Search on:

G G NBN WoRMS

Biology review

Taxonomy

Phylum	Arthropoda	Arthropods, joint-legged animals, e.g. insects, crustaceans & spiders
Order	Mysida	Opossum shrimps and mysids
Family	Mysidae	
Genus	Neomysis	
Authority	(Leach, 1814)	
Recent Synonyms	-	

Biology

Typical abundance	
Male size range	10-17mm
Male size at maturity	
Female size range	>9mm
Female size at maturity	
Growth form	Articulate
Growth rate	1-2mm/month
Body flexibility	High (greater than 45 degrees)
Mobility	
Characteristic feeding method	Predator, Active suspension feeder
Diet/food source	
Typically feeds on	Detritus, diatoms, filamentous algae and small crustaceans.
Sociability	
Environmental position	Epibenthic
Dependency	No information found.
Supports	No information
Is the species harmful?	No

Biology information

Growth rate

In mature adults from the Ythan Estuary, Scotland, growth rate was recorded to be 1-2 mm per month in the field, which followed a rapid period of growth, of 4-5 mm per month in the summer juveniles (Astthorsson, 1980). The winter generation had a growth rate of 3-4 mm monthly for juveniles and about 1 mm per month for mature adults. During the winter there was a period of about 3 months when growth ceased (Astthorsson & Ralph, 1984).

Swimming behaviour

Neomysis integer performs a diel vertical migration, rising towards the surface waters during the night and returning to the deeper waters at daylight where it remains throughout the day (Hough & Naylor, 1992). Normal diurnal light levels are inhibitory and produce a negatively phototactic response in most species; the 24 hour cycle of change in ambient light intensity is the dominant factor controlling the diel vertical migration of mysids, such as *Neomysis integer* (Mauchline, 1980).

Maintenance of position

As a pelagic organism, *Neomysis integer* faces the problem of retaining its position within the estuarine environment, against conditions of net seaward transport (Hough & Naylor, 1992). In general, there are three main controls of the positioning of pelagic invertebrate populations in estuarine systems: reproductive compensation of seaward losses (a relatively large number of juveniles are produced per brood, behavioural adaptations (alterations in swimming activity at different tidal phases) and hydrodynamic process (distribution directly related to patterns of water circulation) (Schlacher & Wooldridge, 1994).

In laboratory experiments, Hough & Naylor (1992) found *Neomysis integer* to have an endogenously controlled circa-tidal swimming activity, with peak swimming activity expressed during the ebb tide. In the investigation of the significance of its endogenously controlled ebb tide swimming, Hough & Naylor (1992) observed *Neomysis integer* to demonstrate rheotaxic behaviour. Typically on the ebb tide in the Conway Estuary, shallow pools of isolated water are left as the tide ebbs. Aggregations of *Neomysis integer* in imminent risk of stranding initially headed into the current, but as the water level dropped, and before a pool was completely cut off, the species swam with the current draining from the pool and entered the stream before finally re-orientating and swimming into the current. Hough & Naylor (1992) suggested that such rheotaxic behaviour coupled a continuous ebb-phased swimming rhythm, may be of importance in the avoidance of stranding on the shore at low tide.

Maximum swimming speed by the mysid is also important, since it dictates in which flow velocities the species can maintain its position. Specimens studied by Roast *et al.* (1998b) from the East Looe River Estuary (Cornwall) tolerated current velocities of 6 and 9 cm s^{-1}, a few could swim at speeds of up to 27cm s^{-1}, but was not sustainable for more than a few seconds. Roast *et al.* (1998b) found the swimming speeds of *Neomysis integer* correlated well with the distribution of the species in the East Looe River Estuary, where mysids were found consistently in slower moving water (<15 cm s^{-1}) and were absent in faster flowing water (>20 cm s^{-1}). Roast *et al.* (1998b) stated that if swimming speed is an important factor in the position maintenance of the species, it is likely to be beneficial for the mysid to utilize any available shelter in order to conserve energy. In experimental conditions, Roast *et al.* (1998b) observed *Neomysis integer* to attach themselves to the substratum, thereby entering the boundary layer where lower velocity flows are experienced. This corresponds with field studies, for instance in the Conway Estuary, North Wales, *Neomysis integer* was always caught in greatest abundance in near-bottom plankton samples (Hough & Naylor, 1992). On the ebb tide, during flood and high-tide periods in the Ythan Estuary, Scotland, the species was concentrated in a band toward the moving tide edge where flows were typically lower. Also on the ebb tide and at low tide the species aggregated in shallower water and in the lee of rocks and macroalgal clumps where water flow rates were less than 10 cm/sec (Lawrie *et al.*,1999). Shallow burrowing into the sediment is also a common means of position maintenance in moving waters, and is a common behaviour of mysids inhabiting areas subject to tidal disturbance (Roast *et al.*, 1998b).

