Southern Inshore Fisheries and Conservation Authority

Black Seabream Literature Review

Supporting Document for the Black Seabream Management Package

Contents

Section A: Introduction to the Literature Review

This literature review is a supporting document for the assessment of existing management and the co-development of additional measures for the Sparid species Black Seabream (*Spondyliosoma cantharus*) in the Southern IFCA district.

The literature review aims to further inform and support understanding of:

- the biology and ecology of the species
- the distribution of the species geographically and within the water column
- population trends
- the relationship between the species and the marine environment
- fishing practice for black seabream
- potential impacts of fishing activities
- potential mitigative measures to reduce impacts
- potential mitigating measures to avoid impacts from fishing gear

This document uses the best available evidence, namely peer reviewed papers and reports, with a focus on the most relevant sources in relation to the location and date published to ensure that sound scientific evidence is used to inform assessments of this species in relation to fishing activities. For each section it is noted whether the evidence presented is more general and relates to black seabream across their distribution and across different fishing gear types or whether evidence has come from specific studies, separated into those from work in the UK and those from work outside the UK.

This literature review relates to the fishing methods of pots/traps, nets (pelagic and demersal) and lines (pelagic and demersal). Bottom towed fishing gears have been considered separately during Phase I of the BTFG Review and resulting management, assessments and literature to support the management decisions relating to BTFG are contained in the relevant supporting documentation for the BTFG Byelaw 2023[1].

This literature review is to be read in conjunction with the **Black Seabream Marine Conservation Zone Assessment Package** and the **Black Seabream Site Specific Evidence Packages**.

Section B: Literature Review

1. Black Seabream Biology and Ecology

1.1 Biology

The following points relate to the general biology of black seabream and are relevant to the species across their geographic distribution.

- Black seabream, *Spondyliosoma cantharus*, are a member of the Sparidae family (Dunn, 1999; Ruiz, 2008).

[1] Part B Assessment for Southbourne Rough for BTFG available on the Southern IFCA Website here: Southbourne-Rough-BTFG-Bream.pdf

- They are a deep bodied oval shaped fish with a slightly forked tail, small head and jaws, and on average reach lengths up to 40 cm, but can reach as long as 60 cm total length (Sussex IFCA, 2020).
- Adults are typically silver in colour, but during breeding season the males become black with three vertical pale bars on the sides. During this season, females also change their colour with a pale horizontal bar along their side (Doggett, 2018).
- Black seabream are opportunistic omnivores able to adapt their diet depending on what is available (Gonçalves & Erzini, 1998; Box *et al.*, 2009). Typically, adult black bream predate on seaweed and invertebrates including cephalopods (cuttlefish), small crustaceans (shrimp and crab), polychaetes and molluscs (Clark & Vause, 2011; Daban, 2022b).
- Black seabream have few natural predators; they are sometimes predated by marine birds and mammals (Vause and Clark, 2011).
- The species are protogynous hermaphrodites, starting out as female and changing to male at a certain age and size (Pajuelo and Lorenzo, 1999; Baldock and Dipper, 2023).
- The Sparidae family display the most complex expression of hermaphroditism in teleost fishes (Beaulieu, 2020).
- The genus *Spondyliosoma* (which includes black seabream) is one of only two genera within the Sparidae family which provides male-only care in the form of nest building and guarding of eggs (Beaulieu, 2020). The evolution of parental care alongside protogyny is a novel evolutionary strategy (Beaulieu, 2020).
- Females have been noted to change sex anywhere between 18 cm and 35 cm depending on the population (Perodou and Nedelec, 1980; Soletchnik, 1982; Mouine *et al.*, 2015; Neves, 2018; Sussex IFCA, 2020; Doggett and Baldock, 2022). The sex change can occur from around October and it can take 2-3 months for an individual to transition from female to male.
- A study in the English Channel in the 1980s found that all individuals under 30cm were female and all above 40cm were male (Perodou and Nedelec, 1980).

1.2 <u>Reproduction</u>

1.2.1 Seasonality of Reproduction in the UK and Bream Movements within Spawning Sites

- For spawning events, large shoals of males and females travel towards areas of the inshore coastline where there are areas of hard bedrock or compacted substrate with a thin layer of finer sediment such as sand or gravel (Collins & Mallinson, 2012; Clark & James, 2013).
- The Natural England advice on seasonality for black seabream in all three of the relevant Dorset MCZs advises that significant numbers of the species are most likely to be present at the site between March and July each year based on combined information from published sources or additional site-specific surveys (Natural England, 2020a, b, c)
- The onset of nesting activity is documented to be variable with the main occurrence along the south coast of England being from early April into early summer (July) (Lythygoe and Lythgoe, 1971; Pawson, 1995).
- In certain studies, it was noted that adult black seabream move inshore to spawn between April and July once water temperatures are between 12-14°C (Wilson, 1958; Collins and Mallinson, 2012).
- From tagging black seabream as far back as the 1980’s, it has been noted that individuals exhibit site fidelity, or philopatry (Clark & James, 2013), where they return to the same spawning grounds each year (Doggett *et al.*, 2016; Pawson, 1995) or at least within 10km (Collins and Mallison, 2012).
- It has been noted over multiple years that nests are present between May and June in the Poole Bay area (Collins and Mallinson, 2012).

