MarLIN

Marine Information Network

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

Giant goby (*Gobius cobitis*)

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

Dr Heidi Tillin & Karen Riley

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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/1305]. All terms and the MarESA methodology are outlined on the website (https://www.marlin.ac.uk)

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***Gobius cobitis*, in a Brittany rockpool.**
Photographer: Robin Gibson

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 Heidi Tillin & Karen Riley	**Refereed by**	Admin
Authority	Pallas, 1814		
Other common names	-	**Synonyms**	*Gobius capito* Linnaeus, 1758

Summary

Description

The giant goby *Gobius cobitis* is Britain's largest goby. It has relatively small and well spaced eyes, a short tail stalk and a deep body throughout its length. Greyish to olive brown in colour with 'pepper and salt' speckling. Dark blotches appear along and below the lateral midline. The edges of the dorsal, tail and anal fins are light greyish in colour. Breeding males are darker in colour than females. It reaches up to 27 cm in length.

Recorded distribution in Britain and Ireland

The distribution of *Gobius cobitis* in Britain is restricted to the south-west coast of England, from Wembury to the Isles of Scilly.

Global distribution

Found in the eastern Atlantic, from the western English Channel to Morocco, the Mediterranean, the Black Sea (except north-west) and the Gulf of Suez.

Habitat

In Britain, *Gobius cobitis* is found typically in the intertidal in high shore rock pools on sheltered shores. It is often found in brackish water with *Ulva* spp. present in the rockpools.

Depth range

Intertidal to up to 10m

Identifying features

- Small scales.
- Scales on top of the head do not extend to the level of the eyes.
- Upper rays of pectoral fin free of membrane.
- Lobes at front edge of pelvic fin disc distinct.
- A large goby, reaching a maximum of 27cm in length.

Additional information

It inhabits high shore rock pools, often with a freshwater input.

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	Gobius	
Authority	Pallas, 1814	
Recent Synonyms	Gobius capito Linnaeus, 1758	

Biology

Typical abundance	Moderate density
Male size range	8 - 27cm
Male size at maturity	13 cm
Female size range	12 cm
Female size at maturity	8 - 27cm
Growth form	Pisciform
Growth rate	Data deficient
Body flexibility	High (greater than 45 degrees)
Mobility	Swimmer
Characteristic feeding method	Grazer (fronds/blades), Predator
Diet/food source	Omnivore
Typically feeds on	Crustaceans, polychaetes, small fishes, insects and large amounts of green algae.
Sociability	Not relevant
Environmental position	Demersal
Dependency	Independent.
Supports	None
Is the species harmful?	No

Biology information

The feeding habits of *Gobius cobitis* vary with the size of the animal. Young fish, which measure about 8-9 cm, feed on smaller food items such as copepods, ostracods and small amphipods (Gibson, 1970). As the individual grows it will feed on larger food items until its diet consists of green algae, *Ulva* spp., crustaceans such as amphipods, crabs, prawns, amphipods, isopods, polychaetes and small fishes, particularly juveniles of the blenny, *Blennius pholis* (Potts & Swaby, 1992). The importance of different types of food vary but in general *Gobius cobitis* is a generalist feeder able to switch between food items depending on what is available (Compaire *et al*., 2016). Its longevity is approximately 10 years and the maximum total length reported was 23-27 cm (Potts & Swaby, 1992; Hayward *et al*., 1996). No difference in longevity has been noticed between sexes (Gibson, 1970).