Habitat preferences

Physiographic preferences	Sea loch / Sea lough, Estuary, Isolated saline water (Lagoon)
Biological zone preferences	Lower infralittoral, Upper infralittoral
Substratum / habitat preferences	Coarse clean sand, Gravel / shingle
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.)
Wave exposure preferences	Sheltered, Very sheltered
Salinity preferences	Low (<18 psu), Reduced (18-30 psu), See additional Information

Depth range	5 - 10 m
Other preferences	No text entered
Migration Pattern	Non-migratory / resident

Habitat Information

Salinity tolerance

Neomysis integer is a euryhaline species normally found in locations with salinities in the range 0.5 - 20 psu. However, it may be found more rarely in adjacent isolated waters of salinities greater than 20 psu, and in freshwaters. For instance, *Neomysis integer* adapted successfully to the transition from brackish lagoon to freshwater lagoon in the case of Loch Mor Barvas, Isle of Lewis, Scotland (Barnes, 1994).

Life history

Adult characteristics

Reproductive type	Gonochoristic (dioecious)
Reproductive frequency	Annual protracted
Fecundity (number of eggs)	11-100
Generation time	See additional information
Age at maturity	2-3 months
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	100 -1000 m
Larval settlement period	Not relevant

Life history information

The life history and biology of *Neomysis integer* differs slightly between localities (Mees *et al*., 1994; Astthorsson, 1980; Parker & West, 1979; Mauchline, 1971; Ralph, 1965; Kinne, 1955; Vorstman, 1951). Apparently the local environmental factors, especially temperature, have an influential role in determining the duration of the breeding season and the number of generations produced per year. Typically there are three generations per year.

For instance, in a population from Loch Etive, studied by Mauchline (1971), the overwintering members consisted predominantly of juveniles and immature males and females. Once mature they began an intensive period of breeding in the spring. The spring generation matured rapidly and bred during late June and early July, which consequently produced a third generation in the autumn. These intensive periods of breeding were set against a background of continuous breeding throughout the year, so that discrete generations were not evident, but modal age groups within the population could be traced over weeks, or in the case of the overwintering population, a

few months.
However, outside periods of intensive breeding the recruitment rate was lower: < 1% of females carried eggs and broods were smaller. Brood size in mysid shrimps has been found to be related to female body length and season (Mauchline, 1971). A winter brood of *Neomysis integer* from Loch Etive consisted of between 10-25 juveniles compared to 20-50 in the summer.
In contrast, to the population of *Neomysis integer* from Loch Etive, a population from the Ythan estuary on the east coast of Scotland studied by Astthorsson (1980), produced only two generations per year with a complete cessation of breeding during winter. Temperature differences between the two locations were implicated as the Ythan estuary had a much lower summer maximum temperature than Loch Etive (17°C cf. 20°C; Leach, 1971; Gage, 1974).

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	Tolerant	Not relevant	Not sensitive	Not relevant

Neomysis integer is a free-swimming mysid shrimp, which may rest on the surface of the substratum, but does not live within it. Therefore it has been assessed to be tolerant of substratum loss.

	Intolerance	Recoverability	Sensitivity	Confidence
Smothering	Tolerant	Not relevant	Not sensitive	Not relevant

Neomysis integer is a free-swimming mysid shrimp, which may rest on the surface of the substratum, but does not live within it and it is sufficiently mobile to avoid the deposition of smothering materials. Therefore *Neomysis integer* has been assessed to be not sensitive to smothering at the benchmark level.

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

Neomysis integer is omnivorous and employs one or both of two distinct methods of feeding. It may filter phytoplankton and suspended detrital material or feed as an active carnivore on zooplankton or benthic invertebrates. Consequently, increased concentrations of suspended matter in the water column may be indicative of an enhanced food supply and the species has been assessed not to be 'tolerant*'.

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

Neomysis integer is omnivorous and employs one or both of two distinct methods of feeding. It may filter phytoplankton and suspended detrital material or feed as an active carnivore on zooplankton or benthic invertebrates. A reduction in the concentration of suspended matter in the water column may reduce the species viability as a consequence of reduced food supply. Therefore intolerance has been assessed to be low. On return to prior conditions, recovery is likely to be immediate as the shrimp commences optimal feeding.

	Intolerance	Recoverability	Sensitivity	Confidence
Dessication	Not relevant	Not relevant	Not relevant	Not relevant

Neomysis integer is likely to be very intolerant of continual exposure to air and sunshine for one hour and any individuals washed ashore would undoubtedly die. But the estuarine environment its endogenous swimming rhythm, coupled with a rheotaxic behaviour serves to prevent stranding on the substratum at low tide (Hough & Naylor, 1992) (see general adult biology). Therefore, dessication is probably not relevant.

	Intolerance	Recoverability	Sensitivity	Confidence
Increase in emergence regime	Not relevant	Not relevant	Not relevant	Not relevant

Neomysis integer is a free-swimming mysid shrimp, which is sufficiently mobile to avoid a change in the emergence regime in its estuarine environment. Therefore an intolerance assessment was not considered to be relevant.

