Pullet carpet shell (*Venerupis corrugata*)

MarLIN – Marine Life Information Network
Marine Evidence–based Sensitivity Assessment (MarESA) Review

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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/1558]. All terms and the MarESA methodology are outlined on the website (https://www.marlin.ac.uk)

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See online review for distribution map

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

Researched by	Will Rayment	**Refereed by**	This information is not refereed.
Authority	(Gmelin, 1791)		
Other common names	-	**Synonyms**	*Venerupis pullastra* , *Venerupis corrugata* , *Venerupis saxatilis* , *Venerupis senegalensis* , *Venerupis pullastra* (Gmelin, 1791), *Venerupis corrugata* (Gmelin, 1791), *Venerupis saxatilis* (Gmelin, 1791)

Summary

Description

An oval, bivalve shell that reaches 5 cm in length. The exterior is sculptured with concentric ridges and faint radiating lines. White, cream or grey in colour, sometimes with purple or brown markings.

Recorded distribution in Britain and Ireland

Recorded from all around the coast of Britain and Ireland where suitable habitat occurs

Global distribution

Recorded in Europe from northern Norway to the Mediterranean and in north west Africa

Habitat

Venerupis senegalensis occurs in wave protected areas such as sheltered inlets and sea lochs. It burrows to a depth of 5 cm in mixed sandy substrata, often attached to small stones or shells by byssal threads. It occasionally inhabits rock crevices. It occurs from the lower shore to the lower circalittoral but is most abundant in the shallow subtidal.

Depth range

lower shore to 35 m

Identifying features

- Elongate, oval shell; anterior end rounded, posterior almost straight.
- Umbones distinctly anterior.
- Sculptured exterior with growth stages clear.
- Each valve with 3 cardinal teeth.
- Adductor scars and pallial line distinct; pallial sinus deep, U-shaped and extending beyond mid-line of shell.
- Inner surface shiny white, occasionally with purple tinges.
- Distinguished from *Tapes rhomboides* (banded carpet shell) by external sculpturing and more angular appearance of posterior part of shell.

Additional information

Venerupis saxatilis has a more sculptured shell than *Venerupis senegalensis* and is typically found attached to firm substrata in rocky crevices. It is unclear whether *Venerupis saxatilis* is a separate species or an ecophenotype of *Venerupis senegalensis* (Hayward *et al.*, 1996).

Listed by

Further information sources

Search on:

Biology review

Taxonomy

Phylum	Mollusca	Snails, slugs, mussels, cockles, clams & squid
Order	Venerida	Cockles, hatchet shells, coin shells, venus shells, otter shells, wedge shells, razor shells and tellins
Family	Veneridae	
Genus	Venerupis	
Authority	(Gmelin, 1791)	
Recent Synonyms	Venerupis pullastra Venerupis corrugata Venerupis saxatilis Venerupis senegalensis Venerupis pullastra (Gmelin, 1791)Venerupis corrugata (Gmelin, 1791)Venerupis saxatilis (Gmelin, 1791)	

Biology

Typical abundance	High density
Male size range	up to 50mm
Male size at maturity	10-20mm
Female size range	10-20mm
Female size at maturity	
Growth form	Bivalved
Growth rate	1.3mm/month
Body flexibility	None (less than 10 degrees)
Mobility	
Characteristic feeding method	Active suspension feeder
Diet/food source	
Typically feeds on	Suspended organic matter, particularly unicellular algae
Sociability	
Environmental position	Infaunal
Dependency	Independent.
Supports	None
Is the species harmful?	No Edible

Biology information

Abundance

Johanessen (1973a) recorded *Venerupis senegalensis* (studied as *Venerupis pullastra*) from a sheltered beach in Norway at a mean density of 31 individuals per 0.25 m^2. Potential production was calculated to be 20 g ash free dry weight per m^2/year, including a loss of 9 g due to mortality.

