MarLIN

Marine Information Network

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

Common piddock (*Pholas dactylus*)

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

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

Please note. This MarESA report is a dated version of the online review. Please refer to the website for the most up-to-date version [https://www.marlin.ac.uk/species/detail/1403]. All terms and the MarESA methodology are outlined on the website (https://www.marlin.ac.uk)

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Large specimen of *Pholas dactylus* from off Mumbles Head.
Photographer: Jon Moore
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See online review for distribution map

Distribution data supplied by the Ocean Biogeographic Information System (OBIS). To interrogate UK data visit the NBN Atlas.

Researched by	Jacqueline Hill	**Refereed by**	Dr Eunice Pinn
Authority	Linnaeus, 1758		
Other common names	-	**Synonyms**	-

Summary

Description

Pholas dactylus is a boring bivalve, approximately elliptical in outline with a beaked anterior end, up to 12 cm long. The shell is thin and brittle with a sculpture of concentric ridges and radiating lines. The shell is dull white or grey in colour, the periostracum yellowish and often discoloured. The siphons are joined and at least one to two times the length of the shell, white to light ivory in colour. *Pholas dactylus* has phosphorescent properties, the outlines of the animal glowing with a green-blue light in the dark.

Recorded distribution in Britain and Ireland

Pholas dactylus occurs in Britain from Kent along the south and south-west coasts including south Wales, Anglesey and Solway. Also recorded from several sites on the east coasts of Yorkshire and Northumbria and southwest Ireland.

Global distribution

Distributed from Britain south to the Iberian Peninsula, the Mediterranean and Black Sea and the Atlantic coast of Morocco.

Habitat

Pholas dactylus bores into a wide range of substrata including various soft rocks such as chalk and sandstone, clay, peat and very occasionally in waterlogged wood. Found from the lower shore to the shallow sublittoral.

Depth range
To 35m

Identifying features

- Shell thin and brittle, elliptical in shape with a beaked anterior end and bulbous umbones in anterior third of shell.
- Anterio-ventral margin deeply concave about a large, elliptical pedal gape, posterior margin regularly rounded, not gaping.
- Shell sculpture of concentric ridges and radiating lines developed as stout tubercles where they intersect, most pronounced anteriorly.
- Hinge line with slender projection, the apophysis (the point of attachment of foot muscles) just below the beak of each valve.
- Interior of shell glossy white with the external sculpture faintly visible.
- Four dorsal accessory plates.
- Siphons joined and at least one to two times the length of the shell, white to light ivory in colour, papillose and devoid of periostracum except for small band near the posterior.

Additional information

- The shell is often thicker in older individuals, up to 2 mm thick in 12 cm specimens (E. Pinn pers. comm.).
- Although thin and brittle the shell of *Pholas dactylus* has a cross-lamellar design which efficiently deflects cracks away from the bulk of the shell which gives it the strength to burrow through soft rocks.

Listed by

Further information sources

Search on:

G G G NBN WoRMS

Biology review

Taxonomy

Phylum	Mollusca	Snails, slugs, mussels, cockles, clams & squid
Order	Myida	Gapers, piddocks, and shipworms
Family	Pholadidae	
Genus	Pholas	
Authority	Linnaeus, 1758	
Recent Synonyms	-	

Biology

Typical abundance	
Male size range	up to 120mm
Male size at maturity	
Female size range	Medium(11-20 cm)
Female size at maturity	
Growth form	Bivalved
Growth rate	Data deficient
Body flexibility	Low (10-45 degrees)
Mobility	
Characteristic feeding method	Active suspension feeder, No information
Diet/food source	
Typically feeds on	Suspended organic particles
Sociability	
Environmental position	Lithotomous
Dependency	Independent.
Supports	None
Is the species harmful?	No *Pholas dactylus* is an edible species. However, it is rarely collected for food in Britain.

Biology information

Live individuals do not support other species but old burrows provide refugia for other species and this has an influence on overall diversity.

