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

Sand goby (*Pomatoschistus minutus*)

MarLIN – Marine Life Information Network
Biology and Sensitivity Key Information 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/1204]. All terms and the MarESA methodology are outlined on the website (https://www.marlin.ac.uk)

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Top view of entire individual on sand.
Photographer: Charlotte Johnston
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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	Karen Riley	**Refereed by**	Dr Angus Jackson
Authority	(Pallas, 1770)		
Other common names	-	**Synonyms**	-

Summary

Description

The sand goby is a small goby, reaching a maximum of 10 cm in length. It has a slender body and the head is about a quarter of the total length. It is pale brown or grey in colour with darker markings on the sides. The underside is creamy-white in colour. Males often have a prominent dark blue spot on the rear of the first dorsal fin.

Recorded distribution in Britain and Ireland

The sand goby is abundant along all British and Irish coasts.

Global distribution

Its distribution extends from the eastern Atlantic (Tromso, Norway) to the Mediterranean and areas of the Baltic Sea.

Habitat

Pomatoschistus minutus is found on sandy or muddy bottoms usually to a depth of about 20 m, but sometimes occurring up to 60-70 m depths. They are usually present in estuaries, lagoons, salt marshes and along coastal waters.

Depth range

Up to 20 m (sometimes up to 60-70 m)

Identifying features

- The sand goby has large eyes that are positioned high on the side of the head.
- There are scales present on the nape and neck.
- Upper rays of pectoral fins have membrane to their tips.
- Tail is rounded, narrow and long.
- Pelvic fins are united to form a crescent-shaped disc.
- Anterior dorsal fin has 6-7 spines.
- Posterior dorsal fin has 1 spine and 10-12 rays.
- There are 55-75 scales in a line from base of pectoral fin to tail fin.

Additional information

Pomatoschistus minutus is a very abundant fish which is present along all British and Irish coasts. Its distribution extends from the eastern Atlantic (Tromso, Norway) to the Mediterranean and to areas of the Baltic Sea. *Pomatoschistus minutus* is a spawning and thermal migratory species. It is usually found on sandy or muddy bottoms to a depth of about 20 m, but may occur up to 60-70 m depths.

Pomatoschistus minutus is sometimes considered to form a species complex with *Pomatoschistus norvegicus* and *Pomatoschistus lozanoi*. *Pomatoschistus lozanoi* is morphologically intermediate between the other forms and may interbreed with them in the wild (Webb, 1980). However, evidence suggests that back-crossing of the resultant hybrids does not occur and *Pomatoschistus lozanoi* is genetically distinct from the other forms (Webb, 1980).

Listed by

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Further information sources

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Biology review

Taxonomy

Phylum	Chordata	Sea squirts, fish, reptiles, birds and mammals
Class	Actinopterygii	Ray-finned fish, e.g. sturgeon, eels, fin fish, gobies, blennies, and seahorses
Order	Perciformes	
Family	Gobiidae	
Genus	Pomatoschistus	
Authority	(Pallas, 1770)	
Recent Synonyms	-	

Biology

Typical abundance	High density
Male size range	up to 10cm
Male size at maturity	4cm
Female size range	4cm
Female size at maturity	
Growth form	Pisciform
Growth rate	No information found
Body flexibility	High (greater than 45 degrees)
Mobility	
Characteristic feeding method	Predator
Diet/food source	
Typically feeds on	Small polychaetes, cumaceans, amphipods and mysids.
Sociability	
Environmental position	Demersal
Dependency	Independent.
Supports	None
Is the species harmful?	No

Biology information

- The sand goby usually remains inactive, except when feeding (Fonds & Veldhuis, 1973). *Pomatoschistus minutus* feeds on small polychaetes, cumaceans, amphipods and mysids. Depending on the bottom type, it has been noted to show colour adaptations (Aquascope, 2000b), and has also been noted to burrow into the sediment to avoid predators (Magnhagen & Forsgren, 1991).
- The sand goby is a small goby, reaching a maximum of 10 cm in length. Males are generally longer than females (Quignard *et al.*, 1983). Growth is slower in winter in the Atlantic, and slower in the summer in the Mediterranean (Quignard *et al.*, 1983). Larvae gradually spend more and more time on the bottom, and at a length of approximately 17-18 mm they are usually fully adapted to the benthic way of life.
- Although of no commercial importance itself, it is incidentally caught in abundance in

French Mediterranean lagoons (Quignard *et al.*, 1983).