Growth rate

Growth rate of *Venerupis senegalensis* varies according to environmental conditions. Quayle (1952) investigated growth rates of *Venerupis senegalensis* (studied as *Venerupis pullastra*) from Millport, Scotland. In the first year following settlement, mean monthly growth rate was 1.3 mm per month over the growing period of 6 months. Growth rate was found to increase for the first 4 years of life (maximum growth rate was *ca* 9 mm per season) after which it began to decrease. Within each growing season, growth rate was found to increase up to the point of spawning, after which it levelled off and then decreased. Johannessen (1973b) investigated growth of *Venerupis senegalensis* (studied as *Venerupis pullastra*) from a sheltered beach in western Norway. The spherical shell of the free swimming larvae developed into an oblong shape after settlement, presumably to aid burrowing. At a shell length greater than 40 mm, the shell shape tended towards a flattened circular form, the biological significance of which is unclear. The shell growth rate was found to be approximately constant (*ca* 15 mm per season) up to a shell length of 40 mm, after which it decreased. Short and/or young individuals were found to grow faster than long and/or old ones.

Diet

Beiras *et al.* (1993) investigated the effect of increasing food rations on *Venerupis senegalensis* (studied as *Venerupis pullastra*). Increased rations of algal food were found to increase ingestion rate and growth. This relationship was found to hold true up to the maximum ration of 300 algal cells/µl. However, at high food concentrations the returns diminished due to decreased absorption efficiency. The optimum food concentration for growth (i.e. maximum increase in biomass per unit weight of food) was 100 cells/µl.

Habitat preferences

Physiographic preferences	Strait / sound, Sea loch / Sea lough, Estuary, Enclosed coast / Embayment, Strait / sound, Sea loch / Sea lough, Estuary, Enclosed coast / Embayment
Biological zone preferences	Lower circalittoral, Lower eulittoral, Lower infralittoral, Sublittoral fringe, Upper circalittoral, Upper infralittoral, Lower circalittoral, Lower eulittoral, Lower infralittoral, Sublittoral fringe, Upper circalittoral, Upper infralittoral
Substratum / habitat preferences	Coarse clean sand, Fine clean sand, Gravel / shingle, Mixed, Muddy gravel, Muddy sand, Coarse clean sand, Fine clean sand, Gravel / shingle, Mixed, Muddy gravel, Muddy sand
Tidal strength preferences	Moderately Strong 1 to 3 knots (0.5-1.5 m/sec.), Weak < 1 knot (<0.5 m/sec.), Moderately Strong 1 to 3 knots (0.5-1.5 m/sec.), Weak < 1 knot (<0.5 m/sec.)
Wave exposure preferences	Extremely sheltered, Sheltered, Very sheltered, Extremely sheltered, Sheltered, Very sheltered
Salinity preferences	Full (30-40 psu), Variable (18-40 psu), Full (30-40 psu), Variable (18-40 psu)
Depth range	lower shore to 35 m
Other preferences	No text entered
Migration Pattern	Non-migratory / resident

Habitat Information

-

Life history

Adult characteristics

Reproductive type	Gonochoristic (dioecious)
Reproductive frequency	Annual episodic
Fecundity (number of eggs)	No information
Generation time	1 year
Age at maturity	1 year
Season	See additional information
Life span	5-10 years

Larval characteristics

Larval/propagule type	-
Larval/juvenile development	Planktotrophic
Duration of larval stage	11-30 days
Larval dispersal potential	Greater than 10 km
Larval settlement period	Insufficient information

Life history information

The reproductive characteristics of *Venerupis senegalensis* vary according to the environment. In Scotland, Quayle (1952) recorded breeding between May and September. However, in northern Spain, spawning occurred in March, April and May (Perez Camacho, 1980). Spawning occurred 2 or more times in a season in a population in western Norway (Johannessen, 1973b) and it has been recorded that spawning can occur up to 4 times per season in *Venerupis senegalensis* (studied as *Venerupis pullastra*) raised in a microsystem (Jara-Jara *et al*., 2000). The Spanish population of *Venerupis senegalensis* (studied as *Venerupis pullastra*) experienced constant mortality of 17.7% per annum between shell lengths of 11 and 50 mm (Perez Camacho, 1980) whereas the Norwegian population exhibited low mortality up to year 8 followed by mass mortality attributed to senility (Johannessen, 1973b).