Habitat preferences

Physiographic preferences	Open coast
Biological zone preferences	Sublittoral fringe
Substratum / habitat preferences	Mixed, Rockpools, Under boulders
Tidal strength preferences	No information
Wave exposure preferences	Sheltered
Salinity preferences	Variable (18-40 psu)
Depth range	Intertidal to up to 10m
Other preferences	None
Migration Pattern	

Habitat Information

- The south-west coast of England represents the most northern limit of the giant goby's range.
- *Gobius cobitis* is common within its geographical limits. Often seen 'basking' in direct sun on exposed patches within pools.
- It feeds on *Ulva* spp., crustaceans and polychaetes.
- Sublittoral pools inhabited by *Gobius cobitis* usually contain large boulders with a crevice large enough to shelter beneath and are devoid of gravel or sand. However, Gibson (1970) recorded gravel and stones on the bottom of their rock pools and Faria *et al.* (1998) noted that they preferentially occupied mixed bottom and sandy substratum. Usually, there is freshwater draining into the rock pools inhabited by *Gobius cobitis*. Upper shore rock pools are likely to experience extremes in temperature, light levels and salinity.
- Despite previous records for Wembury and West Looe, Potts & Swaby (1992) found no *Gobius cobitis* within these areas and, therefore, assumed that populations had declined or were absent at that time. However, a record of *Gobius cobitis* was made at West Looe on 31 January 1998 by John Markham. Although there is no evidence that the species is endangered, it is potentially vulnerable to human interference due to its preferred shore habitat (Potts & Swaby, 1992).
- The giant goby is a very common inshore fish in the North East Atlantic and the Mediterranean (Miller, 1986).

Life history

Adult characteristics

Reproductive type	Gonochoristic (dioecious)
Reproductive frequency	Annual episodic
Fecundity (number of eggs)	See additional information
Generation time	2-5 years
Age at maturity	2-3 years
Season	Spring - Summer
Life span	See additional information

Larval characteristics

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

Life history information

- The lifespan of *Gobius cobitis* is 10 years.
- *Gobius cobitis* usually mature in their second year. Females usually produce 2 clutches of eggs each season for a further 8 years (Potts & Swaby, 1992). Eggs are laid by the female and attached to the under-surface of large boulders. The eggs are fertilized and guarded by the male. Gibson (1970) suggested that males fertilise and guard batches of eggs from at least two females and that spawning occurs twice during the breeding season. Thus the eggs are protected and kept inshore until the feeding larvae hatch.
- The breeding season usually occurs in spring and early summer in Britain, but differences have been noted worldwide. For instance, reproduction takes place between March and May in Naples, and May to early July in Varna, the Black Sea. Fecundity was reported by Gibson (1970) to be dependent on size, and varies between 2,000 and 12,000 eggs per female. Hatching occurs approximately 22- 24 days after spawning at a temperature of 12-16 °C, and between 15 and 17 days after spawning at a temperature of 15-18 °C (Gil *et al.*, 1997).
- *Gobius cobitis* live for approximately 10 years (Potts & Swaby, 1992; Hayward *et al.*, 1996). No difference in longevity has been noticed between sexes (Gibson, 1970).

Sensitivity review

Resilience and recovery rates

Gobius cobitis is fairly long-lived (up to 10 years) and usually breeds twice during the breeding season each year (spring to early summer) (Gibson, 1970). Fecundity depends upon size but is usually high (Gibson, 1970) and the larvae are long-lived (Gil *et al*., 1997). Faria & Almada (1999) considered the larval supply to be more than sufficient to ensure population renewal.

For many pressures, *Gobius cobitis* are likely to be able to migrate in and out of affected areas. If populations are removed over large areas, recovery may be prolonged and sensitivity will be greater.

Resilience assessment. Where resistance is assessed as 'High', resilience is assessed as 'High' (by default). Where resistance is assessed as 'Medium' or 'Low' and only a proportion of habit may be affected or the gobies are considered likely to be able to migrate out of and back into impacted areas, resilience is assessed as 'High', based on recovery through adult migration. Where resistance is 'None' or recovery through migration is considered unlikely, resilience is assessed as 'Medium (2-10 years) unless habitats are affected over long-time scales to allow migration and population spread from adjacent populations. No information was found to support the recovery assessments and no information was found on population connectivity, hence confidence in the resilience assessments is 'Low'.