Habitat preferences

Physiographic preferences	Open coast, Estuary, Isolated saline water (Lagoon), Enclosed coast / Embayment
Biological zone preferences	Lower infralittoral, Sublittoral fringe, Upper infralittoral
Substratum / habitat preferences	Coarse clean sand, Fine clean sand, Mixed, Mud, Muddy sand, Sandy mud
Tidal strength preferences	
Wave exposure preferences	Exposed, Moderately exposed, Sheltered
Salinity preferences	Full (30-40 psu), Variable (18-40 psu)
Depth range	Up to 20 m (sometimes up to 60-70 m)
Other preferences	No text entered
Migration Pattern	Seasonal (environment), Seasonal (reproduction)

Habitat Information

- The sand goby is considered to be an abundant species, found along all coasts of the British Isles. It can tolerate a wide range of temperatures and salinities, shown by its distribution from Norway and the Baltic Sea to the Mediterranean, and the fact that it resides in brackish and fully saline waters. It is usually found in deeper waters and at higher salinities than *Pomatoschistus microps*.
- Fonds (1973) showed that adult sand gobies tolerate salinities between 0.9 psu and 45 psu and that they survived and remained in good condition at a temperature as low as 2 °C. However, in the Thames estuary they preferred high salinity and high suspended solids concentrations (Araújo *et al.*, 2000).
- *Pomatoschistus minutus* is a migratory species of semi-enclosed lagoon-like environments (Pampoulie *et al.*, 1999). It has been noted to undertake spawning migrations in the Mediterranean Sea (Bouchereau *et al.*, 1989) and thermal migrations in the North Sea and the Baltic Sea (Fonds, 1973; Hesthagen, 1977). Thermal migrations occur when temperatures decrease below 4-5 °C (Fonds, 1973) or increase above 19 °C (Hesthagen, 1977). In the Thames estuary an increase in numbers has been noted during autumn and winter (Araújo *et al.*, 2000). In the Severn estuary, however, goby numbers declined in winter. This was suspected to have reflected a movement away from the shallows and towards deeper, warmer water (Claridge *et al.*, 1985). Healey (1971) observed a scarcity of sand gobies in the Ythan estuary from February to June and, after eliminating decreased temperature, a change in salinity or a change in food supply as a cause, suggested that it was a result of a seasonal migration. Healey (1971) hypothesized that the gobies migrated out to sea so that eggs could develop, however, the hypothesis was subsequently rejected.

Life history

Adult characteristics

Reproductive type	Gonochoristic (dioecious)

Reproductive frequency	Annual protracted
Fecundity (number of eggs)	1,000-10,000
Generation time	1-2 years
Age at maturity	7 months to a year old
Season	February - July
Life span	1-2 years

Larval characteristics

Larval/propagule type	-
Larval/juvenile development	Oviparous
Duration of larval stage	2-10 days
Larval dispersal potential	Greater than 10 km
Larval settlement period	Insufficient information

Life history information

- The sand goby becomes sexually mature at about 7 months to a year old (Miller, 1986; Bouchereau *et al.*, 1990). At this time, individuals measure approximately 4 cm (Bouchereau *et al.*, 1990). Reproduction involves repeat spawning between February and May in Britain, and March to July in the Baltic Sea (Miller, 1986). The female usually lays her eggs under empty bivalve shells and the male proceeds to guard them. Males care for approximately 2 egg batches at the same time, belonging to different females (Kvarnemo, 1994), and females respawn with an interval of about 1 to 2 weeks (Kvarnemo, 1998). Fecundity is reported as between 2,878 - 3,000 eggs by Miller (1986) and between 998 and 5100 by Bouchereau *et al.* (1990).
- *Pomatoschistus minutus* spawns at 8 to 15 °C, lower than that of the *Pomatoschistus microps* (Wiederholm, 1987). In the Atlantic reproduction is protracted (Bouchereau & Guelorget, 1998; Rogers, 1989) and in the Mediterranean it is contracted (Bouchereau & Guelorget, 1998).
- The lifespan of the sand goby is approximately 1.3 to 2 years (Miller, 1986). Quignard *et al.* (1983) recorded lifespans of the sand goby as 12 to 14 months in the Mediterranean and up to 22 months in the Atlantic.