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	High

Venerupis senegalensis lives infaunally in mixed sandy sediments, often attached to small stones or shell fragments. Removal of the substratum would remove the entire population of the species and therefore intolerance is recorded as high. Recoverability is recorded as high (see additional information below).

	Intolerance	Recoverability	Sensitivity	Confidence
Smothering	Intermediate	High	Low	Low

Venerupis senegalensis typically burrows to a depth of 3-5 cm and is often attached to small stones or shell fragments by byssal threads. It is an active suspension feeder and therefore requires its siphons to be above the sediment surface in order to maintain a feeding and respiration current. Kranz (1972) (cited in Maurer *et al*., 1986) reported that shallow burying siphonate suspension feeders are typically able to escape smothering with 10-50 cm of their native sediment and relocate to their preferred depth by burrowing. This is likely to apply to the proportion of the *Venerupis senegalensis* population which is not firmly attached by byssal threads. However, those individuals which are attached may be inhibited from relocating rapidly following smothering with 5 cm of sediment and some mortality is expected to occur. Intolerance is therefore recorded as intermediate. Recoverability is recorded as high (see additional information below).

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

Venerupis senegalensis is an active suspension feeder, trapping food particles on the gill filaments (ctenidia). An increase in suspended sediment is therefore likely to affect both feeding and respiration by potentially clogging the ctenidia. In *Venerupis corrugatus*, increased particle concentrations between low and high tide resulted in increased clearance rates and pseudofaeces production with no significant increase in respiration rate (Stenton-Dozey & Brown, 1994). It seems likely therefore that *Venerupis senegalensis* would also be able to clear its feeding and respiration structures, although at high particle concentrations there may be some energetic cost. Over one month, there is not likely to be any mortality. Intolerance is therefore recorded as low. When the suspended sediment falls to typical levels, feeding and respiration would be expected to quickly return to normal so recoverability is recorded as very high.

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

Venerupis senegalensis is an active suspension feeder, feeding on phytoplankton and particulate organic food. A decrease in suspended sediment would decrease food availability and therefore may impair growth rates. However, over a one month period (the benchmark) it is unlikely that survival would be affected. Hence, intolerance is recorded as low. When turbidity returns to normal levels, growth rate should soon return to normal and hence recoverability is recorded as very high.

Dessication	Low	Very high	Very Low	Low

The majority of the population of *Venerupis senegalensis* live infaunally in muddy sand, a substratum with a high water content, and is therefore protected from desiccation stress. Additionally, bivalves are able to respond to desiccation stress by valve adduction during periods of emersion. It is likely that the species would be able to retain enough water in the shell to prevent mortality during the benchmark exposure period of one hour. However, during the period of emersion, the species would not be able to feed and respiration would be compromised, so there is likely to be some energetic cost. Intolerance is therefore recorded as low. On immersion, metabolic activity should quickly return to normal and recoverability is therefore recorded as very high.

Increase in emergence regime	Intermediate	High	Low	Low

Venerupis senegalensis occurs on the lower shore and so is vulnerable to an increase in emergence. The species does not colonize further up the shore and therefore must be limited by one or more factors including desiccation, temperature and wave exposure. The benchmark for emergence is an increase in exposure for one hour every tidal cycle for a year. During this time, exposed individuals will not be able to feed and respiration will be compromised. Over the course of a year, it is expected that the resultant energetic cost to the individuals highest up the shore will lead to some mortality and therefore intolerance is recorded as intermediate. Recoverability is recorded as high (see additional information below).

Decrease in emergence regime	Tolerant	Not relevant	Not sensitive	High

Venerupis senegalensis thrives in the subtidal zone and would therefore be tolerant of a decrease in emergence. It is possible that a decreased emergence regime would allow the species to colonize further up the shore.