Habitat preferences

Physiographic preferences	Open coast, Strait / sound, Enclosed coast / Embayment
Biological zone preferences	Lower eulittoral, Sublittoral fringe
Substratum / habitat preferences	Bedrock
Tidal strength preferences	No information
Wave exposure preferences	No information

Salinity preferences	Full (30-40 psu)
Depth range	To 35m
Other preferences	No text entered
Migration Pattern	No information found

Habitat Information

All boring bivalves begin excavation following settling of the larva and slowly enlarge and deepen the burrow with growth. They are forever locked within their burrows, and only the siphons project to the small surface opening (Barnes, 1980). Individuals in waterlogged wood are quite rare and often deformed (E. Pinn pers. comm.).

Life history

Adult characteristics

Reproductive type	Gonochoristic (dioecious)
Reproductive frequency	Annual episodic
Fecundity (number of eggs)	No information
Generation time	Insufficient information
Age at maturity	Insufficient information
Season	June - August
Life span	up to 14 years

Larval characteristics

Larval/propagule type	-
Larval/juvenile development	Planktotrophic
Duration of larval stage	No information
Larval dispersal potential	No information
Larval settlement period	Insufficient information

Life history information

- Acetate peel work with *Pholas dactylus* indicates that the species has a maximum lifespan of 14 years (E. Pinn pers. comm.).
- There is a free swimming veliger larva which attaches by a byssus at settlement, the byssus later being lost (Fish & Fish, 1996).
- The gonads start to develop in February or March and are fully mature by the beginning of June. The animals are able to spawn all through the summer and usually have released their gametes by the end of August when the temperature of the water is about 19°C. However, in the summer of 1982 all the animals had spawned by the end of July and this early spawning correlated with an earlier than usual increase in temperature (Knight, 1984).
- Fertilization is thought to be external and no evidence was found by Knight (1984) to support earlier suggestions that brooding occurs in this species.

Sensitivity review

This MarLIN sensitivity assessment has been superseded by the MarESA approach to sensitivity assessment. MarLIN assessments used an approach that has now been modified to reflect the most recent conservation imperatives and terminology and are due to be updated by 2016/17.

Physical Pressures

	Intolerance	Recoverability	Sensitivity	Confidence
Substratum Loss	High	High	Moderate	Moderate

Pholas dactylus lives permanently in a burrow excavated in soft rock, peat or similar substrata. Substratum loss will result in the death of the animal because when removed from its burrow and placed on the surface, it cannot excavate a new chamber (Barnes, 1980) and will be at risk from desiccation and predation. Provided a similar substratum remains and there is larval availability, recolonization is likely to occur and so recovery within five years should be possible, though maybe not to previous abundance.

	Intolerance	Recoverability	Sensitivity	Confidence
Smothering	Low	High	Low	Moderate

Intolerance to smothering is expected to be low because feeding apparatus can be cleared of particles although this will be energetically costly. Experimental work with *Pholas dactylus* showed that large particles can either be rejected immediately in the pseudofaeces or passed very quickly through the gut (Knight, 1984). In Exmouth, Knight (1984) found *Pholas dactylus* covered in a layer of sand and in Eastbourne individuals live under a layer of sand with siphons protruding at the surface (E. Pinn pers. comm.). However, smothering by impermeable material such as oil or tar is likely to result in the death of individuals. On return to normal conditions recolonization by pelagic larvae is likely and recovery within five years should be possible.

	Intolerance	Recoverability	Sensitivity	Confidence
Increase in suspended sediment	Low	High	Low	Moderate

Intolerance to siltation is likely to be low because *Pholas dactylus* produces sediment in the process of burrow drilling. This sediment is eliminated by taking it into the mantle cavity and then ejecting it with the pseudofaeces through the gut. Experimental work with *Pholas dactylus* showed that large fragments are either rejected immediately in the pseudofaeces or passed very quickly through the gut (Knight, 1984). An increase in the organic content of suspended sediment is likely to be beneficial to suspension feeders such as the common piddock. Occurrence of *Pholas dactylus* has been recorded from silty habitats in north Yorkshire (JNCC, 1999).