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	Low	High	Low	Moderate

Adult *Pomatoschistus minutus* live on inshore sandy and muddy substrata in open coastal areas, whereas juveniles are found in lower estuaries. The sand goby has been noted to show colour adaptations, depending on the bottom type (Aquascope, 2000), and has also been noted to burrow into the sediment when under attack (Magnhagen & Forsgren, 1991). Their substratum is therefore important to them for the purpose of protection. Loss of substrata may cause a proportion of the species to die. However, adults are sufficiently mobile and will be able to recolonize areas which contain suitable substrata. A low intolerance to substratum loss is recorded. Recoverability is likely to be high (see Additional Information section (1) below).

	Intolerance	Recoverability	Sensitivity	Confidence
Smothering	Intermediate	High	Low	Moderate

Pomatoschistus minutus will not be affected by smothering as they are mobile and able to swim away. However, destruction of habitat is important. Cordone & Kelley (1961) reported that (in a freshwater habitat) deposition of sediment on the bottom of the substratum would destroy needed shelter, reduce the availability of food, impair growth and lower the survival rate of eggs and larvae of fish. It is likely that, due to the ability of adult *Pomatoschistus minutus* to burrow into the sediment, they will only be slightly intolerant of smothering. However, if smothering occurred during the breeding season destruction of broods of eggs is possible. Materials such as concrete, oil or tar are likely to have a greater negative impact on the population. An intermediate intolerance to smothering has been recorded. Recoverability is likely to be high (see Additional Information section (1) below).

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

Moore (1977) indicated that an increase in siltation can have a negative effect on the growth of adult fish, survival of eggs and larvae and pathological effects on gill epithelia. However, bottom-dwelling species are generally found to be tolerant of suspended solids and juveniles have been reported as being more intolerant of siltation than adults (Moore, 1977). Araújo *et al.* (2000) found that *Pomatoschistus minutus* was preferentially found in areas of high suspended sediment in the Thames estuary. On balance, tolerant has been suggested with a low confidence.

Decrease in suspended sediment

	Intolerance	Recoverability	Sensitivity	Confidence
Dessication	Low	High	Low	Moderate

Pomatoschistus minutus is found in inshore coastal waters. The animal is soft-bodied, so stranding of the individual, and subsequent exposure to sunshine and air for an hour would more than likely result in a proportion of the population dying. This event, however, is unlikely to occur as the sand goby is sufficiently mobile to avoid this situation and can burrow into the sediment to survive low water levels. In an experiment designed to investigate the ecological importance of the sand goby, Jaquet & Raffaelli (1989) set up cages on an intertidal mudflat in the Ythan estuary. They reported that the gobies were apparently unaffected by the presence or absence of water and that many of the fish were entirely buried at the sediment surface. Intolerance to desiccation has therefore been assessed as low. Recoverability is likely to be high (see Additional Information section (1) below).

Increase in emergence regime	Tolerant	Not relevant	Not sensitive	Moderate

It is unlikely that *Pomatoschistus minutus* would be affected by a change in the emergence regime as it is sufficiently mobile to avoid its effects.

Decrease in emergence regime

Increase in water flow rate	Low	Very high	Very Low	Low

It is unlikely that the sand goby could withstand a large increase in water flow rate, as this would decrease its ability to feed, migrate and reproduce. However, it is sufficiently mobile to avoid effects and so intolerance is assessed as low.

Decrease in water flow rate

Increase in temperature	Intermediate	High	Low	Moderate

The geographical distribution of *Pomatoschistus minutus* extends from the north-eastern Atlantic (Tromso, Norway) to the Mediterranean and areas of the Baltic Sea. *Pomatoschistus minutus* populations in southern waters are therefore exposed to warmer waters, and those in northern waters are exposed to colder waters. Long term increases in temperature due to climate warming would be unlikely to have an effect on the population.
As temperature is important in determining the distribution of the sand goby (e.g. winter migration), Wiederholm, (1987) suggested that a cold summer may reduce the population density and a series of cold years may wipe out the northernmost population. During the severe winter of 1962-63 there was heavy mortality of observed populations of *Gobius paganellus*, *Gobius minutus* and *Gobius flavens* (Crisp (ed.), 1964). Therefore a decrease in temperature may affect populations in the British Isles, by either shifting the geographical distribution further southwards towards warmer waters, or killing a proportion of the northern-most population.
Furthermore, temperature could also have an effect on the time and duration of the breeding season. For example, *Pomatoschistus minutus* spawns at 8 to 15 °C. Therefore, temperatures outside this range would decrease the ability of the species to spawn, and also decrease the hatching success rate of their eggs. Sensitivity to a temperature increase is recorded as low, whereas a decrease in temperature is likely to cause a proportion of the population to die and is therefore recorded as intermediate. Recoverability is likely to be high (see Additional Information section (1) below).