Increase in water flow rate	Intermediate	High	Low	Low

Venerupis senegalensis thrives in low energy environments such as sheltered beaches where the tidal flow is weak (Connor *et al.*, 1997a). The benchmark for an increase in water flow would be a change to strong flow for one year (see glossary). This would place the species outside its habitat preferences and some mortality would be likely to occur, probably due to interference with respiration and feeding, although this is poorly understood. In addition, increased water flow rate will change the sediment characteristics in which the species lives, primarily by re-suspending and preventing deposition of finer particles (Hiscock, 1983). This may result in erosion of the preferred habitat, which would contribute further to mortality. Intolerance is therefore recorded as intermediate. Recoverability is recorded as high (see additional information below).

Decrease in water flow rate	Tolerant	Not relevant	Not sensitive	Low

Venerupis senegalensis thrives in low energy environments such as sheltered beaches where the tidal flow is weak (Connor *et al.*, 1997a). It is an active suspension feeder capable of generating its own feeding and respiration current by ciliary action. The species is therefore likely tolerate a decrease in water flow rate. However, it should be noted that decreases in water flow will also result in increased risk of smothering and changes in oxygenation. These factors are discussed in their relevant sections.

Increase in temperature	Low	Very high	Very Low	Moderate

The geographic range of *Venerupis senegalensis* extends to northern Africa. Therefore, the species must be capable of surviving in higher temperatures than it experiences in Britain and Ireland and thus would be expected to tolerate temperature change over an extended period.

A population of *Venerupis corrugatus* endured a temperature rise from 13 to 18°C over 5 hours in a rockpool and then a drop to 14°C following inundation by the tide, with no obvious ill effects (Stenton-Dozey & Brown, 1994). Albentosa *et al.* (1994) investigated the scope for growth of *Venerupis senegalensis* (studied as *Venerupis pullastra*) by considering rates of ingestion, respiration and excretion at varying temperatures. Scope for growth was found to increase with temperature until the optimum at 20°C after which it declined. Hence, it is expected that *Venerupis senegalensis* would be able to tolerate a long term, chronic temperature increase and a short term acute change with no mortality. However, a rapid increase in temperature may result in sub-optimal conditions for growth and reproduction and therefore an intolerance of low is recorded. When the temperature decreases, metabolic activity should quickly return to normal and therefore recoverability is recorded as very high.

Decrease in temperature Intermediate High Low Moderate

The geographic range of *Venerupis senegalensis* extends to northern Norway. Therefore, the species must be capable of survival at lower temperatures than it does in Britain and Ireland and would be expected to tolerate a chronic temperature decrease over an extended period. However, in the harsh British winter of 1962-63, when the south coast experienced temperatures 5-6°C below average for a period of 2 months, *Venerupis senegalensis* (studied as *Venerupis pullastra*) suffered 50% mortality around the Isle of Wight and near 100% mortality in Poole Harbour (Waugh, 1964). The species is less tolerant therefore of acute decreases in temperature and an intolerance of intermediate is recorded. Recoverability is recorded as high (see additional information below).

Increase in turbidity Low Very high Very Low Low

Venerupis senegalensis does not require light and therefore is not directly affected by an increase in turbidity for the purposes of light attenuation. An increase in turbidity may affect primary production in the water column and therefore reduce the availability of phytoplankton food. However, phytoplankton will also immigrate from distant areas and so the effect may be decreased. As the turbidity increase only persists for a year, decreased food availability would probably only affect growth and fecundity and an intolerance of low is recorded. As soon as light levels return to normal, primary production will increase and hence recoverability is recorded as very high.

Decrease in turbidity Tolerant Not relevant Not sensitive High

Venerupis senegalensis does not require light and therefore would not be affected by a decrease in turbidity for light attenuation purposes. It is possible that decreased turbidity would increase primary production in the water column and by micro-phyto benthos. The resultant increase in food availability may enhance growth and reproduction in *Venerupis senegalensis*, but only if food was previously limiting.