	Intolerance	Recoverability	Sensitivity	Confidence
Decrease in emergence regime	Not relevant	Not relevant	Not relevant	Not relevant

Neomysis integer is a free-swimming mysid shrimp, which is sufficiently mobile to avoid a change in the emergence regime in its estuarine environment. Therefore an intolerance assessment was not considered to be relevant.

Increase in water flow rate Intermediate Very high Low Moderate

In the field, where flows in the open channel over the tidal cycle were greater than that which *Neomysis integer* can swim against or maintain position, Lawrie *et al*., (1999) observed *Neomysis integer* to aggregate in low-flow areas, such as in the lee of rocks and macroalgal clumps, in the shallowest edge waters and at the 'boundary layer' (sediment-water interface), where water flow rates were not in excess of 10 cm/sec (0.2 of a knot). Intolerance of *Neomysis integer* to the benchmark increase in water flow rate has been assessed to be intermediate. The species would be exposed to flow rates of between 0.5-1.5 m/sec and in the absence of objects behind which to shelter the species would be washed rapidly seawards. Some individuals may die following exposure to fully saline conditions (see increase in salinity) but the abundance of the population is more likely to be reduced as other coastal currents disperse the population and fewer may be washed back into the estuary on the flood tide. On return to prior conditions the species is likely to have a very high capacity for recovery (see additional information below).

Decrease in water flow rate Tolerant* Not relevant Not sensitive* Not relevant

The benchmark decrease in water flow rate would create areas where water flow was negligible and the species may be better able to maintain position in open water, potentially enabling enhanced periods of feeding with reduced risk of displacement from the estuarine environment. Therefore an assessment of tolerant* has been made.

Increase in temperature Intermediate Very high Low Moderate

Environmental temperature exerts an influence on many of the physiological processes of mysid shrimps (Mauchline, 1980). However, the tolerance of mysid shrimps to changes in environmental temperatures varies between species and, to a lesser extent, between populations of the same species in different environments (Mauchline, 1980). Very little information concerning environmental temperatures and the distribution of mysid shrimps is available. However, the distribution of *Neomysis integer* extends to the south of the UK, along the Atlantic coast of Spain, so the species may be able to tolerate a chronic change of 2 °C. Kinne (1955) found that juveniles of *Neomysis integer* had a different tolerance to temperature changes than adults. Kuhlman (1984) also found that over-wintering and summer generations of *Neomysis integer* demonstrated distinct differences to increasing temperature, the upper tolerance of the winter generation being 10-12 °C in comparison to 20-25 °C for the summer generation. Consequently, an acute increase in temperature may be more damaging to the population during the spring, when the over wintering population commences breeding, than at other times and intolerance has been assessed to be intermediate. Following a decrease in population, *Neomysis integer* is likely to recover within a few weeks or at most six months following summer recruitment and probable migration between suitable habitats, therefore recoverability has been assessed to be very high.

Decrease in temperature Intermediate Very high Low

The distribution of *Neomysis integer* extends to the north of the UK, along the Arctic coast of Norway, so the species may be able to tolerate a chronic change of 2 °C. Acute decreases in temperature may cause death of some vulnerable individuals, such as those that are parasitized owing to additional stress and intolerance has therefore been assessed to be intermediate. Following a decrease in population, *Neomysis integer* is likely to recover within a few weeks or at most six months following summer recruitment and probable migration between suitable habitats, therefore recoverability has been assessed to be very high.

Increase in turbidity	Tolerant*	Not relevant	Not sensitive*	Not relevant

In general, mysids are attracted to weak sources of light, but avoid bright light (Mauchline, 1980). Bright light often inhibits swimming activity. Normal diurnal light levels are inhibitory and produce a negatively phototactic response in most species and the 24 hour cycle of change in ambient light intensity is the dominant factor controlling the diel vertical migration of mysids. The nocturnal period of darkness stimulates the upward migration into the pelagic zone (Beeton, 1960; McNaught & Hasler, 1966; Heubach, 1969; Teraguchi *et al.*, 1975; cited in Mauchline, 1980). Increased turbidity may serve to extend the nocturnal vertical migration period of *Neomysis integer* during dawn and dusk, as turbidity inhibits light penetration. As diel migration is a normal behavioural pattern of *Neomysis integer* an increase in turbidity is unlikely to affect the species. Furthermore, increased turbidity may hinder predatory fish which feed upon *Neomysis integer*.

Decrease in turbidity	Low	Very high	Very Low	Low

In general, mysids are attracted to weak sources of light, but avoid bright light (Mauchline, 1980). Bright light often inhibits swimming activity. Normal diurnal light levels are inhibitory and produce a negatively phototactic response in most species and the 24 hour cycle of change in ambient light intensity is the dominant factor controlling the diel vertical migration of mysids. The nocturnal period of darkness stimulates the upward migration into the pelagic zone (Beeton, 1960; McNaught & Hasler, 1966; Heubach, 1969; Teraguchi *et al.*, 1975; cited in Mauchline, 1980). Decreased turbidity may serve to reduce the extent of the nocturnal vertical migration of *Neomysis integer*, as light penetration of the water column increases, and possibly limit feeding. Furthermore, fish may exploit populations of *Neomysis integer* more effectively as *Neomysis integer* probably becomes more easily distinguishable. Intolerance has been assessed to be low and on return to prior conditions recovery is likely to be very high (see additional information below).