Hydrological Pressures

	Resistance	Resilience	Sensitivity
Temperature increase (local)	Medium Q: High A: High C: Medium	High Q: Low A: NR C: NR	Low Q: Low A: Low C: Low

Intertidal species are exposed to high and low air temperatures during periods of emersion and must also be able to cope with sharp temperature fluctuations over a short period of time during the tidal cycle. In winter air temperatures are colder than the sea; conversely in summer air temperatures are much warmer than the sea. Species that occur in the intertidal are therefore generally adapted to tolerate a range of temperatures, with the width of the thermal niche positively correlated with the height of the shore (Davenport & Davenport, 2005).

Berschick et al. (1987) and Trouchot & Duhamel-Jouve (1980) stated that *Gobius cobitis* is well-adapted to the short-term oxygen and temperature changes which occur on a daily basis within intertidal rockpools. The geographical distribution of *Gobius cobitis* extends from the south-western tip of Britain to waters further south. *Gobius cobitis* populations in southern waters are therefore exposed to warmer waters. Long-term increases in temperature due to climate warming would, therefore, be likely to increase the population size. Furthermore, it has been shown that temperature does have an effect on the speed of larval development (the greater the temperature the shorter the development time needed) (Gil *et al*., 1997) and the time of the breeding season. Horn & Gibson (1990) also showed that food consumption increased and gut transition times decreased.

Sensitivity assessment. *Gobius cobitis* is expected to be tolerant of an increase in temperature at the chronic benchmark level. An acute increase in temperature may lead to some thermal stress, especially in populations acclimated to lower temperatures. Resistance to an acute increase in temperature is assessed as 'Medium' although most exposed individuals would move out of impacted pools and other habitats, a proportion of the population may be trapped in rock pools high on the shore when the tide is out. Recovery is assessed as 'High' and sensitivity is, therefore, assessed as 'Low', based on ability to migrate in and out of affected areas. If populations are removed over large areas recovery will be prolonged and sensitivity will be greater. Confidence in this assessment is low and the assessment should be used cautiously.

Temperature decrease (local)	Low Q: High A: High C: NR	Medium Q: Low A: NR C: NR	Medium Q: Low A: Low C: Low

Many intertidal species are tolerant of freezing conditions as they are exposed to extremes of low air temperatures during periods of emersion. They must also be able to cope with sharp temperature fluctuations over a short period of time during the tidal cycle. In winter air temperatures are colder than the sea, conversely in summer air temperatures are much warmer than the sea. Species that occur in the intertidal are therefore generally adapted to tolerate a range of temperatures, with the width of the thermal niche positively correlated with the height of the shore (Davenport & Davenport, 2005).

During the severe winter period in 1962-63 the south-west coast of Britain experienced temperatures 5 and 6 °C below the long-term average for about 2 months. During this period 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.

Sensitivity assessment. Gobius cobitis is expected to be tolerant of a decrease in temperature at the chronic benchmark level. An acute decrease in temperature may lead to some thermal stress, especially in populations acclimated to warmer temperatures. Resistance is assessed as 'Low' based on other populations of gobies (Crisp, 1964. Recovery is assessed as 'Medium' and sensitivity is, therefore, assessed as 'Medium'.

Salinity increase (local)	Low Q: Low A: NR C: NR	High Q: Low A: NR C: NR	Low Q: Low A: Low C: Low

No evidence was found to assess the salinity tolerances of *Gobius cobitis*. As it occurs in intertidal coastal habitats that experience full salinity the assessed change at the pressure benchmark is an increase in salinity to hypersaline (>40ppt). Like all species found in the intertidal, *Gobius cobitis* will naturally experience fluctuations in salinity where evaporation on warm days increases salinity in pools and inputs of rainwater expose individuals to freshwater.