Increase in wave exposure Intermediate High Low Low

Venerupis senegalensis characteristically inhabits muddy sand in low energy environments. This suggests that it would, in some way, be intolerant of an increase in wave exposure. An increase in wave exposure by two categories for one year would be likely to affect the species in several ways. Fine sediments would be eroded (Hiscock, 1983) resulting in the likely reduction of the habitat of *Venerupis senegalensis*. Strong wave action may cause damage or withdrawal of the siphons, resulting in loss of feeding opportunities and compromised growth. Furthermore, individuals may be dislodged by scouring from sand and gravel mobilized by increased wave action. For the above reasons, some mortality would be likely to occur and intolerance is recorded as intermediate. Recoverability is recorded as high (see additional information below).

Decrease in wave exposure Tolerant Not relevant Not sensitive Low

Venerupis senegalensis characteristically inhabits muddy sand in low energy environments, including 'extremely sheltered' on the wave exposure scale (Connor *et al.*, 1997a). It is an active suspension feeder and is capable of maintaining a feeding and respiration current by ciliary action. It is therefore unlikely to be affected by a decrease in wave exposure. However, it should be noted that decreased wave exposure will lead to changes in oxygenation and increased risk of smothering due to siltation. These factors are discussed in their relevant sections.

Noise Tolerant Not relevant Not sensitive Low

No information was found concerning the intolerance of *Venerupis senegalensis* to noise. The siphons are likely to detect vibrations and are probably withdrawn as a predator avoidance mechanism, but the species is probably not sensitive at the level of the benchmark.

Visual Presence Tolerant Not relevant Not sensitive Low

No information was found concerning the intolerance of *Venerupis senegalensis* to visual disturbance. It is not a visual species and is not likely to be sensitive.

Abrasion & physical disturbance Intermediate High Low Low

Despite their robust body form, bivalves are vulnerable to physical abrasion. For example, as a result of dredging activity, mortality and shell damage has been reported in *Mya arenaria* and *Cerastoderma edule* (Cotter *et al.*, 1997). Similarly, beam trawling in sand sediments was shown to adversely affect a number of bivalve species depending on their size, the robustness of their shells or density (Bradshaw and van Santbrink, 2000). *Venerupis senegalensis* is a shallow burrower and may be damaged by the passing of a scallop dredge and so intolerance is recorded as intermediate. Recoverability is assessed as high (see additional information below).

Displacement Intermediate High Low Low

When displaced and returned to the surface of the substratum, *Venerupis senegalensis* is able to bury itself (e.g. Kaschl & Carballeira, 1999). This probably occurs naturally due to shifting sediments caused by storms. However, while exposed at the sediment surface, the species is more vulnerable to predation and some mortality may occur. Intolerance is therefore recorded as intermediate. Recoverability is recorded as high (see additional information below).

Chemical Pressures

	Intolerance	Recoverability	Sensitivity	Confidence
Synthetic compound contamination	High	High	Moderate	

No information was found concerning the effects of synthetic chemicals specifically on *Venerupis senegalensis*. However, inference can be drawn from related species. Beaumont *et al.* (1989) concluded that bivalves are particularly sensitive to tri-butyl tin (TBT), the toxic component of many antifouling paints. For example, when exposed to 1-3 µg TBT/l, *Cerastoderma edule* and *Scobicularia plana* suffered 100% mortality after 2 weeks and 10 weeks respectively. There is also evidence that TBT causes recruitment failure in bivalves, either due to reproductive failure or larval mortality (Bryan & Gibbs, 1991). *Venerupis decussata* was found to be a potentially useful indicator of TBT pollution; concentrating and tolerating high levels of the compound in its tissues (bioconcentration factors ranged from 10,000 to 40,000) (Gomez-Arica *et al.*, 1999). In light of the intolerance of other bivalve species, intolerance of

Venerupis senegalensis to synthetic chemicals is assessed as high. Recoverability is recorded as high (see additional information below).