Increase in wave exposure	High	Very high	Low	Very low

Wave action in the littoral region affects the distribution of many intertidal species and for mysids in particular it tends to depress their vertical range on the shore, they move offshore into deeper water in order to avoid the effects of breaking waves (Mauchline, 1980). *Neomysis integer* avoids water flow rates against which it cannot maintain position by sheltering in the lee of rock, macroalgal clumps and in the 'boundary layer' (see increased water flow rate). Increased wave exposure would increase the turbulence of water flow around objects used for shelter and may displace the object. Furthermore, mysids such as *Neomysis integer* demonstrate rheotaxis (orientate in flowing water, facing into the current) and such behaviour may become energetically exhausting if caught in the wash and back-wash of waves. Intolerance has therefore been assessed to be high. Recovery, following loss of the population is likely to be very high (see additional information, below).

Decrease in wave exposure	Not relevant	Not relevant	Not relevant	Not relevant

The estuarine environment inhabited by *Neomysis integer* is typically very/extremely wave sheltered and an assessment for a decrease in wave exposure was not considered relevant.

Noise	Tolerant	Not relevant	Not sensitive	Not relevant

Neomysis integer 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	Not relevant

Neomysis integer is unlikely to have the visual acuity to detect the presence of boats, machinery present in its environment, and it has been assessed not to be sensitive to the factor.

Abrasion & physical disturbance	Not relevant	Not relevant	Not relevant	Not relevant

Neomysis integer is a free-swimming mysid shrimp and not likely to be damaged by a passing scallop dredge as it will probably avoid its effects. (see benchmark). Therefore, an intolerance assessment was not considered to be relevant.

Displacement	Not relevant	Not relevant	Not relevant	Not relevant

Neomysis integer is a free-swimming mysid shrimp and therefore cannot be physically displaced from the substratum. An intolerance assessment was considered not to be relevant.

Chemical Pressures

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

Several synthetic chemicals have been reported to have a toxic effect on *Neomysis integer*:

- Davies *et al.*, (1997) investigated the acute toxicity of Ivermectin (22, 23-dihydroavermectin B1), a proposed chemotherapeutant for the treatment of farmed salmon infested with sea lice, to *Neomysis integer*. The 96 hour LC_{50} of Ivermectin to *Neomysis integer* was 70 ng/l , with 95% confidence limits of 44 ng/l and 96 ng /l. However, in assessing the potential risk to the marine environment from dissolved Ivermectin from use on fish farms, results indicated that the ratios of the 'Predicted Environmental Concentration' to the 'Predicted No Effect Concentrations' (PEC/PNEC) were small, and the authors suggested that direct toxic effects are unlikely.
- Following 7-day exposure to 0.038 µg chlorpyrifos/l, an organophosphate pesticide, *Neomysis integer* became hyperactive and more swam forward into a slow current (3 cm m^{-1}) than control mysids (Roast *et al.*, 2000b). However despite the hyperactivity, chlorpyrifos-exposed *Neomysis integer* were unable to swim faster than 15 cm m^{-1}, whereas control specimens were able to swim faster than 18 cm m^{-1}. In addition to changes in swimming behaviour, fewer pesticide exposed specimens were unable to maintain a position in the annular flume test tank, in comparison with control specimens, and 'swam' in higher current velocities (> 18 cm s^{-1}), a behaviour which is inconsistent with that in the field. Lawrie *et al.*, (1999) observed *Neomysis integer* to aggregate in low-flow areas, such as in the lee of rocks, macroalgal clumps and in the shallowest edge waters, where water flow rates were not in excess of 10 cm s^{-1}. Roast *et al.*, (2000b) suggested that such disruption to the swimming behaviour of *Neomysis integer* would reduce its ability to maintain position in the natural estuarine environment and populations would probably be lost. Furthermore, the swimming behaviour of *Neomysis integer* was affected at a pesticide concentration lower than the seven day LC_{50} concentration of 0.084 µg chlorpyrifos per litre.

intolerance has been assessed to be intermediate. Sub-lethal effects (disruption of swimming) are experienced at low concentrations but are likely to cause the loss or reduce the abundance of estuarine populations owing to the inability of *Neomysis integer* to maintain position following contaminant exposure. The species is likely to have a very high capacity for recovery (see additional information, below) assuming the decay of the synthetic contaminant.