Species found in the intertidal typically have some form of physiological adaptations to withstand fluctuations in salinity. Typically the upper shore distribution of species in the intertidal is determined by physiological tolerances to emersion, salinity and temperature (Barnes & Hughes, 1999). Species that occur lower on the shore are exposed to salinity variations for shorter times (due to tidal immersion) than those that occur on the upper shore levels and tend to be less tolerant of salinity changes.

Sensitivity assessment. Although some increases in salinity may be tolerated by *Gobius cobitis*, the natural variation, (rather than the pressure benchmark) is generally short-term and mitigated during tidal inundation. Based on the distribution of *Gobius cobitis* in pools on the mid to lower shore, this species is considered to be sensitive to a persistent increase in salinity to > 40 ppt. Resistance is assessed as 'Low' and it is likely that individuals would move out of impacted pools and habitats if possible. Recovery is assessed as 'High' (following restoration of usual salinity if adjacent populations can relocate to pools. Sensitivity is, therefore, assessed as 'Low', based on ability to migrate in and out of affected areas. If populations are removed over large areas recovery will be prolonged and sensitivity will be greater. Confidence in this assessment is low and the assessment should be used cautiously.

Salinity decrease (local)	Low Q: Low A: NR C: NR	High Q: Low A: NR C: NR	Low Q: Low A: Low C: Low

No evidence was found to assess the salinity tolerances of *Gobius cobitis*. As this species occurs in the UK in intertidal coastal habitats that experience full salinity or in rockpools high on the shore that may be brackish and equivalent to variable salinity (18-35 ppt) or reduced salinity (18-30 ppt), the assessed change at the pressure benchmark is a reduction in salinity to low (<18ppt).

Species found in the intertidal typically have some form of physiological adaptations to withstand fluctuations in salinity. Typically the upper shore distribution of species in the intertidal is determined by physiological tolerances to emersion, salinity and temperature (Barnes & Hughes, 1999). Species that occur higher on the shore are exposed to salinity variations for longer times (due to lower levels of tidal immersion) than those that occur on lower shore levels and tend to be more tolerant of salinity changes.

Sensitivity assessment. *Gobius cobitis* is considered to be sensitive to a long-term decrease in salinity at the pressure benchmark. Resistance is therefore assessed as 'Low' and it is likely that individuals would move out of impacted pools if possible. Recovery is assessed as 'High' (following restoration of usual salinity if adjacent populations can relocate to pools. Sensitivity is, therefore, assessed as 'Low', based on ability yto migrate in and out of affected areas. If populations are removed over large areas recovery will be prolonged and sensitivity will be greater. Confidence in this assessment is low and the assessment should be used cautiously.

Water flow (tidal current) changes (local)	High Q: Low A: NR C: NR	High Q: High A: High C: High	Not sensitive Q: Low A: Low C: Low

No direct evidence was found to assess this pressure. The ability of *Gobius cobitis* to shelter in rock pools and in crevices between large boulders would be able to shield them from a moderate increase in the water flow rate. *Gobius cobitis* is also likely to be tolerant of a decrease in water flow rate.

Sensitivity assessment. Resistance is assessed as 'High' and resilience as 'High' (by default) and *Gobius cobitis* is assessed as 'Not sensitive'.

Emergence regime changes	Low Q: Low A: NR C: NR	High Q: Low A: NR C: NR	Low Q: Low A: Low C: Low

Gobius cobitis is mobile and can relocate to its preferred location on the shore. A change in emergence may indirectly affect this species through changes in the provision of suitable habitats and effects on food supply. An increase in emergence is likely to significantly affect physico-chemical environment of the rockpool and its resident community. An increase in emergence will increase the time that the pool is exposed to fluctuating air temperatures, wind, rain and sunlight, all of which will affect the and temperature, salinity regime within the pool. A decrease in emergence will reduce the time the pool spends exposed to the air and cut off from the sea. Therefore, the range of temperatures and oxygen levels characteristic of rockpool environments is likely to decrease.