Decrease in suspended sediment

	Intolerance	Recoverability	Sensitivity	Confidence
Dessication	Intermediate	High	Low	Low

Pholas dactylus inhabits the shallow sub-tidal and lower shore so is likely to have some tolerance of desiccation. However, the species is fixed in position within its burrow and the shell does not completely close to protect against water loss so intolerance to an increase in desiccation is assessed as intermediate. An increase in desiccation at the level of the benchmark, equivalent to a change in position of one vertical biological zone on the shore is likely to result in the death of many individuals particularly at the top of the populations' range. *Pholas dactylus* is likely to be tolerant to a decrease in desiccation and may be able to extend its range up-shore. Recolonization by pelagic larvae is likely to occur and recovery within 5 years, though maybe not to previous abundance, is expected.

Increase in emergence regime Intermediate High Low Low

Pholas dactylus is fixed in position within its burrow and so will be exposed to changes in emergence. An increase in emergence may cause the death of some individuals at the upper limit of the species range because of increased desiccation. During an extended period of exposure animals squirt some water from their inhalant siphon and extend their gaping siphons into the air (Knight, 1984). Recolonization by pelagic larvae is likely to occur and recovery of the population within 5 years is expected.

Decrease in emergence regime

Increase in water flow rate Low Very high Very Low Low

Pholas dactylus is fixed permanently within a burrow and is unlikely to be washed away by an increase in water flow rate. However, a significant increase in water flow rates may interfere with suspension feeding and may also increase rates of substratum erosion. A change in turbidity associated with changing water flow rate may affect the supply of particulate matter available for suspension feeding (see turbidity). Changes in food supply are likely to have an impact on growth and fecundity. On return to normal water flow rates typical suspension feeding, growth and fecundity should resume.

Decrease in water flow rate

Increase in temperature Intermediate High Low High

Pholas dactylus is a southern species and occurrence in Britain represents the northern limit of its range. An increase in temperature may allow the species to extend its presence further north. The animals are able to spawn all through the summer and usually have released their gametes by the end of August when the temperature of the water is about 19°C. However, in the summer of 1982 all the animals had spawned by the end of July and this early spawning correlated with an earlier than usual increase in temperature (Knight, 1984). Spawning can be induced by increasing the water temperature. A decrease in temperature will probably have a detrimental effect on colonies because *Pholas dactylus* is fixed in position and unable to move and may impair the reproductive potential of the species. At a temperature of 7°C *Pholas dactylus* did not siphon actively and oxygen consumption was much lower than that observed at between 15 and 18°C when the animals were seen to be siphoning actively (Knight, 1984). During the exceptionally cold winter of 1962-3 no living individuals of *Pholas dactylus* could be found above the low-water mark at Lyme Regis in the southwest of England (Crisp, 1964). Cold certainly kills individuals (E. Pinn pers. comm.) and so intolerance is assessed as intermediate. Recolonization by pelagic larvae is likely to occur and recovery within five years, though maybe not to previous abundance.

Decrease in temperature

Increase in turbidity Low Immediate Not sensitive Moderate

Pholas dactylus lives in chalk areas where water can be very turbid. A change in light availability due to changes in turbidity is unlikely to affect *Pholas dactylus* directly because the species is a suspension feeder. However, changes in turbidity determines the amount of light available for primary production by phytoplankton, benthic microalgae and macroalgae and may therefore, affect food availability affecting growth and reproductive potential. At high levels, the suspended sediment that causes turbidity may clog feeding apparatus but this effect is included in siltation'. Therefore, changes in turbidity at the level of the benchmark are unlikely to result in the loss of individuals and so intolerance is assessed as low.

Decrease in turbidity

Increase in wave exposure	Low	High	Low	Low

Pholas dactylus is fixed permanently within a burrow and so is unlikely to be damaged or removed by exposure to wave action. However, in soft substratum habitats long term increases in wave exposure will cause erosion and a consequent loss of habitat. Changes in wave exposure may influence the supply of particulate matter for suspension feeding.

Decrease in wave exposure

Noise	Low	Immediate	Not sensitive	Low

Pholas dactylus probably has limited facility for detection of noise. However, the species can probably detect the vibration caused by predators and will withdraw its siphons, ejecting water from the burrow as it does so. Humans walking over piddock grounds often get squirted as the animals pull down into their burrows in response to human movement. On removal of noise or vibration disturbance normal behaviour will resume.