Heavy metal contamination	Intermediate	Very high	Low	High

Roast *et al.*, (2000a) examined the effects of cadmium (Cd) on the swimming behaviour of *Neomysis integer*. Mysid shrimps such as *Neomysis integer*, maintain their optimum position in their habitat independent of the forces of river flow and tides; therefore any disruption of swimming behaviour will have significant implications for their survival and position maintenance (Roast *et al.*, 2000a). Following 7 day exposure cadmium, swimming behaviour (ability and orientation) in *Neomysis integer* was disrupted at 0.5 µg $Cd_{(aq)}^{2+}$ per litre, a significantly lower cadmium concentration than that causing mortality (7 day LC_{50} of 2.58 µg $Cd_{(aq)}^{2+}$ per litre).
Furthermore, toxicity of cadmium to *Neomysis integer* also varies with salinity. Wildgust & Jones (1998) found that mortalities resulting from free cadmium ion exposure were greater at salinities of 28 and 12 psu than at 20 psu. Wildgust & Jones (1998) thought that the reduction in toxicity of cadmium at a salinity of 20 psu was attributable to an interaction between the cadmium ion and some physiologically active mechanism of *Neomysis integer*. As the isosmotic point of *Neomysis integer* (19 psu) is close to 20 psu, the authors interpreted the results to implicate osmoregulation in mediating the uptake, and hence the toxicity, of cadmium to this euryhaline species.
intolerance has been assessed to be intermediate. Sub-lethal effects (disruption of swimming) are experienced at low concentrations but are likely to cause the loss or reduce the abundance of estuarine populations owing to the inability of *Neomysis integer* to maintain position following heavy metal exposure. *Neomysis integer* is likely to have a very high capacity for recovery (see additional information, below) assuming the loss of the heavy metal from the environment.

Hydrocarbon contamination Intermediate Very high Low High

Following the sinking of the tanker '*Sefir*' during February, 1981, in the Baltic Sea, extreme mortality of littoral fauna, including mysids, was observed after the light fuel oil had washed ashore (Lindén *et al.*, 1983). Laughlin & Linden (1983) exposed *Neomysis integer* to water-soluble fractions (WSF) of light fuel oil under two different regimes. The first, a chronic exposure scheme, employed concentrations of between 200-500 ng WSF per litre and lasted two weeks. The second, acute exposure, employed concentrations of between 200 and 1000 µg WSF per litre, concentrations that the authors thought representative of oil escaping from a sunken ship or in the vicinity of a spill, especially in sheltered conditions. During the acute exposures, physiological parameters of oxygen consumption, ammonium excretion rate and oxygen : nitrogen ratios were calculated. Exposure of *Neomysis integer* to WSF oil at concentrations between 200-1000 µg per litre produced increases in oxygen consumption and decreases in ammonia excretion, which were strongly influenced by temperature. Oil exposure had greatest effect on the species at higher temperature, especially 21.5 °C. In contrast, changes in the physiological parameters did not occur to such an extent during the chronic exposure, Laughlin & Linden (1983) considered that the oil doses were probably too low. Furthermore, Laughlin & Linden (1983) suspected that during the chronic exposures, increased temperature alone exerted an effect on *Neomysis integer* (mortality at time of moults) and the chronic effects of WSF were not measurable. However, in contrast, at temperature < 10 °C, the WSF did qualitatively affect the mysid shrimp. Intolerance has been assessed to be intermediate as some mortality arising from hydrocarbon exposure was reported in the field, and that the species may experience sub-lethal stress in physiological parameters. *Neomysis integer* is likely to have a very high capability for recovery following degradation of the oil in the environment (see additional information below).

Radionuclide contamination Not relevant Not relevant

Insufficient information.

Changes in nutrient levels	Tolerant*	Not relevant	Not sensitive*	Not relevant

Neomysis integer is normally resident in estuarine and lagoon environments with comparatively higher nutrient concentrations than that of the open coast. Nutrient enrichment that stimulates phytoplankton productivity may benefit *Neomysis integer*, as it is omnivorous and suspension feeds on both phytoplankton and suspended detrital material. Furthermore, *Neomysis integer* is sufficiently mobile to avoid inhospitable conditions that may result from eutrophication, and therefore it has been assessed to be tolerant*.

Increase in salinity	High	Very high	Low	High

Neomysis integer is a euryhaline species which typically occurs in brackish water habitats, and occasionally in freshwater habitats, but more rarely in fully marine conditions. In laboratory experiments, Kuhlman (1984) found the upper salinity tolerance of *Neomysis integer* to be between 20 psu to 25 psu, and mortality increased significantly at 30 psu. Under normal circumstances the species is typically found in waters of up to 20 psu, both the acute and chronic benchmark increases in salinity would expose *Neomysis integer* to a salinity to which it is intolerant. Therefore intolerance has been assessed to be high.

Decrease in salinity	Tolerant	Not relevant	Not sensitive	High

Neomysis integer is a euryhaline species which typically occurs in brackish water habitats, and occasionally in freshwater habitats which were once connected to the sea. For instance, *Neomysis integer* adapted successfully to the transition from brackish lagoon to freshwater lagoon in the case of Loch Mor Barvas, Isle of Lewis, Scotland (Barnes, 1994). In laboratory experiments, Kuhlman (1984) reported the lowest salinity tolerance of the species to be lower than 5 psu, and in other texts it is suggested that *Neomysis integer* tolerates salinities down to 0.5 psu (Koepcke & Kausch, 1996; Barnes, 1994). Therefore *Neomysis integer* has been assessed as not sensitive at the benchmark leve decrease in salinity.