- Black seabream that had been fitted with acoustic tags off Sussex were detected at their nesting areas from late March to early July. On average, the fish stayed around for about 31 days at Kingmere and 39 days at Boulder Bank. These stay lengths are shorter than those seen in a similar species (*S. emarginatum*), where males were observed staying for 57 days, spending about a quarter of that time caring for their offspring. Even though the spawning season is long, individual fish don't stay in one nesting site for very long. This may mean different fish reproduce at different times.
- Further acoustic tagging work looking at Marine Conservation Zones and nesting sites in Sussex found that 92% of fish tagged were detected at known nesting areas during the period April to June in 2022 and almost exclusively within this period in 2023 (Davies *et al.,* 2024).
- It was noted in the same study that detection time at nesting sites was shorter than expected, whilst it cannot be excluded that this may be related to the array design and the returning location of individual fish, there is potential that a low residency time may suggest the spawning season is long compared to individual residency at nest sites (Davies *et al.,* 2024).
- In multiple years, transparent eggs were noted in June at nest sites on bare rock in Poole Bay and Southbourne Rough. By July each year, it was noted that no eggs were present, the assumption being made that eggs had hatched due to the presence of juvenile black bream swimming around adjacent reefs (Collins and Mallinson, 2012).
- A study under The Black Bream Project found that, in Kimmeridge, in June eggs had hatched, nests had been abandoned and the black seabream had left the site, however in late June/early July over a 10-12 day period the bream returned, re-built nests and underwent another spawning period (Doggett, 2018).
- Following egg laying, females can remain in loose shoals near the spawning area or head towards feeding grounds such as seagrass beds where cuttlefish and small crustaceans can be found (Jackson *et al.*, 2006).
- Following the spawning season, the adult males leave the site (Jackson *et al.*, 2002).
- The eggs typically hatch between 9 days (Wilson, 1958) and two weeks (Jackson *et al.*, 2002) and remain in a larval form for approximately 38 days (Wilson, 1958).
- Juveniles remain around nest sites until 7-8 cm in length when they migrate to estuaries, shallow rocky reefs, and seagrass beds. These habitats are important for juveniles providing sanctuary and a food source for example seagrass beds can host prey in high abundance such as small crabs, shrimp and cuttlefish (Jackson *et al.*, 2002).
- Juveniles have been noted to use both natural and artificial habitats as areas of refuge (Hall *et al.*, 2021).
- Juveniles remain within these habitats for two to three years until they are sexually mature (approx. 20 cm total length), they then join the adult stock in the English Channel (Baldock & Dipper, 2023; Clark & James, 2013).

1.2.2 Fecundity

- In terms of reproductive resilience, black seabream are classed as 'medium', with a minimum population doubling time of 1.4 - 4.4 years (Arkley and Caslake, 2004).
- Black seabream are found to exhibit relatively low fecundity, which is thought to be related to their reproductive behaviour with parental care potentially increasing success rates for fertilization and hatching (Goncalves and Erzini, 2000).

Evidence from outside the UK

- Annual fecundity estimates are only available from studies undertaken in the Mediterranean. Estimates in this case range between 31,670 and 544,070 eggs per female (Dulcic *et al.*, 1998).

1.2.3 Size of Maturity

Evidence from the UK

- There are few studies (2) that have identified size of maturity (SOM) for black seabream in their northern range (Small, 2021).
- A study from the English Channel conducted in the 1980s estimated that females reach 50% maturity (L50) between 20-22 cm in length with 95% of females captured at 25cm being mature (Soletchnik, 1982). There was no SOM estimate for males from this study.

Evidence from outside the UK

- At the southern range for black seabream, SOM (as L50) has been noted to range from 17.3-22 cm for females and 21.3 to 22.7 cm for males (Small, 2021).
- For a Portuguese population of black seabream, a combined SOM (L50) for both sexes, hermaphrodites and individuals of indetermined sex was given as 20.1 cm corresponding to 2-3 years of age (Goncalves and Erzini, 2000).
- Other studies in the Mediterranean found that L50 occurred in females at 2 years and males at 3 years (Perodou and Nedelec, 1980; Pajuelo and Lorenzo, 1999; Boughamou *et al.*, 2015), although in Tunisia females matured later at around 4 years of age (Mouine *et al.*, 2015).