Visual Presence	Low	Immediate	Not sensitive	Moderate

Pholas dactylus reacts to changes in light intensity by withdrawing its siphon which may be an adaptive response to avoid predation by shore birds and fish (Knight, 1984). However, the visual presence of boats or humans is not likely to be detrimental to *Pholas dactylus* communities. On removal of visual disturbance normal behaviour will resume.

Abrasion & physical disturbance	Intermediate	High	Low	High

The shell of *Pholas dactylus* is thin and brittle so a force, equivalent to a 5-10 kg anchor and its chain being dropped or a passing scallop dredge, is likely to result in death. However, because the common piddock lives within a burrow in soft rock, generally only those individuals close to the surface will be damaged by an abrasive force or physical disturbance. Individuals living in softer the substrata such as clays or peats may be more vulnerable. Therefore, an intolerance of intermediate has been recorded to represent the possible loss of a proportion of the population. Recolonization of the affected area by pelagic larvae is likely to occur and with several months spawning every year recovery within five years is expected.

Displacement	High	High	Moderate	Moderate

Intolerance to removal from the substratum and displacement from original position onto a suitable substratum is high because *Pholas dactylus* cannot excavate a new chamber (Barnes, 1980) and so will die from predation or desiccation. Provided a suitable substratum remains and there is larval availability (the species spawns throughout the summer), recolonization is likely to occur and so recovery within five years should be possible, though maybe not to previous abundance.

Chemical Pressures

	Intolerance	Recoverability	Sensitivity	Confidence
Synthetic compound contamination	High	High	Moderate	Moderate

Although no information on the specific effects of chemicals on *Pholas dactylus* was found TBT has been found to be toxic to many adult bivalves. Reports of reductions in numbers of bivalves in estuaries with high pleasure craft activity, have provided evidence of the high toxicity of TBT to bivalves (Beaumont *et al*., 1989). Laboratory toxicity trials have demonstrated that growth in oysters is inhibited by TBT (Waldock & Thain, 1983). In microcosm studies Beaumont *et al*. (1989) demonstrated that levels of 1-2µg/l TBT can rapidly kill adult bivalves in their natural habitat. For example, all *Cerastoderma edule* individuals died within two weeks at 1-3µg/l TBT concentrations and 80% died after 17 weeks at a TBT concentration of 0.06-0.17µg/l and *Scrobicularia plana* (Beaumont *et al*., 1989). *Cerastoderma edule* was found to be more intolerant of TBT than *Scrobicularia plana* in toxicity trials and was thought to be a reflection of the mode of feeding of the two species with filter feeding being a more direct route delivering a higher burden of the toxic material to the animal. Therefore, as a filter feeding bivalve *Pholas dactylus* it is likely that this species is also highly intolerant of TBT. *Pholas dactylus* spawns for several months every year, so when normal conditions resume rapid recolonization by the pelagic larvae is likely.

Heavy metal contamination Intermediate High Low Moderate

Bryan (1984) states that Hg is the most toxic metal to bivalve molluscs while Cu, Cd and Zn seem to be most problematic in the field. In bivalve molluscs Hg was reported to have the highest toxicity, mortalities occurring above 0.1-1 µg/l after 4-14 days exposure (Crompton, 1997), toxicity decreasing from Hg > Cu and Cd > Zn > Pb and As > Cr (in bivalve larvae, Hg and Cu > Zn > Cd, Pb, As, and Ni > to Cr). In investigations of faunal distribution in the metal contaminated Restronguet Creek in the Fal estuary bivalve molluscs appear to be the most vulnerable (Bryan, 1984). The bivalve *Scrobicularia plana*, for example, is absent from large areas of the intertidal muds where, under normal conditions, it would account for a large amount of the biomass (Bryan & Gibbs, 1983). Bryan (1984) also reports that metal-contaminated sediments can exert a toxic effect on burrowing bivalves and so intolerance has been assessed as intermediate. The embryonic and larval stages of bivalves are the most intolerant of heavy metals (Bryan, 1994). *Pholas dactylus* spawns for several months every year, so when normal conditions resume rapid recolonization by the pelagic larvae is likely.

