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

Sea grapes (*Molgula manhattensis*)

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/1735]. All terms and the MarESA methodology are outlined on the website (https://www.marlin.ac.uk)

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***Molgula manhattensis* dominated seabed, Middle Channel Rocks, entrance to Milford Haven.**
Photographer: Keith Hiscock
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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	Dr Keith Hiscock	**Refereed by**	This information is not refereed.
Authority	(De Kay, 1843)		
Other common names	-	**Synonyms**	-

Summary

Description

A rounded solitary ascidian about 1-3 cm across that often occurs in dense clusters. The colour is grey or greenish-blue and the test is covered with fibrils that may or may not be attached with sand grains, shell fragments etc.

Recorded distribution in Britain and Ireland

Distributed all around Britain and Ireland but no records from the east basin of the Irish Sea.

Global distribution

In the north Atlantic, extending from the White Sea and North Cape to Portugal and, on the American coast from Maine to the Gulf of Mexico (Berrill 1950). Since the early 1970's at least, it has been present in the western Pacific (Tokioka & Kado 1972).

Habitat

Attached to bedrock, boulders, stones and shells in the littoral and sublittoral to depths of 90 m. *Molgula manhattensis* is found especially in ports and harbours.

Depth range

0-90 m

Identifying features

- Solitary, up to 3 cm diameter.
- Body more or less spherical.
- Greyish to greenish-blue.
- Prominent siphons (when expanded).
- Six branchial folds

Additional information

Several species had, until recently, been included in *Molgula manhattensis*: *Molgula simplex* Alder & Hancock, 1870; *Molgula siphonata* Alder 1850; *Molgula socialis* Alder 1848, and *Molgula tubifera* Orstedt 1844 (Connor & Picton in Howson & Picton, 1997). Separation for the purpose of this review has not been carried out as it is uncertain to what extent authors of papers have worked with *Molgula manhattensis sensu stricto*. It also seems (Kott 1976 quoted in Kott 1985) that the eastern Atlantic species may be *Molgula tubifera* and that *Molgula manhattensis* occurs on the Atlantic coast of North America from Maine to Lousiana. Nevertheless, the Species Directory (Howson & Picton, 1997) lists *Molgula manhattensis* for Britain and Ireland and so no change in name is suggested here.

Listed by

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Biology review

Taxonomy

Phylum	Chordata	Sea squirts, fish, reptiles, birds and mammals
Class	Ascidiacea	Sea squirts
Order	Stolidobranchia	
Family	Molgulidae	
Genus	Molgula	
Authority	(De Kay, 1843)	
Recent Synonyms	-	

Biology

Typical abundance	High density
Male size range	
Male size at maturity	
Female size range	Small(1-2cm)
Female size at maturity	
Growth form	Globose
Growth rate	Data deficient
Body flexibility	Low (10-45 degrees)
Mobility	
Characteristic feeding method	Active suspension feeder
Diet/food source	
Typically feeds on	Plankton
Sociability	
Environmental position	Epibenthic
Dependency	Independent.
Supports	Host Host for the marine protist *Nephromyces* as an endosymbiont.
Is the species harmful?	No

Biology information

Molgula manhattensis typically lives on hard substrata including artificial substrata. *Molgula manhattensis sensu stricto* (see taxonomy page) occurs especially in ports and harbours (Connor & Picton in Howson & Picton, 1997).

Habitat preferences

Physiographic preferences	Ria / Voe, Estuary, Enclosed coast / Embayment
Biological zone preferences	Lower circalittoral, Lower infralittoral, Upper circalittoral
Substratum / habitat preferences	Bedrock, Cobbles, Large to very large boulders, Small boulders

Tidal strength preferences	Moderately Strong 1 to 3 knots (0.5-1.5 m/sec.), Very Weak (negligible), Weak < 1 knot (<0.5 m/sec.)
Wave exposure preferences	Exposed, Extremely sheltered, Moderately exposed, Sheltered, Very sheltered
Salinity preferences	Full (30-40 psu), Variable (18-40 psu)
Depth range	0-90 m
Other preferences	No text entered
Migration Pattern	Non-migratory / resident

Habitat Information

Identifying the distribution of *Molgula manhattensis* is confused by taxonomic problems (see taxonomy page). Although indicated as a native species, the author of this review suggests that it is possible that *Molgula manhattensis* is an early 'import' from North America as it settles on the hull of ships and could have been transported on wooden sailing ships at a very early stage in north Atlantic crossings. Van Name (1945), quoted in Kott (1985), noted that *Molgula manhattensis* occurred in salinities equivalent to 20 to 36 psu.