Changes in oxygenation	Not relevant	Not relevant	Not relevant	Not relevant

In laboratory experiments, Kuhlman (1984), lowered the oxygen saturation of seawater in which specimens of *Neomysis integer* were held over two days, to 20 % (approximately 6.5 mg /O_2 per litre with no negative influence on behaviour or survival. A narrow sublethal and lethal threshold was determined between 20% (6.5 mg /O_2 per litre) and 13 % (4.23 mg/O_2 per litre) saturation (Kuhlman, 1984). However, the species is sufficiently mobile to avoid sub optimal concentrations of oxygen and therefore an intolerance assessment of not relevant has been made.

Biological Pressures

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

Astthorsson (1980) found specimens of *Neomysis integer* collected from the Ythan Estuary, Scotland, to be parasitized by the third larval stage of the nematode *Thynnascaria adunca*. The nematodes were found in both the thorax and the abdomen, usually coiled. In some instances, the total length of the *Thynnascaria adunca* larvae was almost the same length as the *Neomysis integer* hosting it. Astthorsson (1980) suspected that the larvae would probably have an influence on the internal physiology of the host, but there is insufficient information concerning any effect upon the population that such parasitization may have.

Introduction of non-native species		Not relevant		Not relevant

No information concerning non-native species that might affect the abundance or survival of *Neomysis integer* was found.

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

Neomysis integer is not a species targeted for extraction. However, other mysid species have been harvested for human consumption and in Japan there is a commercial fishery of several species e.g. *Neomysis intermedia*, *Neomysis japonica*, *Acanthomysis mitsukurii* (Astthorsson, 1980).

Extraction of other species Not relevant Not relevant

No information concerning the extraction of other species that might affect the abundance or survival of *Neomysis integer* was found.

Additional information

Recoverability

Leuchs & Nehring (1996) described *Neomysis integer* as a rapidly growing species, with a high reproduction rate. It was able to rapidly recolonize and maintain a population over a 2 km stretch of the Elbe Estuary, Germany, that received dredged mud daily from the Brunsbuettel locks and had an otherwise impoverished fauna. Parker & West (1979) interpreted the ecology of *Neomysis integer* in the brackish Lough Furnace to be a compromise between r- and K-strategies. The reproductive strategy of mysid species is apparently K-selected, in that a relatively small number of offspring are produced which are released from the female brood pouch at an advanced stage. Thereafter, *Neomysis integer* lives a short r-selected lifespan, is small in size and reproduces intensively during the most favourable period of the year. However, as Parker & West (1979) pointed out, the compromise between the two strategies is fallible, and *Neomysis integer* experiences large fluctuations in population density. However, being planktonic, *Neomysis integer* can escape (at least partly) from adverse conditions by migration, for instance seasonality in the abundance of *Neomysis integer* was observed in the Swanpool Lagoon, Cornwall, into which the species migrated for the summer (Barnes *et al.*, 1979), and in the Severn Estuary where *Neomysis integer* over-wintered at comparatively low densities, but swarmed inshore during the summer with most females carrying eggs or embryos (Moore *et al.*, 1979). This evidence suggests that *Neomysis integer* would have a very high capacity for recruitment, recovery, and re-population via migration after an impact.

Importance review

Policy/legislation

- no data -

Status

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

Non-native

Native	-		
Origin	-	Date Arrived	-

Importance information

- *Neomysis integer* has been studied as a potential food organism for mariculture purposes (Kuhlmann, 1984).
- Mysids are used routinely by regulatory authorities for conducting 96 hour LC_{50} toxicity tests to evaluate the potential hazards of pollutants to aquatic ecosystems. *Neomysis integer* has been reported to be comparatively sensitive to trace metals and organophosphate pesticides (Roast *et al.*,2001; Roast *et al.*, 2000, 2000b; Roast *et al.*, 1999, 1999b; Roast *et al.*, 1998; Wildgust & Jones, 1998) and it has been suggested that *Neomysis integer* may be a suitable alternative to the frequently used sub-tropical American mysid *Americamysis* (=*Mysidopsis*) *bahia* for testing the toxicity of chemical contaminants to European estuarine biota. Furthermore, *Neomysis integer* exhibits disrupted swimming activity in the presence of contaminants, which is a more sensitive endpoint for assessing the effects of contaminants on aquatic biota than mortality.
- Mysid shrimps such as *Neomysis integer* are ubiquitous members of the permanent, endemic hyperbenthic fauna of estuarine and other coastal systems. Mysid shrimps occurs in high numbers and their ecological importance, particularly their role in food chains as a link between the benthic and pelagic systems is becoming increasingly apparent (Roast *et al.*, 1998). Estuaries function as nurseries for several important demersal fish species, and *Neomysis integer* is known to be important in the diets of; *Pomatoschistus minutus*, *Trisopterus luscus*, *Merlangius merlangus*, *Platichthys flesus*, Trigla lucerna, *Clupea harengus* and *Pleuronectes platessa* (Hostens & Mees, 1999).