Heavy metal contamination High High Moderate High

The capacity of bivalves to accumulate heavy metals in their tissues, far in excess of environmental levels, is well known. Reactions to sub-lethal levels of heavy metal stressors include siphon retraction, valve closure, inhibition of byssal thread production, disruption of burrowing behaviour, inhibition of respiration, inhibition of filtration rate, inhibition of protein synthesis and suppressed growth (see review by Aberkali & Trueman, 1985). Kaschl & Carballeira (1999) investigated the effect of sediment contamination on *Venerupis senegalensis* (studied as *Venerupis pullastra*) by exposing the species to sediments spiked with copper sulphate. Following placement of clams on the sediment surface, slowing of burial was observed in proportion to the concentration of copper added to the sediment. The effect was detectable at a pore water concentration of 95 µg Cu/l. At the highest copper concentrations (spiking solution concentration > 125 mg Cu/l), the majority of clams closed up and did not bury. Spiking of the sediments with copper also resulted in re-emergence between 24 and 120 hours after burial, a behaviour not observed in controls. The proportion of clams re-emerging increased with the copper concentration in the sediment, and was concluded to be an avoidance behaviour. Kaschl & Carballeira (1999) suggested that the delay in burial at low copper concentrations was due to physiological disruption as it did not avoid exposure to the toxin and further increased the risk of predation. At higher concentrations, there was a payoff between toxin avoidance (by valve closure or re-emergence) and predator avoidance. The copper 10 day LC_{50} for *Venerupis senegalensis* was found to be 88 µg/l in sandy sediments (Kaschl & Carballeira, 1999). For reference to polluted UK sediments, copper concentration in the interstitial water of Restronguet Creek sediments has been measured at 100µg/l (Bryan & Langston, 1992). Abbot (1977) investigated the intolerance of *Venerupis senegalensis* (studied as *Venerupis pullastra*) to molybdenum and concluded it not to be toxic at levels realistically encountered in the marine environment. In light of the lethal and sublethal effects of copper, intolerance of *Venerupis senegalensis* to heavy metals is assessed as high. Recoverability is recorded as high (see additional information below).

Hydrocarbon contamination Intermediate High Low

Suchanek (1993) reviewed the effects of oil on bivalves. Sublethal concentrations may produce substantially reduced feeding rates and/or food detection ability, probably due to ciliary inhibition. Respiration rates have increased at low concentrations and decreased at high concentrations. Generally, contact with oil causes an increase in energy expenditure and a decrease in feeding rate, resulting in less energy available for growth and reproduction. Sublethal concentrations of hydrocarbons also reduce byssal thread production (thus weakening attachment) and infaunal burrowing rates. No information was found on the effects of hydrocarbons on *Venerupis senegalensis* specifically. Mortality following oil spills has been recorded in other bivalve species, e.g. *Mya arenaria* (Dow, 1978; Johnston, 1984) and *Cerastoderma edule* (SEEEC, 1998). Therefore, it is possible that some mortality of *Venerupis senegalensis* would result from hydrocarbon contamination and an intolerance of intermediate is recorded. Recoverability is recorded as high (see additional information below).

Radionuclide contamination Not relevant Not relevant

Stamouli & Papadapoulou (1990) investigated bioaccumulation of radioactive trivalent Chromium 51 (Cr-51) in a *Venerupis* species from Greece. Cr-51 is derived from nuclear tests, disposal of radioactive waste and is one of the principal corrosion products of nuclear powered ships. Cr-51 was found to rapidly accumulate in *Venerupis* sp., predominantly in the shell, and reached a stable level in 8 days. No mortality was reported after 20 days. No further information was found concerning the effect of radionuclides on *Venerupis senegalensis*.