Hydrocarbon contamination Not relevant

Insufficient information.

Radionuclide contamination Not relevant

Insufficient information.

Changes in nutrient levels Not relevant

Insufficient information.

Increase in salinity Intermediate High Low Low

The species inhabits the lower intertidal zone and so will be exposed to some changes in salinity due to precipitation. However, *Pholas dactylus* is a marine species, permanently fixed within its burrow and unable to avoid changes in salinity. A change in salinity at the level of the benchmark is likely to result in the species being outside its habitat preference so intolerance has been assessed as intermediate. *Pholas dactylus* spawns for several months every year, so when normal conditions resume rapid recolonization by the pelagic larvae is likely.

Decrease in salinity

Changes in oxygenation Low High Low Moderate

There is no information regarding the tolerance of *Pholas dactylus* to changes in oxygen concentration. Cole *et al*., (1999) suggest possible adverse effects on marine species below 4 mg/l and probable adverse effects below 2mg/l. However, as an intertidal species *Pholas dactylus* is able to gain oxygen from the air during periods of emersion. In experiments with oxygen levels the species was able to tolerate water oxygen saturation of only 5% for about 17 hours by 'air gaping', that is extending the inhalent siphon into air (Knight, 1984). Therefore, intolerance has been assessed as low. Knight (1984) found *Pholas dactylus* living in peat with a very high concentration of hydrogen sulphide suggesting a tolerance to low oxygenation. On return to normal conditions recovery should be rapid.

Biological Pressures

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

A ciliated protozoon, *Syncilancistrumina elegantissima*, has been found associated with *Pholas dactylus* and may be specific to this host (Knight & Thorne, 1982). However, the effect of the protozoon, which inhabits the gills and mantle cavity of *Pholas dactylus* is unknown.

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

The American piddock *Petricola pholadiformis* has become established along south and east coasts of England from Lyme Regis in Dorset to the Humber. It is most common off Essex and the Thames estuary and is more similar to the hyposaline tolerant white piddock, *Barnea candida*. There is no documentary evidence, however, that *Petricola pholadiformis* has displaced any native piddocks (Eno *et al*., 1997). There may however, be some competition between *Pholas dactylus* and *Petricola pholadiformis* for substratum (E. Pinn pers. comm.).

	Intolerance	Recoverability	Sensitivity	Confidence
Extraction of this species	Intermediate	High	Low	Low

Although *Pholas dactylus* is edible it is not widely harvested in Britain. In Italy, harvesting of piddocks has had a destructive impact on habitats and has now been banned (E. Pinn pers. comm.). Farming methods are being investigated as an alternative. It is possible therefore, that targeted extraction could be a future possibility. However, if extracted recovery should be high because recolonization by pelagic larvae should be rapid and return to normal population levels possible within five years.

	Intolerance	Recoverability	Sensitivity	Confidence
Extraction of other species	Tolerant		Not sensitive	Very low

Pholas dactylus has no known obligate relationships. Extraction of other species is not likely to have any effect on a *Pholas dactylus* habitat.

Additional information

Importance review

Policy/legislation

- no data -

Status

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

Non-native

Native	-		
Origin	-	**Date Arrived**	-

Importance information

- May provide a food source for shore birds such as oystercatchers that are frequently seen pecking at rocks as the tide recedes (Knight, 1984).
- Empty piddock burrows can influence the abundance of species by providing additional habitats and refuges. Eunice Pinn (pers. comm.) found a statistically significant increase in species diversity in areas where old burrows were present compared to where they were absent.

Bibliography

Barnes, R.D., 1980. *Invertebrate Zoology*, 4th ed. Philadelphia: Holt-Saunders International Editions.

Beaumont, A.R., Newman, P.B., Mills, D.K., Waldock, M.J., Miller, D. & Waite, M.E., 1989. Sandy-substrate microcosm studies on tributyl tin (TBT) toxicity to marine organisms. *Scientia Marina*, **53**, 737-743.