Bibliography

Astthorsson, O.S. & Ralph, R., 1984. Growth and moulting of *Neomysis integer* (Crustacea; Mysidacea). *Marine Biology*, **79**, 55-61.

Astthorsson, O.S., 1980. *The life history and ecological energetics of* Neomysis integer *(Leach) (Crustacea, Mysidacea).* , Ph.D. thesis, University of Aberdeen.

Barnes, R.S.K., 1994. *The brackish-water fauna of northwestern Europe.* Cambridge: Cambridge University Press.

Barnes, R.S.K., Williams, A., Little, C. & Dorey, A.E., 1979. An ecological study of the Swanpool, Falmouth. IV. Population fluctuations of some dominant macrofauna. In: *Ecological processes in coastal environments*, (ed. R.L. Jefferies & A. J. Davy), pp. 177-197. Oxford: Blackwell.

Davies, I.M., McHenery, J.G. & Rae, G.H., 1997. Environmental risk from dissolved Ivermectin to marine organisms. *Aquaculture*, **158**, 263-275.

Gage, J., 1974. Shallow-water zonation of sea-loch benthos and its relation to hydrographic and other physical features. *Journal of the Marine Biological Association of the United Kingdom*, **54**, 223-249.

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

Hostens, K. & Mees, J., 1999. The mysid-feeding guild of demersal fishes in the brackish zone of the Westerschelde Estuary. *Journal of Fish Biology*, **55**, 704-719.

Hough, A.R. & Naylor, E., 1992. Distribution and position maintenance behaviour of the estuarine mysid *Neomysis integer*. *Journal of the Marine Biological Association of the United Kingdom*, **72**, 869-876.

JNCC (Joint Nature Conservation Committee), 1999. *Marine Environment Resource Mapping And Information Database (MERMAID): Marine Nature Conservation Review Survey Database.* [on-line] http://www.jncc.gov.uk/mermaid

Kinne, O., 1955. *Neomysis vulgaris* Thompson eine autökologisch-biologische studie. *Biologisches Zentralblatt.*, **74**, 160-202.

Koepcke, B. & Kausch, H., 1996. Distribution and variability in abundance of *Neomysis integer* and *Mesopodopsis slabberi* (Mysidacea; Crustacea) in relation to environmental factors in the Elbe Estuary. *Archiv fur Hydrobiologie. Supplementband. Untersuchungen des Elbe-Aestuars. Stuggart*, **110**, 263-282.

Kuhlmann, D., 1984. Effects of temperature, salinity, oxygen and ammonia on the mortality and growth of *Neomysis integer* Leach. *Limnologica*, **15**, 479-485.

Laughlin, R. & Linden, O., 1983. Oil pollution and Baltic mysids: Acute and chronic effects of the water soluble fractions of light fuel oil on the mysid shrimp *Neomysis integer*. *Marine Ecology Progress Series*, **12**, 29-41.

Lawrie, S.M, Speirs, D.C., Raffaelli, D.G., Gurney, W.S.C., Paterson, D.M. & Ford, R., 1999. The swimming behaviour and distribution of *Neomysis integer* in relation to tidal flow. *Journal of Experimental Marine Biology and Ecology*, **242**, 95-106.

Leach, J.H., 1971. Hydrology of the Ythan Estuary with reference to distribution of major nutrients and detritus. *Journal of the Marine Biological Association of the United Kingdom*, **51**, 137-157.

Leuchs, H. & Nehring, S., 1996. Effects of dredging and dumping on macrozoobenthos in coastal areas, represented by an example from the Elbe Estuary. (Actual problems of the marine environment. Lectures at the 6th Scientific Symposium 14 & 15 May 1996 in Hamburg), *Deutsche Hydrographische Zeitschrift, Supplement*, **6**, 177-186.

Lindén, O., Mattson, J. & Notini, M., 1983. A spill of light fuel oil in the Baltic Sea. In *1983 oil spill conference*, pp. 517-520., Washington. D.C., American Petroleum Institute.

Makings, P., 1977. A guide to the British coastal Mysidacea. *Field Studies*, **4**, 575-595.

Mauchline, J., 1971. The biology of *Neomysis integer* (Crustacea; Mysidacea). *Journal of the Marine Biological Association of the United Kingdom*, **51**, 347-354.

Mauchline, J., 1980. The biology of Mysids. *Advances in Marine Biology*, **18**, 1-369.

Mees, J., Abdulkerim, Z. & Hamerlynck, O., 1994. Life history, growth and production of *Neomysis integer* in the Westerschelde Estuary (SW Netherlands). *Marine Ecology Progress Series*, **109**, 43-57.