Sensitivity assessment. As emergence may be a key factor structuring the suitability of rock pool habitats for *Gobius cobitis*, resistance to a change in emergence (increase or decrease) is assessed as 'Low' and it is likely that individuals would move out of impacted pools if possible. Recovery is assessed as 'High' (following restoration of usual emergence regime if adjacent populations can relocate to pools. Sensitivity is, therefore, assessed as 'Low', based on ability to migrate in and out of affected areas. If populations are removed over large areas recovery will be prolonged and sensitivity will be greater. Confidence in this assessment is low and the assessment should be used cautiously.

Wave exposure changes (local)	High Q: Low A: NR C: NR	High Q: High A: High C: High	Not sensitive Q: Low A: Low C: Low

No direct evidence was found to assess this pressure. The low exposure of high shore rockpools to this pressure over a tidal cycle and the ability of *Gobius cobitis* to shelter in rock pools and in crevices between large boulders would be able to shield them from a moderate increase in the wave action at the pressure benchmark. *Gobius cobitis* is also likely to be tolerant of a decrease in wave height.

Sensitivity assessment. Resistance is assessed as 'High' and resilience as 'High' (by default) and *Gobius cobitis* is assessed as 'Not sensitive'.

Chemical Pressures

	Resistance	Resilience	Sensitivity
Transition elements & organo-metal contamination	Not Assessed (NA) Q: NR A: NR C: NR	Not assessed (NA) Q: NR A: NR C: NR	Not assessed (NA) Q: NR A: NR C: NR

Not sensitive at the pressure benchmark that assumes compliance with all relevant environmental protection standards.

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., a different species of goby, very low concentrations of cadmium, copper and lead (0.5 g/l Cd2+; 5 g/l Cu2+; 20 g/l Pb2+) brought about changes in activity and an obstruction to the gill epithelia by mucus. This may also be true for *Gobius cobitis*.
Inorganic mercury concentrations as low as 30 µg/l (96-h LC50) 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 HgCl2 by a factor of 30 for the goby *Pomatoschistus microps*.

Hydrocarbon & PAH contamination	Not Assessed (NA) Q: NR A: NR C: NR	Not assessed (NA) Q: NR A: NR C: NR	Not assessed (NA) Q: NR A: NR C: NR

Not sensitive at the pressure benchmark that assumes compliance with all relevant environmental protection standards.

No information was available regarding specific toxicity to gobies. However, it is known that 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, can 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), the main problem being smothering of the intertidal habitat.

Bowling *et al.* (1983) found that anthracene, a PAH, had a photo-induced toxicity to the bluegill sunfish. In fact, they 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 *Gobius cobitis* could be similarly intolerant of hydrocarbons, however this is not known.

Synthetic compound contamination	Not Assessed (NA) Q: NR A: NR C: NR	Not assessed (NA) Q: NR A: NR C: NR	Not assessed (NA) Q: NR A: NR C: NR

Not sensitive at the pressure benchmark that assumes compliance with all relevant environmental protection standards.

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 LC50s of 0.25 µg/l and 0.04 µg/l respectively. TBT is generally very toxic to algae and fish. However, toxicity of TBT is highly variable with 96-hr LC50 ranging from 1.5 to 36 µg/l, with larval stages being more intolerant 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).

Radionuclide contamination	No evidence (NEv) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR	No evidence (NEv) Q: NR A: NR C: NR

No evidence.

Introduction of other substances	Not Assessed (NA) Q: NR A: NR C: NR	Not assessed (NA) Q: NR A: NR C: NR	Not assessed (NA) Q: NR A: NR C: NR

Not sensitive at the pressure benchmark that assumes compliance with all relevant environmental protection standards.

De-oxygenation	High Q: High A: High C: High	High Q: High A: High C: High	Not sensitive Q: High A: High C: High

Temperature and oxygen levels change drastically over a tidal cycle in a rockpool. Berschick *et al.* (1987) and Trouchot & Duhamel-Jouve (1980) stated that *Gobius cobitis* is well-adapted to the hypoxic and hyperoxic conditions that occur on a daily basis within intertidal rockpools (0.1 to 32.5 mg/l). Therefore the species has been recorded as being not sensitive (resistance and resilience are high) to deoxygenation at the pressure benchmark.