Life history

Adult characteristics

Reproductive type	Gonochoristic (dioecious)
Reproductive frequency	Annual protracted
Fecundity (number of eggs)	
Generation time	<1 year
Age at maturity	Insufficient information
Season	Insufficient information
Life span	Insufficient information

Larval characteristics

Larval/propagule type	-
Larval/juvenile development	Oviparous
Duration of larval stage	< 1 day
Larval dispersal potential	1 km -10 km
Larval settlement period	Insufficient information

Life history information

Berrill (1931) noted that *Molgula tubifera* (possibly a synonym of *Molgula manhattensis*) collected from the Salcombe Estuary and Millbay Docks in Plymouth were oviparous and had a tadpole larva that developed outside of the body. The tadpole developed and hatched in about 10 hours at a temperature of 18°C and the tadpole larva settled after a further one to 10 hours. Samples were collected in spring and summer and it seems likely that time of reproduction is for an extended time and certainly during summer. Berrill (1931) further describes the larval biology of *Molgula manhattensis* from North America and notes much the same development as in *Molgula tubulifera*.

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

The species is permanently attached to the substratum so substratum loss will result in loss of the population. Therefore an intolerance of high has been reported. For recoverability, see additional information below.

Smothering	Low	Very high	Very Low	High

The species is permanently attached to the substratum and is an active suspension feeder so that some clearance of smothering silt may occur. The species can extend its siphons to a small extent above silt. It can also most likely maintain a passage through the silt to the siphons. However, groups are likely to be covered by silt or other material and therefore be subject to hypoxia. Of greatest importance may therefore be the ability of *Molgula manhattensis* to live in the hypoxic conditions that might occur under silt. Sagasti *et al.* (2000) demonstrated that *Molgula manhattensis* can withstand episodes of hypoxia and so mortality is unlikely to occur. Intolerance is likely to be low. Recovery of condition is likely to be very high.

Increase in suspended sediment	Low	Immediate	Not sensitive	Moderate

Molgula manhattensis frequently occurs in habitats with high levels of suspended matter. Increased suspended sediment may potentially have some detrimental effects in clogging feeding filtration mechanisms, however, there are possible benefits from increased siltation (Naranjo *et al.* 1996). On resumption of normal energy expenditure and feeding, condition should be restored rapidly.

Decrease in suspended sediment	Tolerant	Not relevant	Not sensitive	Moderate

Although there may be some reliance on the organic material associated with suspended silt for nutrition, the reduced need for energy expenditure to remove silt may be beneficial. On balance, the species is most likely tolerant.

Dessication	Intermediate	Very high	Low	Moderate

The species occurs in the intertidal near to low water level and so is exposed to some desiccation. Nevertheless, it has a soft body and may be easily subject to drying-up. Exposure to desiccating influences for one hour will probably kill a proportion of the population. Therefore, an intolerance of intermediate has been recorded. For recoverability, see additional information below.

Increase in emergence regime	Intermediate	Very high	Low	Moderate

The species occurs in the intertidal near to low water level and so is exposed to some emergence. Nevertheless, it has a soft body and may be easily subject to drying-up. Exposure to desiccating influences as a result of increased emergence will probably kill a proportion of the population. Therefore, an intolerance of intermediate has been recorded. For recoverability, see additional information below.

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

As a predominantly sublittoral species, increase in emergence may benefit populations found on the lower shore by providing additional substratum for colonization.

Increase in water flow rate Low Immediate Not sensitive High

As a general rule, ascidians require a reasonable water flow rate in order to ensure sufficient food availability. High water flow rates may also be detrimental to feeding ability and posture. Hiscock (1983) found that, for the solitary ascidian *Ascidia mentula*, siphons closed when the current velocity rose above about 15 cm/sec. It seems likely therefore that some reduction in feeding would occur with increased water flow rate although that would result in slower growth and loss of condition but not mortality. Intolerance has therefore been assessed as low. On resumption of normal energy expenditure and feeding, condition should be restored rapidly.

Decrease in water flow rate Low Immediate Not sensitive Moderate

As a general rule, ascidians require a reasonable water flow rate in order to ensure sufficient food availability and oxygen supply. However, *Molgula manhattensis* is frequently found in areas with minimal water exchange and renewal such as harbours, marinas and docks. Intolerance has therefore been assessed as low. Sagasti *et al.* (2000) demonstrated that *Molgula manhattensis* can withstand episodes of hypoxia and so, even if stagnation occurs for short periods, mortality is unlikely to occur. Whilst food availability may be reduced in comparison with areas with higher flow rates, on resumption of normal energy expenditure and feeding, condition should be restored rapidly.