1.2.4 Summary of Biology and Reproduction

- Black seabream prey on a variety of species as opportunistic omnivores but have few natural predators themselves.
- The species are protogynous hermaphrodites starting as female and changing to male.
- The sex change can occur anywhere between 18cm to 35cm, taking 2-3 months to complete in the autumn. All individuals above 40cm in the English Channel have previously been found to be males.
- The species aggregates for spawning in inshore areas with suitable habitats and exhibit site fidelity, returning to the same spawning grounds each year.
- There are varying periods given for the spawning aggregation between March and July. The general breeding season from studies specific to the south coast of England and MCZs in Dorset is from April to July.
- Following egg laying females may remain or leave the site to head for feeding grounds.
- Males remain in the spawning areas until the spawning period is concluded.
- Juveniles remain in the spawning areas until 7-8cm when they move to suitable juvenile fish habitats where they remain until 2-3 years old.
- Black seabream are noted to exhibit relatively low levels of fecundity, likely related to the increased level of parental care used to increase success rates for fertilization and egg hatching.
- There is limited data for Size of Maturity in black seabream, the only data available from the English Channel indicates an L50 of 20-22cm for females, no size is given for males.

1.2.5 Nesting Behaviours and Parental Care

The following points relate to the general behaviours exhibited by black seabream and are relevant to the species across their geographic distribution.

- Data shows black seabream returning to the same nesting areas across multiple years, indicating strong site fidelity and likely spatial structuring of the population, with some fish returning within ~20 meters of their previous capture location, suggesting highly accurate homing. (Davies *et al.*, 2024).

- Males scout the area for suitable sites to establish their territories and build their nests, excavating small areas until they find a suitable substrate (Clark & James, 2013).
- Males often compete with each other through circling and flexing behaviour to claim their area (Faure-Beaulieu & Attwood, 2022; James *et al.*, 2011). With territories established, multiple males tend to build their nests grouped next to each other creating a “compound nesting site”, which increases egg survival against predation (Faure-Beaulieu and Attwood, 2022).
- Once a site is chosen males use their tails in a swiping motion to clear lighter sediment from the area down to the solid substrate up to 30 cm deep and up to two metres in diameter (Clark & James, 2013). They use their bodies to physically remove larger obstructions like stones and sessile organisms, forming a rampart structure outlining the perimeter of their nests (Baldock & Dipper, 2023).
- Nest building is an energetically costly process, a male black seabream may excavate over 70-80kg of sediment depending on the surrounding habitat (Doggett and Baldock, 2022).
- It has been observed that where nests have been destroyed (either the nest is absent or covered in sand) following natural disturbance from wind and wave action, most of the pre-existing nests were re-built within a span of days following the event (Faure-Beaulieu and Attwood, 2022).
- Males may maintain their nests for days or weeks prior to a female spawning, it is postulated this is to demonstrate the suitability of the nest substrate and their ability to care for the eggs once spawned (Doggett and Baldock, 2022).
- Once nests are built, the males attract females down to the seabed to inspect their nests by swimming within their territory angling their body, flaunting the pale bands on their sides (Jackson *et al.*, 2006). During this time the male keeps the nest surface exceptionally clean, if the female approves of the nest, they lay their eggs and the male fertilises them (Dulcic et al, 1998).
- The female lays her eggs in a thin layer within the nest where they adhere to the rock due to their sticky exterior (James *et al.*, 2010). In some cases eggs have also been noted to be laid on algae bordering the nest surface (Faure-Beaulieu and Attwood, 2022).
- The males constantly maintain the eggs using their tail to keep the eggs clean and prevent a build-up of sediment which could result in the eggs being smothered (Wilson, 1958; James *et al.*, 2010).
- Having benthic eggs implies that biotic factors including predation and parental care may be more relevant for reproductive success in black seabream than environmental factors such as currents and wave action (Goncalves and Erzini, 2000).
- Males can have multiple females’ eggs within their nest at different stages of development, as they continue to attract females whilst on guard (Wilson, 1958). The male remains guarding the nest and caring for the eggs until all batches have hatched (Jackson *et al.*, 2006).
- Males become physically aggressive to invaders and predators, chasing or physically attacking and removing the threat. Male Steentjie seabream were observed only leaving the nest to chase trespassers or to avoid predation or anthropogenic disturbance (Faure-Beaulieu & Attwood, 2022).
- Males protect the eggs from predators including gobies, wrasse, crustaceans, whelk, and even other black bream (Beaulieu, 2020).
- It has also been observed that males remain at the nest site to brood the eggs until they hatch (Wilson, 1958).
- It is thought that larger males have a higher probability of success in defending nest territory and therefore have increased reproductive success. On this basis the protogynous reproductive strategy may confer an ecological advantage to black seabream (Goncalves and Erzini, 2000).