Nutrient enrichment	High Q: High A: Low C: NR	High Q: High A: High C: High	Not sensitive Q: High A: Low C: Low

This pressure relates to increased levels of nitrogen, phosphorus and silicon in the marine environment compared to background concentrations. The pressure benchmark is set at compliance with Water Framework Directive (WFD) criteria for good status, based on nitrogen concentration (UKTAG, 2014).

Higher nutrient levels may encourage the growth of algae such as *Ulva* spp., *Gobius cobitis*, may feed on. A reduction in nutrients in order to meet the requirement for good status may reduce growth of *Ulva* spp. *Ulva* spp. are unlikely to be replaced by less palatable red and brown seaweeds as the upper shore rockpools with freshwater input that *Gobius cobitis* prefers are not suitable for these species. Freshwater inputs from land-run-off may also carry nutrients and support the growth of green algae. *Gobius cobitis* is a generalist feeder, with invertebrates, including terrestrial invertebrates such as chironomids, a part of the diet of gobies in undisturbed conditions (Compaire *et al*., 2016). The ability to switch diet to whatever food is readily available suggests that changes in nutrient level at the pressure benchmark are unlikely to affect this species.

Sensitivity assessment. As *Gobius cobitis* is unlikely to be directly or indirectly impacted by changes in nutrient level at the pressure benchmark, resistance is assessed as 'High', resilience as 'High' and this species is assessed as 'Not sensitive'.

Organic enrichment	High Q: Low A: NR C: NR	High Q: High A: High C: High	Not sensitive Q: Low A: Low C: Low

Gobius cobitis is a generalist feeder, with the importance of algae vs invertebrates varying between studies (Compaire *et al*., 2016). Detritus does not form part of its diet and an increase in organic matter at the pressure benchmark is unlikely to directly affect this species, although it may increase secondary production of detritus feeding crustaceans and polychaetes that form part of its diet.

Sensitivity assessment. Increases in organic matter at the pressure benchmark are unlikely to impact gobies. Resistance is, therefore, assessed as 'High' and resilience as 'High' (by default) so that this species is assessed as 'Not sensitive'.

Physical Pressures

	Resistance	Resilience	Sensitivity
Physical loss (to land or freshwater habitat)	None Q: High A: High C: High	Very Low Q: High A: High C: High	High Q: High A: High C: High

All marine habitats and benthic species are considered to have a resistance of 'None' to this pressure and to be unable to recover from a permanent loss of habitat (resilience is 'Very Low'). Sensitivity within the direct spatial footprint of this pressure is therefore 'High'. Although no specific evidence is described confidence in this assessment is 'High', due to the incontrovertible nature of this pressure.

Physical change (to another seabed type)	None Q: High A: High C: High	Very Low Q: High A: High C: High	High Q: High A: High C: High

Gobius cobitis lives and forages on a variety of substrata. It requires rockpools in the intertidal to survive at low tide. The loss of hard substratum would remove the rock pool habitat of *Gobius cobitis*. Free draining sediments would not support this species and artificial hard substratum habitats may also differ in water retention from natural hard substratum, so that replacement of natural surfaces with artificial may lead to a loss of habitat.

Sensitivity assessment. Based on the loss of suitable habitat, resistance is assessed as 'None', resilience is assessed as 'Very Low', as the change at the pressure benchmark is permanent and sensitivity is, therefore, 'High'.

Physical change (to another sediment type)	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR

Gobius cobitis can forage on a variety of substrata but inhabits rock pools in the intertidal. This pressure is therefore 'Not relevant' as the species is not dependent on sedimentary habitats.