Increase in temperature Tolerant Not relevant Not sensitive High

In the North Atlantic and in Pacific locations where *Molgula manhattensis* has developed populations, temperatures may be higher by several degrees than in Britain and Ireland. It is not therefore expected that increased temperatures at the level of the benchmark will adversely affect populations.

Decrease in temperature Tolerant Not relevant Not sensitive High

The distribution of *Molgula manhattensis* in the North Atlantic extends to Maine and to northern Norway so that decrease in temperatures at the level of the benchmark is unlikely to adversely affect populations.

Increase in turbidity Tolerant Not relevant Not sensitive Moderate

Molgula manhattensis lives in harbours and the entrances to estuaries where turbidity may increase to high levels. In experiments aimed at identifying the effects of adding clay suspensions to water, Frank *et al.* (2000) showed the ability of *Molgula manhattensis* to increase clearance rates as concentration of particles increased. It is not expected that increase in turbidity at the level of the benchmark will adversely affect *Molgula manhattensis*.

Decrease in turbidity Tolerant* Not relevant Not sensitive* Low

Although there may be some reliance on the organic material associated with turbidity for nutrition, the reduced need for energy expenditure to clear silt may be beneficial and an intolerance of tolerant* has been recorded.

Increase in wave exposure Intermediate Very high Low Low

As a general rule, ascidians require a reasonable water flow rate in order to ensure sufficient food availability and oxygen supply. However, high water flow rates may be detrimental to feeding ability and posture. Hiscock (1983) found that, for the solitary ascidian *Ascidia mentula*,

siphons closed when current velocity rose above about 15 cm/sec. It seems likely therefore that some reduction in feeding would occur with increased oscillatory water movement although that would result in slower growth and loss of condition but not mortality. On resumption of normal energy expenditure and feeding, condition should be restored rapidly. Although individuals are firmly attached, there is a possibility that, especially in closely packed colonies, wave action may displace large numbers. Intermediate intolerance but with low confidence is recorded. Recovery is likely to be very high (see additional information below).

Decrease in wave exposure	Tolerant*	Not relevant	Not sensitive*	Low

As a general rule, ascidians require a reasonable water flow rate in order to ensure sufficient food availability and oxygen supply and maintain surfaces clean of silt. If decrease in wave action occurs where tidal flow continues to provide favourable conditions, the species may benefit because of reduction in the likelihood of displacement. However, *Molgula manhattensis* is frequently found in areas with minimal water exchange and renewal such as harbours, marinas and docks suggesting that decrease in wave exposure even in the absence of significant tidal currents would not be adverse. Sagasti *et al.* (2000) demonstrated that *Molgula manhattensis* can withstand episodes of hypoxia and so, even if stagnation occurs for short periods, mortality is unlikely to occur. Whilst food availability may be reduced by reduction in wave action, on resumption of normal energy expenditure and feeding, condition should be restored rapidly. Overall, bearing in mind that the favoured location for *Molgula manhattensis* is in wave sheltered habitats, the species might benefit from decrease in wave exposure.

Noise	Tolerant	Not relevant	Not sensitive	High

Tunicates are not known to have organs sensitive to noise.

Visual Presence	Tolerant	Not relevant	Not sensitive	High

Tunicates are not known to respond to visual presence.

Abrasion & physical disturbance	High	Very high	Low	Moderate

Colonies are flexible and soft providing a buffer against external abrasion from such factors as a fishing pot landing on a colony. However, individuals and colonies may be scraped off the rock by an anchor or passing dredge Intolerance is therefore assessed as high. For recoverability, see additional information.

Displacement	High	Very high	Low	Moderate

The colonies are attached permanently to the substratum and will not re-attach so that displacement, even if to a suitable habitat, would most likely result in mortality. An assessment of high intolerance is therefore made. For recoverability, see additional information below.

Chemical Pressures

	Intolerance	Recoverability	Sensitivity	Confidence
Synthetic compound contamination	Low	Immediate	Not sensitive	Low

Molgula manhattensis is most likely tolerant of synthetic chemical pesticides. Weis & Weis (1992) found that the ascidian was commonly present, although in small numbers, on wood treated with chromated arsenate. In mesocosm experiments, Flemer *et al.* (1995) studied the effect of the pesticide endosulfan and found that the average abundance of *Molgula manhattensis* increased with increasing concentration of the pesticide possibly as a result of reduced competition with more susceptible organisms. The high abundance of the species in harbours where levels of tributyl tin are or were likely to be high also suggests tolerance. *Molgula manhattensis* may benefit from tolerance to synthetic pollutants by occupying space

that would have been colonized by less tolerant species. No evidence has been found for sublethal effects from which recovery would be likely to be rapid. Overall, an intolerance of low is suggested but with a low confidence.