Decrease in temperature

Increase in turbidity	Low	High	Low	Moderate

Pomatoschistus minutus does not depend on algae as a food source, but depends on other food sources (such as Crustacea and polychaetes). These would still be readily available. The minimum light intensity needed for the detection and recognition of food are of great importance in many species of fish (Kinne, 1970). For instance if the organism needs to spend more time foraging for food, its energy expenditure will increase and could possibly lead to growth and reproductive problems. In highly turbid waters fish larvae have been noted to show a greater than normal mortality. It is probable that *Pomatoschistus minutus* would be intolerant of changes in turbidity on a large scale, but probably not with changes of approximately 50 mg/l over a month. Therefore, a low intolerance to changes in turbidity has been recorded. Recoverability is likely to be high (see Additional Information section (1) below).

Decrease in turbidity

Increase in wave exposure Tolerant | Not relevant | Not sensitive | Not relevant

The sand goby is sufficiently mobile to move away from the area undergoing changes in wave exposure, therefore it is assigned a low intolerance. Recoverability is likely to be high (see Additional Information section (1) below).

Decrease in wave exposure

Noise

Insufficient information.

Visual Presence Low | High | Low | Low

Fish generally forage for food using visual methods and can detect differing levels of light and shade. It is therefore probable that *Pomatoschistus minutus* can also detect these changes and would be slightly affected by activity on the shore, more so in the breeding season. However, periods of time when activity might be reduced due to hiding would most likely be slight. Intolerance to visual presence is assessed as low. Recoverability is likely to be high (see Additional Information section (1) below).

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

Pomatoschistus minutus is sufficiently mobile to avoid abrasive contact. Therefore it is unlikely to suffer from abrasion.

Displacement Low | High | Low | Low

It is unlikely that *Pomatoschistus minutus* would be affected by displacement, as it is sufficiently mobile to recolonize other areas. However, if displacement occurs during the breeding season negative effects on the species could be noted. Furthermore, if a male that is protecting fertilized eggs is displaced, the eggs are not likely to survive. Therefore, a low intolerance has been recorded. Recoverability is likely to be high (see Additional Information section (1) below).

Chemical Pressures

	Intolerance	Recoverability	Sensitivity	Confidence
Synthetic compound contamination	Intermediate	High	Low	Low

Lindane is likely to bioaccumulate significantly and is considered to be highly toxic to fish (Cole *et al*., 1999). Ebere & Akintonwa (1992) conducted experiments on the toxicity of various pesticides to *Gobius* sp. They found Lindane and Diazinon to be very toxic, with 96 hr LC_{50s} of 0.25 µg/l and 0.04 µg/l respectively. TBT is very toxic to algae and fish. However, toxicity of TBT is highly variable with 96-hr LC_{50} ranging from 1.5 to 36 µg/l, with larval stages being more sensitive than adults (Cole *et al*., 1999). PCBs are highly persistent in the water column and sediments, have the potential to bioaccumulate significantly and can be very toxic to marine invertebrates. However their toxicity to fish is not clear (Cole *et al*., 1999). Therefore, an Intermediate intolerance has been recorded. Recoverability is likely to be high (see Additional Information section (1) below).

Heavy metal contamination High High Moderate Low

Cadmium, mercury, lead, zinc and copper are highly persistent, have the potential to bioaccumulate significantly and are all considered to be very toxic to fish (Cole *et al.*, 1999). Mueller (1979) found that in *Pomatoschistus* sp., very low concentrations of cadmium, copper and lead (0.5 g/l Cd^{2+}; 5 g/l Cu^{2+}; 20 g/l Pb^{2+}) brought about changes in activity and an obstruction to the gill epithelia by mucus.
Inorganic mercury concentrations as low as 30 µg/l (96-h LC_{50}) are considered to be toxic to fish, whereas organic mercury concentrations are more toxic to marine organisms (World Health Organisation, 1989, 1991). Oertzen *et al.* (1988) found that the toxicity of the organic mercury complex exceeded that of $HgCl_2$ by a factor of 30 for *Pomatoschistus microps*. As *Pomatoschistus microps* and *Pomatoschistus minutus* are similar in their distribution and morphology (Wiederholm, 1987) it is probable that *Pomatoschistus minutus* would react in the same way. Therefore, a high intolerance to heavy metals has been recorded. Recoverability is likely to be high (see Additional Information section (1) below).