Moore, J.W., Moore, I.A. & Claridge, P.N., 1979. Seasonal changes in density, composition and reproductive biology of crustacean populations in the Severn Estuary. *Crustaceana*, **36**, 113-122.

Parker, M. & West, B., 1979. The natural history of *Neomysis integer* (Leach) in Lough Furnace, Co. Mayo, a brackish lough on the west coast of Ireland. *Estuarine and Coastal Marine Science*, **8**, 157-167.

Parker, M., 1979. *Neomysis integer* (Leach) (Crustacea: Mysidacea): Records and distribution in Ireland. *Irish Naturalists' Journal*, **19**, 339-342.

Picton, B.E. & Costello, M.J., 1998. *BioMar* biotope viewer: a guide to marine habitats, fauna and flora of Britain and Ireland. [CD-ROM] *Environmental Sciences Unit, Trinity College, Dublin.*

Ralph, R., 1965. *Some aspects of the ecology and osmotic regulation of* Neomysis integer *Leach.* , Ph.D. thesis, Southampton University.

Roast, S.D., Thompson, R.S., Donkin, P., Widdows, J. & Jones, M.B., 1999b. Toxicity of the organophosphate pesticides chlorpyrifos and dimethoate to *Neomysis integer* (Crustacea: Mysidacea). *Water Research*, **33**, 319-326.

Roast, S.D., Thompson, R.S., Widdows, J. & Jones, M.B., 1998. Mysids and environmental monitoring: a case for their use in estuaries. *Marine and Freshwater Research*, **49**, 827-932.

Roast, S.D., Widdows, J. & Jones, M.B., 1998b. The position maintenance behaviour of *Neomysis integer* (Peracarida: Mysidacea) in response to current velocity, substratum and salinity. *Journal of Experimental Marine Biology and Ecology*, **220**, 25-45.

Roast, S.D., Widdows, J. & Jones, M.B., 1999. Scope for growth of the estuarine mysid *Neomysis integer* (Peracarida: Mysidacea): effects of the organophosphate pesticide chlorpyrifos. *Marine Ecology Progress Series*, **191**, 233-241.

Roast, S.D., Widdows, J. & Jones, M.B., 1999c. Respiratory responses of the estuarine mysid *Neomysis integer* (Peracarida: Mysidacea) in relation to a variable environment. *Marine Biology*, **133**, 643-649.

Roast, S.D., Widdows, J. & Jones, M.B., 2000. Mysids and trace metals: disruption of swimming as a behavioural indicator of environmental contamination. *Marine Environmental Research*, **50**, 107-112.

Roast, S.D., Widdows, J. & Jones, M.B., 2000b. Disruption of swimming in the hyperbenthic mysid *Neomysis integer* (Peracarida: Mysidacea) by the organophosphate pesticide chlorpyrifos. *Aquatic Toxicology*, **47**, 227-241.

Roast, S.D., Widdows, J. & Jones, M.B., 2001. Impairment of mysid (*Neomysis integer*) swimming ability: an environmentally realistic assessment of the impact of cadmium exposure. *Aquatic Toxicology*, **52** , 217-227.

Schlacher, T.A. & Wooldridge, T.H., 1994. Tidal influence on distribution and behaviour of the estuarine opossum shrimp *Gastrosaccus brevifissura*. In: *Changes in fluxes in estuaries: implications from science to management*, (ed. K.D. Dyer & R.J. Orth), pp.307-312. Fredesborg: Olsen & Olsen.

Tattersall, W.M. & Tattersall, O.S., 1951. *The British Mysidacea*. London: Ray Society.

Vorstman, A.G., 1951. A year's investigation on the life cycle of *Neomysis vulgaris* Thompson. *Verhandlungen der Internationalen Vereinigung fur Theoretische und Angewandte Limnologie*, **11**, 437-445.

Wildgust, M.A. & Jones, M.B., 1998. Salinity change and the toxicity of the free cadmium ion [$Cd^{2+}_{(aq)}$] to *Neomysis integer* (Crustacea: Mysidacea). *Aquatic Toxicology*, **41**, 187-192.

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.

Centre for Environmental Data and Recording, 2018. Ulster Museum Marine Surveys of Northern Ireland Coastal Waters. Occurrence dataset https://www.nmni.com/CEDaR/CEDaR-Centre-for-Environmental-Data-and-Recording.aspx accessed via NBNAtlas.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

Merseyside BioBank., 2017. Merseyside BioBank (verified). Occurrence dataset: https://doi.org/10.15468/ar0p6s 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.

Norfolk Biodiversity Information Service, 2017. NBIS Records to December 2016. Occurrence dataset: https://doi.org/10.15468/jca5lo accessed via GBIF.org on 2018-10-01.

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

Suffolk Biodiversity Information Service., 2017. Suffolk Biodiversity Information Service (SBIS) Dataset. Occurrence dataset: https://doi.org/10.15468/ab4vwo accessed via GBIF.org on 2018-10-02.