Heavy metal contamination Not relevant Not relevant

No information has been found.

Hydrocarbon contamination Not relevant Not relevant

No information has been found.

Radionuclide contamination Not relevant Not relevant

No information has been found.

Changes in nutrient levels Not relevant Not relevant

No information has been found.

Increase in salinity Tolerant Not relevant Not sensitive Moderate

Van Name (1945), quoted in Kott (1985), noted that *Molgula manhattensis* occurred in salinities equivalent to 20 to 36 psu whilst Hartmeyer (1923), quoted in Tokioka & Kado (1972), recorded *Molgula manhattensis* in brackish (16-30 psu) water of the Belt Sea. Ascidians are mainly found in full salinity and it is not expected that increase in salinity will have an adverse effect except in the possibility of allowing other species to out-complete *Molgula manhattensis*.

Decrease in salinity Intermediate Very high Low Moderate

Van Name (1945), quoted in Kott (1985), noted that *Molgula manhattensis* occurred in salinities equivalent to 20 to 36 psu whilst Hartmeyer (1923) quoted in Tokioka & Kado (1972) recorded *Molgula manhattensis* in brackish (16-30 psu) water of the Belt Sea. A fall in salinity from full to reduced would not therefore be expected to have an adverse effect. However, in situations where salinity is already variable or reduced, a further lowering is likely to result in mortality. Intolerance is indicated as intermediate but may be high. For recoverability, see additional information.

Changes in oxygenation Low Immediate Not sensitive Moderate

Sagasti *et al.* (2000) demonstrated that *Molgula manhattensis* can withstand episodes of hypoxia and so intolerance is likely to be low amounting to some loss in condition.

Biological Pressures

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

Saffo & Davis (1982) describe how the renal sac of *Molgula manhattensis* consistently harbours a collection of fungus-like cells, "*Nephromyces*". In turn, *Nephromyces* is infected with bacteria (Saffo, 1990). Both fungus and bacteria act in a symbiotic way and not strictly as harmful pathogens. In the absence of information about other pathogens, 'not sensitive' is recorded.

Introduction of non-native species Tolerant Not relevant Not sensitive Moderate

There are no non-native species currently known to displace or adversely affect *Molgula manhattensis* although the stalked ascidian *Styela clava* may occur in similar habitats.

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

There is no known extraction of this species.

Extraction of other species	Not relevant	Not relevant	Not relevant	Not relevant

There are no species with which *Molgula manhattensis* is associated that may be extracted.

Additional information

Molgula manhattensis eggs and larvae are free-living for only a few hours (see Berrill 1931) and so recolonization would have to be from existing individuals no more than a few km away. *Molgula manhattensis* settles onto bare surfaces and grows rapidly (for instance, Otsuka & Dauer, 1982; Morales-Alamo & Mann, 1990; Osman & Whitlatch, 1995) including in polluted or hypoxia-stressed situations (for instance, Weis & Weis, 1992; Sagasti *et al.*, 2000). It is also likely that *Molgula manhattensis* larvae are attracted by existing populations and settle near to adults (Osman *et al.*, 1992 found that settlement was significantly higher on panels adjacent to other *Molgula manhattensis* control panels). Fast growth means that a dense cover could be established within about 2 months. However, if mortality and the consequent establishment of free space available occurs at a time when larvae are not being produced, other species may settle and dominate. Therefore a recoverability of 'very high' is for when larvae are available to settle. If another species colonizes and dominates the substratum, recolonization by *Molgula manhattensis* may take several years.

Importance review

Policy/legislation

- no data -

Status

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

Non-native

Native	Non-native		
Origin	Northern America	**Date Arrived**	1960

Importance information

Molgula manhattensis rapidly colonizes bare hard substratum in suitable locations often to the exclusion of most other epifauna.

"*Molgula*" is indicated as a main food source for the opisthobranch *Okenia elegans* (see Thompson & Brown 1976). However, the species of *Molgula* is not given and is not believed to be *Molgula manhattensis*. *Molgula manhattensis* is preyed upon by the gastropod *Anachis avara* on the east coast of North America (see, for instance, Osman *et al.* 1992). No records have been found of predation specifically on *Molgula manhattensis* around Britain and Ireland.

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