Hydrocarbon contamination Intermediate High Low Moderate

Toxicity of low molecular weight poly-aromatic hydrocarbons (PAH) to organisms in the water column is moderate (Cole *et al.*, 1999). They have the potential to accumulate in sediments and, depending on individual PAH, to be toxic to sediment dwellers at levels between 6 and 150 µg/l (Cole *et al.*, 1999). The toxicity of oil and petrochemicals to fish ranges from moderate to high (Cole et al., 1999). Berge *et al.* (1983) performed an experiment on the effects of the water soluble fraction (WSF) of North Sea crude oil on sand gobies. They found that after 1 to 2 days exposure to WSF crude oil at a concentration of 0.1 to 1.0 ppm, there was increased mortality and decrease in normal nocturnal behaviour. After 6 days exposure, a 50 % survival was noted. Berge *et al.* (1983) also noted that, after restoration of clean sea water normal activity resumed and mortality gradually became less, although some fish still died.
Bowling *et al.* (1983) found that anthracene, a PAH, had a photo-induced toxicity to the bluegill sunfish. In fact, Bowling *et al.* (1983) reported that when exposed to sunlight, anthracene was at least 400 times more toxic than when no sunlight was present. According to Ankley *et al.* (1997) only a subset of PAH's are phototoxic (fluranthene, anthracene, pyrene etc.). Effects of these compounds are destruction of gill epithelia, erosion of skin layers, hypoxia and asphyxiation (Bowling *et al.*, 1983). It is possible that *Pomatoschistus minutus* could be similarly intolerant of hydrocarbons, however this is not known. An intermediate intolerance to hydrocarbons has been recorded. Recoverability is likely to be high (see Additional Information section (1) below).

Radionuclide contamination Intermediate High Low Very low

Kinne (1984) reported that for the marine goby, *Chasmichthys glosus*, doses of as little as 100 rad (type not known) produced a readily observable response, causing severe damage to gonads of both males and females. The testes showed slightly greater intolerance. It is probable that *Pomatoschistus minutus* would respond similarly to sublethal irradiation at levels indicated above. An intermediate intolerance to radionuclides has been recorded. Recoverability is likely to be high (see Additional Information section (1) below).

Changes in nutrient levels Tolerant Not relevant Not sensitive Low

An increase or decrease in nutrient levels is not likely to exert an effect on the sand goby.

Increase in salinity Low High Low Low

Fonds (1973) found that the sand goby could tolerate salinities between 0.9 and 45 psu. Healey (1971) investigated survival of eggs at various salinities at a temperature of 11-13 °C.

He found that they survived best at salinities between 10 and 25 psu, and poorly at 0 and 35 psu. Healey (1971) also found poor survival of sand goby eggs at 0.5 psu. The sand goby is therefore able to survive in a wide range of salinities, and its intolerance is recorded as low. Recoverability is likely to be high (see Additional Information section (1) below).

Decrease in salinity

	Intolerance	Recoverability	Sensitivity	Confidence
Changes in oxygenation	Low	High	Low	Very low

A drastic short term decrease in oxygen levels would be expected to have a slight negative impact on the population. Peterson & Peterson (1990) found that the sand goby became restless at oxygen levels below 40 %. It was not known if the increased activity was due to respiratory stress or through adaptation to lower oxygen saturation. Where deoxygenation occurs as a result of thermal isolation of enclosed waters or decay following a plankton bloom, sand gobies would be expected to swim away from the affected area. Intolerance to oxygenation is assessed as low. Recoverability is likely to be high (see Additional Information section (1) below).