Changes in nutrient levels Intermediate High Low

No information regarding the direct effects of nutrients on *Venerupis senegalensis* was found. However, increased nutrients are likely to enhance ephemeral algal and phytoplankton growth, increase organic material deposition and enhance bacterial growth. At low levels, an increase in phytoplankton and benthic diatoms may increase food availability for *Venerupis senegalensis*, thus enhancing growth and reproductive potential (e.g. Beiras *et al.*, 1993). However, increased levels of nutrient (beyond the carrying capacity of the environment) may result in eutrophication, algal blooms and concomitant reductions in oxygen concentrations (e.g. Rosenberg & Loo, 1988). Rosenberg & Loo (1988) reported mass mortalities of *Mya arenaria* and *Cerastoderma edule* following a eutrophication event in Sweden, although no direct causal link was established. It is likely therefore that a dramatic increase in nutrient levels would cause some mortality of *Venerupis senegalensis* and so an intolerance of intermediate is recorded. Recoverability is recorded as high (see additional information below).

Increase in salinity Tolerant Not relevant Not sensitive High

Venerupis senegalensis inhabits areas with full salinity (Connor *et al.*, 1997a) and therefore probably relatively tolerant of increases in salinity. No information was found concerning intolerance to hypersaline conditions.

Decrease in salinity Intermediate High Low Low

No information was found concerning the effects of decreasing salinity on *Venerupis senegalensis* specifically. However, Lange (1972) reported that the muscle volume of *Venerupis rhomboides*, a stenohaline species, increased as salinity decreased, and hence concluded that the species was unable to regulate its muscle volume. Euryhaline bivalve species, however, e.g. *Mya arenaria*, *Cerastoderma edule*, were able to regulate muscle volume with changing salinity. *Venerupis japonica* displayed a variety of behavioural reactions in response to reduced salinity in the Sea of Japan (Yaroslavtseva & Fedoseeva, 1978). Salinities typically encountered ranged from 11-30 psu over the course of a day. *Venerupis japonica* was active down to 20 psu, below which it reacted with siphon withdrawal and valve closure. Mortality occurred if salinity remained below 14 psu for an extended period. *Venerupis senegalensis* occurs in variable salinity conditions (Connor *et al.*, 1997a). The benchmark includes a change of 2 categories on the salinity scale for a week (see glossary). This would place some of the population in a reduced salinity environment (<18 psu) and it is likely that some mortality would occur. An intolerance of intermediate is therefore recorded. Recoverability is recorded as high (see additional information below).

Changes in oxygenation Intermediate High Low Low

Venerupis senegalensis is an aerobic organism and therefore will be intolerant in some degree to lack of oxygen. No evidence was found for specific effects of reduced oxygenation on *Venerupis senegalensis* but inferences can be drawn from the effects on other species. Jorgensen (1980) recorded the effects of low oxygen levels on benthic fauna in a Danish fjord. At dissolved oxygen concentrations of 0.2-1.0 mg/l the bivalves, *Cerastoderma edule* and *Mya arenaria*, suffered mortality between 2 and 7 days. Rosenberg & Loo (1988) reported mass mortalities of *Mya arenaria* and *Cerastoderma edule* in Sweden, following a eutrophication event which resulted in low oxygen concentrations over several years (often <1 ml O_2/l). At the benchmark level of exposure (2 mg/l for one week) it is expected that some mortality of

Venerupis senegalensis would occur and an intolerance of intermediate is recorded. Recoverability is recorded as high (see additional information below).

Biological Pressures

	Intolerance	Recoverability	Sensitivity	Confidence
Introduction of microbial pathogens/parasites	Intermediate	High	Low	High

Navas *et al.* (1992) investigated the parasites of *Venerupis senegalensis* (studied as *Venerupis pullastra*), from a population in south west Spain. The following were recorded:

- 36.6% prevalence of *Perkinsus atlanticus*; trophozoites found in the connective tissue of different organs with a very intensive hemocytic response, encysting the parasite and destroying tissue structure,
- 96.6% prevalence of ciliates in gills, including *Trichodina* sp.,
- 11.8% prevalence of turbellarians,
- 11.1% prevalence of trematodes.