Bryan, G.W. & Gibbs, P.E., 1983. *Heavy metals from the Fal estuary, Cornwall: a study of long-term contamination by mining waste and its effects on estuarine organisms.* Plymouth: Marine Biological Association of the United Kingdom. [Occasional Publication, no. 2.]

Bryan, G.W., 1984. Pollution due to heavy metals and their compounds. In *Marine Ecology: A Comprehensive, Integrated Treatise on Life in the Oceans and Coastal Waters*, vol. 5. *Ocean Management*, part 3, (ed. O. Kinne), pp.1289-1431. New York: John Wiley & Sons.

Crisp, D.J. (ed.), 1964. The effects of the severe winter of 1962-63 on marine life in Britain. *Journal of Animal Ecology*, **33**, 165-210.

Crompton, T.R., 1997. *Toxicants in the aqueous ecosystem.* New York: John Wiley & Sons.

Eno, N.C., Clark, R.A. & Sanderson, W.G. (ed.) 1997. *Non-native marine species in British waters: a review and directory*. Peterborough: Joint Nature Conservation Committee.

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

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.

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.]

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

Knight, J.H., 1984. *Studies on the biology and biochemistry of* Pholas dactylus *L..* , PhD thesis. London, University of London.

Knight, R. & Thorne, J., 1982. *Syncilancistrumina elegantissima* (Scuticociliatida: Thigmotrichina), a new genus and species of ciliated protozoon from *Pholas dactylus* (Mollusca: Bivalvia), the common piddock. *Protistologica*, **18**, 53-66.

Seaward, D.R., 1982. *Sea area atlas of the marine molluscs of Britain and Ireland*. Peterborough: Nature Conservancy Council.

Seaward, D.R., 1990. *Distribution of marine molluscs of north west Europe.* Peterborough: Nature Conservancy Council.

Seaward, D.R., 1993. Additions and amendments to the *Distribution of the marine Molluscs of north west Europe.* , *Joint Nature Conservation Committee, Peterborough. [JNCC Report no.* 165].

Tebble, N., 1976. *British Bivalve Seashells. A Handbook for Identification*, 2nd ed. Edinburgh: British Museum (Natural History), Her Majesty's Stationary Office.

Turner, R.D., 1954. The family Pholadidae in the western Atlantic and the eastern Pacific Part 1 - Pholadinae. *Johnsonia*, **3**, 1-64.

Waldock, M.J. & Thain, J.E., 1983. Shell thickening in *Crassostrea gigas*: organotin antifouling or sediment induced? *Marine Pollution Bulletin*, **14**, 411-415.

Wood, C., 1984. *Sussex sublittoral survey. Selsey Bill to Beachy Head.* (Contractor: Marine Conservation Society, South East Branch), unpublished report to *Nature Conservancy Council*, CSD Report, no. 527.

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.

Conchological Society of Great Britain & Ireland, 2018. Mollusc (marine) data for Great Britain and Ireland - restricted access. Occurrence dataset: https://doi.org/10.15468/4bsawx accessed via GBIF.org on 2018-09-25.

Conchological Society of Great Britain & Ireland, 2018. Mollusc (marine) data for Great Britain and Ireland. Occurrence dataset: https://doi.org/10.15468/aurwcz accessed via GBIF.org on 2018-09-25.

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

Kent Wildlife Trust, 2018. Biological survey of the intertidal chalk reefs between Folkestone Warren and Kingsdown, Kent 2009-2011. Occurrence dataset: https://www.kentwildlifetrust.org.uk/ accessed via NBNAtlas.org on 2018-10-01.

Kent Wildlife Trust, 2018. Kent Wildlife Trust Shoresearch Intertidal Survey 2004 onwards. Occurrence dataset: https://www.kentwildlifetrust.org.uk/ accessed via NBNAtlas.org on 2018-10-01.

Manx Biological Recording Partnership, 2018. Isle of Man historical wildlife records 1990 to 1994. Occurrence dataset:

https://doi.org/10.15468/aru16v 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.

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

National Trust, 2017. National Trust Species Records. Occurrence dataset: https://doi.org/10.15468/opc6g1 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 Molluscs (South East Wales). Occurrence dataset: https://doi.org/10.15468/jos5ga 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