Biological Pressures

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

Podocotyle atomon (Digenea) was noted to have a very high infestation rate in *Pomatoschistus minutus* (Zander *et al.*, 1993). *Neoechinorhynchus Rutili* (Acanthocephala), *Hysterothylacium* sp. (Nematoda), and *Bothriocephalus scorpii* (Cestoda) were also noted by Zander *et al.* (1993) to infest the sand goby, in the SW Baltic Sea. Although no information was found about specific effects of these parasites on the sand goby, it is likely that it will cause a reduction in its fitness. High parasite levels have very little effect on *Pomatoschistus microps* (T. Matthews, pers. comm. to A. Jackson). Therefore, a low intolerance has been recorded. Recoverability is likely to be high (see Additional Information section (1) below).

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

No alien or non-native species are known to affect *Pomatoschistus minutus* in Britain and Ireland.

Extraction of this species	Low	High	Low	Low

Although of no commercial importance itself, the sand goby is incidentally caught in abundance in French Mediterranean lagoons (Quignard *et al.*, 1983). The species is extremely common, and therefore extraction of the species is only likely to have slight effects on the population. Recoverability is likely to be high (see Additional Information section (1) below).

Extraction of other species	Low	Very high	Very Low	Low

Pomatoschistus minutus is not known to depend on any other species. Although of no commercial importance itself, it is incidentally caught in abundance in French Mediterranean lagoons (Quignard *et al.*, 1983). Therefore, it is likely to be intolerant of fish trawls for the extraction of other species.

Additional information

1. The sand goby becomes sexually mature at about 7 months to a year old (Miller, 1986).

Although it has a short life span of about 1.3 to 2 years (Miller, 1986; Quignard *et al.*, 1983), reproduction involves repeat spawning and fecundity is high (2,878 - 3,000 Miller, 1986).

2. The impact of sewage sludge, which contains metals, organic contaminants, nutrients and parasites, on *Pomatoschistus minutus* was tested by Waring *et al.* (1996). This was achieved by exposing individuals to 0.1 % sewage sludge for 19 weeks prior to the end of spawning. Waring *et al.* (1996) found that although fecundity of female sand gobies was not affected, the survival rate of eggs and larvae was reduced, the number of spawning females was reduced, and male mortality was higher than usual. Contamination by sewage sludge would therefore decrease the recruitment potential and increase the mortality rate, leading to a decline in the overall population density.

Importance review

Policy/legislation

Berne Convention	Appendix III
Priority Marine Features (Scotland)	☑

Status

National (GB) importance	Not rare/scarce	**Global red list (IUCN) category**	-

Non-native

Native	-		
Origin	-	**Date Arrived**	Not relevant

Importance information

Pomatoschistus minutus is protected under the Bern Convention, Appendix III (Protected Fauna Species). Under this the species is protected, but a certain exploitation is possible if the population level permits.

Bibliography

Ankley, G.T., Erickson, R.J., Sheedy, B.R., Kosian, P.A., Mattson, V.R. & Cox, J.S., 1997. Evaluation of models for predicting the phototoxic potency of polycyclic aromatic hydrocarbons. *Aquatic Toxicology*, **37**, 37-50.

Aquascope, 2000b. More about the sand goby. [On-line] http://www.vattenkikaren.gu.se/fakta/arter/chordata/teleoste/pomaminu/pomami1e.html, 2001-02-22

Araújo, F.G., Williams, W.P. & Bailey, R.G., 2000. Fish assemblages as indicators of water quality in the middle Thames Estuary, England (1980-1989). *Estuaries*, **23**, 305-317.

Berge, J.A., Johannessen, K.I. & Reiersen, L.O., 1983. Effects of the water soluble fraction of the North Sea crude oil on the swimming activity of the sand goby, *Pomatoschistus minutus* (Pallas). *Journal of Experimental Marine Biology and Ecology*, **68**, 159-167.

Bouchereau, J.L, Joyeux, J.C. & Quignard, J.P., 1989. La reproduction de *Pomatoschistus microps* (Kroyer, 1938), Poissons, Gobiides, dans la lagune de Mauguio. (France). *Bulletin d'ecologie*, **20**, 193-202.

Bouchereau, J.L. & Guelorget, O., 1998. Comparison of 3 Gobiidae (Teleostei) life history strategies over their geographical range. *Oceanologica Acta*, **21**, 503-517.

Bouchereau, J.L., Quignard, J.P., Tomansi, J.A. & Capape, C., 1990. Sexual cycle, condition, fecundity and spawning of *Pomatoschistus minutus* (Pallas, 1770) (Gobiidae), from the Gulf of Lion, France. *Cybium*, **14**, 251-267.