Perkinsus atlanticus was also recorded as causing mortality in *Venerupis decussatus* and *Venerupis aureus*. Freire-Santos *et al.* (2000) recorded the presence of oocysts of *Cryptosporidium* sp. in *Venerupis senegalensis* (studied as *Venerupis pullastra*) collected from north west Spain and destined for human consumption.
The parasite loads of *Venerupis senegalensis* have the potential to cause mortality and therefore an intolerance of intermediate is recorded. Recoverability is recorded as high (see additional information below).

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

No information was found concerning the intolerance of *Venerupis senegalensis* to alien or introduced species.

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

Venerupis senegalensis is a very important commercial shellfish in Spain. It is harvested from the wild and raised in aquaculture (Jara-Jara *et al.*, 2000). No information was found concerning the effect of harvesting on wild populations but it can be assumed that high mortality would occur in the intertidal where populations are more accessible to harvesters. However, not all individuals would be found and small ones would probably be left. The subtidal population is less likely to be exploited. An intolerance of intermediate is therefore recorded. Recoverability is recorded as high (see additional information below).

	Intolerance	Recoverability	Sensitivity	Confidence
Extraction of other species	Intermediate	High	Low	

Commercial extraction of other infaunal species is likely to have an effect on *Venerupis senegalensis* where their distributions overlap. Hall & Harding (1997) demonstrated that commercial cockle harvesting by suction dredging had significant effects on soft-sediment infaunal communities. Following dredging, species numbers were reduced by up to 30% and abundances by up to 50%. Bait harvesting has also been shown to impact infaunal bivalves. For example, mechanical harvesting for *Arenicola marina* resulted in drastic reduction in the population of *Mya arenaria* in the Wadden Sea (Beukema, 1995). Some mortality of *Venerupis senegalensis* may occur therefore due to harvesting of other species so an intolerance of intermediate is recorded. Recoverability is recorded as high (see additional information below).

Additional information

Venerupis senegalensis is a long lived, fast growing species that reaches maturity within one year and spawns several times in one season (Johannessen, 1973b; Perez Camacho, 1980). No information was found concerning number of gametes produced, but the number is likely to be high as with other bivalves exhibiting planktotrophic development (Olafsson *et al.*, 1994). The larvae remain in the plankton for up to 30 days (Fish & Fish, 1996) and hence have a high potential for dispersal. Given these life history features, it is expected that *Venerupis senegalensis* would have strong powers of recoverability. However, recoverability will be influenced by pre and post recruitment processes. The species exhibits pronounced year class variability in abundance (Johannessen, 1973b; Perez Camacho, 1980) which suggests that recruitment is patchy and/or post settlement processes are highly variable. Olafsson *et al.* (1994) reviewed the potential effects of pre and post recruitment processes. Recruitment may be limited by predation of the larval stage or inhibition of settlement due to intraspecific density dependent competition. Post settlement processes affecting survivability include predation by epibenthic consumers, physical disturbance of the substratum and density dependent starvation of recent recruits. Hence, for *Venerupis senegalensis*, an annual predictable population recovery is not certain. However, given the strong powers of recoverability discussed above it is expected that recovery would occur within 5 years and therefore is recorded as high.

Importance review

Policy/legislation

- no data -

Status

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

Non-native

Native	-		
Origin	-	Date Arrived	-

Importance information

Predation

Johannessen (1973a) observed predation of *Venerupis senegalensis* by oystercatchers, *Haemotopus ostralegus*. It was suggested that predation by shore birds may explain why intertidal populations of *Venerupis senegalensis* were dominated by small individuals, as the larger ones were preferentially predated.

Management

Venerupis senegalensis is harvested from the wild in Spain and is also the subject of commercial aquaculture (Jara-Jara *et al*., 2000). It has been the subject of extensive research concerning diet and growth rate (e.g. Albentosa *et al*., 1993; Beiras *et al*., 1993). Jara-Jara *et al.* (2000) suggested the possibility of raising *Venerupis senegalensis* in the effluent from fin fish aquaculture.

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