Habitat structure changes - removal of substratum (extraction)	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR

Gobius cobitis would be sensitive to the removal of the habitat. However, extraction of rock substratum is considered unlikely and this pressure is considered to be 'Not relevant' to hard substratum habitats.

Abrasion/disturbance of the surface of the substratum or seabed	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR

Gobius cobitis is sufficiently mobile to avoid abrasive contact and to shelter from it, therefore it is unlikely to suffer from abrasion.

Penetration or disturbance of the substratum subsurface	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR

Not relevant to species occurring in rock habitats.

Changes in suspended solids (water clarity)	High Q: Low A: NR C: NR	High Q: High A: High C: High	Not sensitive Q: Low A: Low C: 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. Bottom-dwelling species are generally found to be tolerant of suspended solids (Moore, 1977). Juveniles have been reported as being more intolerant of siltation than adults (Moore, 1977). Therefore, a low intolerance to siltation has been recorded. *Gobius cobitis* is likely to be tolerant of a decrease in suspended sediment.

An increase in suspended would result in a reduction in the amount of light penetration and, subsequently, a decrease in algal growth, however, other food sources (such as Crustacea and Polychaeta) 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 heavily turbid waters fish larvae have been noted to show a greater than normal mortality.

Sensitivity assessment. *Gobius cobitis* is considered to be 'Not sensitive' to decreases in suspended solids. An increase in suspended solids may lead to some sublethal effects on feeding rates or reproductive success over the course of a year. Resistance is assessed as 'High' and resilience as 'High' by default so that this species is assessed as 'Not sensitive'.

Smothering and siltation rate changes (light)	High Q: Low A: NR C: NR	High Q: High A: High C: High	Not sensitive Q: Low A: Low C: Low

As *Gobius cobitis* are mobile they may be able to avoid sediment deposition or to burrow out of a deposit of 5cm. However, a deposit of fine sediment in the preferred habitat of rockpools high on the shore is likely to have effects on habitat quality. 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. If sediment deposition occurred during the breeding season broods of eggs would be smothered.

Sensitivity assessment. Resistance is assessed as 'High' based on mobility, resilience is assessed as 'High' by default and this species is assessed as 'Not sensitive'.

Smothering and siltation rate changes (heavy)	None Q: Low A: NR C: NR	Medium Q: Low A: NR C: NR	Medium Q: Low A: NR C: NR

No evidence was found to assess this pressure. The deposition of 30cm of fine sediment in a high shore rockpool when the tide is out is likely to smother *Gobius cobitis* and result in loss of the habitat through infilling and the loss of prey species. In wave exposed conditions and pools on the lower shore the sediment may be removed, but in sheltered areas and the pools higher on the shore preferred by *Gobius cobitis*, sediments are likely to be retained for longer.

Sensitivity assessment. Based on smothering of the population, resistance is assessed as 'None' and resilience as 'Medium'. Sensitivity is, therefore assessed as 'Medium'.

Litter	Not Assessed (NA) Q: NR A: NR C: NR	Not assessed (NA) Q: NR A: NR C: NR	Not assessed (NA) Q: NR A: NR C: NR

Not assessed.

Electromagnetic changes	No evidence (NEv) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR	No evidence (NEv) Q: NR A: NR C: NR

No evidence.

Underwater noise changes	High Q: Low A: NR C: NR	High Q: High A: High C: High	Not sensitive Q: Low A: Low C: Low

No evidence was found to assess sensitivity to noise at the pressure benchmark although it is likely that *Gobius cobitis* can sense noise as vibrations. Noise disturbance may lead to startle responses and hiding, disrupting feeding and other behaviours. Following disruption, normal activties are likely to resume.

Sensitivity assessment. Noise may lead to some sub-lethal stress but not mortality. Resistance is, therefore, assesssed as 'High' and resilience as 'High' by (default) and this species is assessed as 'Not sensitive'.