Bowling, J.W., Leversee, G.J., Landrum, P.F. & Giesy, J.P., 1983. Acute mortality of anthracene-contaminated fish exposed to sunlight. *Aquatic Toxicology*, **3**, 79-90.

Bruce, J.R., Colman, J.S. & Jones, N.S., 1963. *Marine fauna of the Isle of Man.* Liverpool: Liverpool University Press.

Campbell, A., 1994. *Seashores and shallow seas of Britain and Europe.* London: Hamlyn.

Claridge, P.N., Hardisty, M.W., Potter, I.C. & Williams, C.W., 1985. Abundance, life history and ligulosis in the gobies (Teleostei) of the inner Severn estuary. *Journal of the Marine Biological Association of the United Kingdom*, **65**, 951-968.

Cordone, A.J. & Kelley, D.W., 1961. The influences of inorganic sediment on the aquatic life of streams. *California Fish Game*, **47**, 189-228.

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.

Ebere, A.G. & Akintonwa, A., 1992. Acute toxicity of pesticides to *Gobius* sp., *Palaemonetes africanus*, and *Desmocaris trispimosa*. *Bulletin of Environmental Contamination and Toxicology*, **49**, 588-592.

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.

Fonds, M. & Veldhuis, C., 1973. The oxygen consumption of four *Pomatoschistus* species (Pisces, Gobiidae) in relation to water temperature. *Netherlands Journal of Sea Research*, **7**, 376-386.

Fonds, M., 1973. Sand gobies in the Dutch Wadden Sea (*Pomatoschistus*, Gobiidae, Pisces). *Netherlands Journal of Sea Research*, **6**, 417-478.

Froese, R. & Pauly, D. (ed.), 2000e. Species summary for *Pomatoschistus minutus*, sand goby. http://www.fishbase.org, 2001-02-22

Geffen, A.J., Pearce, N.J.G. & Perkins, W.T., 1998. Metal concentrations in fish otoliths in relation to body composition after laboratory exposure to mercury and lead. *Marine Ecology Progress Series*, **165**, 235-245.

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

Healey, M.C., 1971. The distribution and abundance of sand gobies, *Gobius minutus*, in the Ythan estuary. *Journal of Zoology, London*, **163**, 177-229.

Hesgathen, I.H., 1977. Migrations, breeding and growth in *Pomatoschistus minutus* (Pallas) (Pisces, Gobiidae) in Oslofjorden, Norway. *Sarsia*, **63**, 17-26.

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.]

Jaquet, N. & Raffaelli, D., 1989. The ecological importance of the sand goby *Pomatoschistus minutus* (Pallas). *Journal of Experimental Marine Biology and Ecology*, **128**, 147-156

Kinne, O. (ed.), 1970. *Marine Ecology: A Comprehensive Treatise on Life in Oceans and Coastal Waters. Vol. 1 Environmental Factors Part 1.* Chichester: John Wiley & Sons

Kinne, O. (ed.), 1984. *Marine Ecology: A Comprehensive, Integrated Treatise on Life in Oceans and Coastal Waters.*Vol. V. *Ocean Management Part 3: Pollution and Protection of the Seas - Radioactive Materials, Heavy Metals and Oil.* Chichester: John Wiley & Sons.

Kvarnemo, C., 1994. Temperature differentially affects male and female reproductive rates in the sand goby: consequences for operational sex ratio. *Proceedings of the Royal Society of London, Series B,*, **256**, 151-156.

Kvarnemo, C., 1998. Temperature modulates competitive behaviour: why sand goby males fight more in warmer water. *Ethology*, *Ecology and Evolution*, **10**, 105-114.

Magnhagen, C. & Forsgren, E., 1991. Behavioural responses to different types of predators by sand goby *Pomatoschistus minutus*: An experimental study. *Marine Ecology Progress Series*, **70**, 11-16.

Miller, P.J., 1986. Gobiidae. P. 1019 - 1085. Fishes of the North-eastern Atlantic and Mediterranean. In Whitehead, P.J.P., Bauchot, M.-L., Hureau, J.C., Nielson, J., & Tortonese, E. (eds.), Paris: UNESCO, vol. 3

Moore, P.G., 1977a. Inorganic particulate suspensions in the sea and their effects on marine animals. *Oceanography and Marine Biology: An Annual Review*, **15**, 225-363.

Mueller, D., 1979. Sublethal and lethal effects of copper, cadmium and lead to organisms representative for the intertidal flats at the outer Elbe Estuary. *Archiv fur hydrobiologie*, supplement **43** (2-3), 289-346.

Oertzen, J.-A., Wulf, D. & Bruegmann, L., 1988. Ecotoxicological effects of two mercury compounds on *Neomysis integer* (Leach) and *Pomatoschistus microps* (Kroyer). *Kieler Meeresforschungen Sonderheft*, **6**, 414-123.

Pampoulie, C., Rosecchi, E. & Bouchereau, J.L., 1999. Life history traits of *Pomatoschistus minutus* in the Rhone Delta, France. *Journal of Fish Biology*, 55, **4**, 892-896.

Peterson, C.G.J., 1919. On the development of our common gobies (*Gobius*) from the egg to the adult stages etc. Report of the Danish Biological Station to the Board of Agriculture, **26**, 3-16.

Peterson, J.K. & Peterson, G.I., 1990. Tolerance, behaviour and oxygen consumption in the sand goby, *Pomatoschistus minutus* (Pallas), exposed to hypoxia. *Journal of Fish Biology*, **37**, 921-933.

Quignard, J.P., Mazoyer-Mayere, C., Vianet, R., Man-Wai, R. & Benharrat, K., 1983. Un exemple d'exploitation lagunaire en Langue-doc: l'etang de l'Or (Mauguio). Peche et production halieutique. *Science peche*, **336**, 3-23.

Rogers, S.I., 1989. Seasonal variations in fecundity and egg size of the common goby, *Pomatoschistus microps*. *Journal of the Marine Biological Association of the United Kingdom*, **69**, 535-543.

Russell, F.S., 1976. The eggs and planktonic stages of British marine fishes.

Waring, C.P., Stagg, R.M., Fretwell, K., MsKlay, H.A. & Costello, M.J., 1996. The impact of sewage sludge exposure on the reproduction of the sand goby, *Pomatoschistus minutus*. *Environmental Pollution*, 93, **1**, 17-25.

Webb, C.J., 1980. Systematics of the *Pomatoschistus minutus* complex (Teleostei: Gobioidei). *Philosophical Transactions of the Royal Society of London, Series B*, **291**, 201-241.

WHO (World Health Organization), 1989. Mercury - Environmental Aspects. *Environmental Health Criteria No. 86*. Geneva: World Health Organization., Geneva: World Health Organization.

WHO (World Health Organization), 1991. Mercury - inorganic - Environmental Aspects. *Environmental Health Criteria No. 118*. Geneva: World Health Organization., Geneva: World Health Organization.

Wiederholm, A.M., 1987. Distribution of *Pomatoschistus minutus* and *Pomatoschistus microps* (Gobiidae, Pisces) in the Bothnian Sea: importance of salinity and temperature. *Memoranda Societatis Pro Fauna and Flora Fennica*, **63**, 56-62.

Zander, C.D., Strohbach, U. & Groenewold, S., 1993. The importance of gobies (Gobiidae, Teleostei) as hosts and transmitters of parasites in the SW Baltic. *Helgolander Meeresuntersuchungen*, **47**, 81-111.

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.

Cofnod – North Wales Environmental Information Service, 2018. Miscellaneous records held on the Cofnod database. Occurrence dataset: https://doi.org/10.15468/hcgqsi accessed via GBIF.org on 2018-09-25.

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

Isle of Wight Local Records Centre, 2017. IOW Natural History & Archaeological Society Marine Records. Occurrence dataset: https://doi.org/10.15468/7axhcw accessed via GBIF.org on 2018-09-27.

Kent & Medway Biological Records Centre, 2017. Fish: Records for Kent.. Occurrence dataset https://doi.org/10.15468/kd1utk accessed via GBIF.org on 2018-09-27.

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.

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

Manx Biological Recording Partnership, 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.

Manx Biological Recording Partnership, 2018. Isle of Man historical wildlife records 1995 to 1999. Occurrence dataset:

https://doi.org/10.15468/lo2tge 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.

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.

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 Fish (South East Wales). Occurrence dataset: https://doi.org/10.15468/htsfiy 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