Introduction of light or shading	High Q: Low A: NR C: NR	High Q: High A: High C: High	Not sensitive Q: Low A: Low C: Low

Fish generally forage for food using visual methods and can detect differing levels of light and shade. It is, therefore, probable that *Gobius cobitis* would detect changes in incident light. No evidence was found to assess this pressure. Changes in foraging activity and feeding rate may occur, either due to effects on the behaviour of *Gobius cobitis* or prey species.

Sensitivity assessment. Introduction of light may lead to some sub-lethal stress but not mortality. Resistance is, therefore, assessed, as 'High' and resilience as 'High' by (default) and this species is assessed as 'Not sensitive'.

Barrier to species movement	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR

No evidence was found to assess this pressure. *Gobius cobitis* is typically found in rock pools high on the shore. Barriers that limit tidal excursion or extend across a waterbody are unlikely to directly impact *Gobius cobitis* and this pressure is assessed as 'Not relevant'.

Death or injury by collision	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR

Gobius cobitis are mobile and may be able to detect and avoid artificial structures. As they are demersal fish associated with rock pools and substratum rather than pelagic it is unlikely that there will be much potential interaction between gobies and the intakes of artificial structures (unless these create strong suction). This pressure is therefore assessed as 'Not relevant'.

Visual disturbance	High Q: Low A: NR C: NR	High Q: High A: High C: High	Not sensitive Q: Low A: Low C: Low

No evidence was found to assess sensitivity to noise at the pressure benchmark although it is likely that visual disturbance may lead to startle responses and hiding, disrupting feeding and other behaviours. Following disruption, normal activities are likely to resume.

Sensitivity assessment. Visual disturbance may lead to some sub-lethal stress but not mortality. Resistance is, therefore, assessed, as 'High' and resilience as 'High' by (default) and this species is assessed as 'Not sensitive'.

Biological Pressures

	Resistance	Resilience	Sensitivity
Genetic modification & translocation of indigenous species	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR

Gobius cobitis is not cultivated or translocated. This pressure is therefore considered ‘Not relevant’ to this species.

	Resistance	Resilience	Sensitivity
Introduction or spread of invasive non-indigenous species	No evidence (NEv) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR	No evidence (NEv) Q: NR A: NR C: NR

No evidence was found for impacts of invasive non-indigenous species on *Gobius cobitis*.

	Resistance	Resilience	Sensitivity
Introduction of microbial pathogens	No evidence (NEv) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR	No evidence (NEv) Q: NR A: NR C: NR

No evidence was found to assess this impact in UK populations. The parasite, *Haliotrema capensis*, has been found in *Gobius cobitis* in the Mediterranean Sea (Sasal *et al*., 1998). Although no information was found about specific effects of this parasite on the giant goby, it is likely that it will cause a reduction in its fitness.

	Resistance	Resilience	Sensitivity
Removal of target species	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR

Gobius cobitis is not commercially or recreationally harvested and this pressure is ‘Not relevant’.

	Resistance	Resilience	Sensitivity
Removal of non-target species	Medium Q: Low A: NR C: NR	High Q: Low A: NR C: NR	Low Q: Low A: NR C: NR

Gobius cobitis can shelter within rockpool crevices and are mobile and able to move swiftly when disturbed. They are unlikely to be removed in large numbers by recreational or commercial harvesters using small hand-held nets to target other species such as shrimp are being targeted. Removal of algae and prey species may reduce food supply and some incidental damage or mortality may occur where other species are being targeted.

Sensitivity assessment. Resistance is assessed as 'Medium' and resilience as 'High' so that sensitivity is assessed as 'Low'.

Importance review

Policy/legislation

Wildlife & Countryside Act	Schedule 5, section 9
Features of Conservation Importance (England & Wales)	✔

Status

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

Non-native

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

Importance information

The giant goby is protected under the Wildlife Countryside Act 1981, Schedule 5. This means that the species is fully protected. You therefore cannot injure, kill or take it from the wild, possess it or control it and you may not disturb it in any way.

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