- The cost of reproduction for male bream species is related to a combination of gonadal investment, energetically expensive nesting activities, loss of feeding opportunities and a heightened risk of predation (Faure-Beaulieu and Attwood, 2022).
- Fish typically leave nesting sites after spawning, indicating these areas are not used as summer feeding grounds (Davies *et al.*, 2024).

Evidence from the UK

- Specifically in Dorset, nests have been observed being exploited by corkwing and goldsinny wrasse (Collins and Mallinson, 2012).

Evidence from outside the UK

- A study in South Africa on Steentjie seabream (*Spondyliosoma emarginatum*) noted that in the presence of eggs, males spent 86% of their time on the nest compared to 51% in the absence of eggs (Faure-Beaulieu and Attwood, 2022). The increased presence on the nest was accompanied by a reduced frequency of nest departures, and a reduction in the length of time of a departure from 56 seconds on an empty nest to 16 seconds when eggs were present (Faure-Beaulieu and Attwood, 2022). Over a 67-day nesting period, it was noted that only 13 minutes per hour was spent off the nest suggesting that the males do not feed during the nesting period (Faure-Beaulieu and Attwood, 2022).
- In Steentjie seabream, females have been noted to visit empty male nests more frequently than those with eggs but the time spent per visit did not change based on egg presence (Faure-Beaulieu and Attwood, 2022).
- For an average sized ripe male Steentjie seabream, the total condition loss over the nesting period was estimated at 10% or 30g body mass (Faure-Beaulieu and Attwood, 2022).

Summary

- Male black seabream build nests, competing with other males to claim a particular area.
- Once territories have been established, males tend to build nests in groups to increase egg survival against predation.
- Males will clear nest sites of sediment and remove larger objects to create a clear nest area with an elevated boundary.
- Nest building is an energetically costly process for male black seabream with additional costs coming from gonadal investment, loss of feeding opportunities and risk of predation.
- Nests are maintained for days or weeks prior to a female spawning, damage to the nests from natural processes is observed to result in the nest being re-built within a few days.
- The male’s ability to look after its nest is a method of attracting females to lay eggs.
- Eggs are laid onto the rock surface where they stick and are then guarded by the male to keep the eggs clean and prevent predation.
- There may be eggs from multiple females within a single nest, at different stages of development. The male will remain guarding the nest until all the eggs have hatched.
- Males are likely to spend the majority of their time on the nest when eggs are present with a reduced frequency of departures from the nest and the length of time spent away from the nest.
- Males are aggressive to invaders/predators, chasing, attacking and/or physically removing the threat. Larger males have a higher probability of successfully defending a nest and thus have increased reproductive success.
- It is noted that male black seabream are likely not to actively feed whilst guarding a nest and therefore may not take bait or may exhibit aggressive behaviours rather than fully taking a baited line.

1.2.6 Nesting Habitat

The following points relate to features of nesting sites from evidence sources related to the UK.

- A common feature of studied nesting sites is a thin sediment veneer over a hard or compacted layer of stones, shells or bedrock with this lower, hard habitat exposed by the male during nest building (Vause and Clark, 2011; Collins and Mallison, 2012; Doggett and Baldock, 2022).
- Nests have been noted to be constructed adjacent to areas of rocky reef or shipwrecks (Vause and Clark, 2011; Doggett and Baldock, 2022).
- Sediments excavated during nest building are commonly mobile in nature and may shift with tide and wave action. This results in scouring over the underlying harder substrate which helps keep the area clean and reduces the energetic burden on male black seabream during nest construction (Doggett and Baldock, 2022).
- Rock surfaces covered in dense algal or faunal turf have not been recorded as associated with black seabream nesting sites (Doggett and Baldock, 2022).
- There are factors which have not been fully tested which may impact the geographic distribution of nest sites, these include fluctuations in population numbers between years with certain sites only being used when others have reached a carrying capacity (Doggett and Baldock, 2022).
- The size of a given area may influence site selection by male seabream, if there is insufficient suitable nesting habitat available, nests may be more isolated increasing the predation risk for both the male seabream and the eggs resulting in lower female interest and thus lower levels of successful spawning (Doggett and Baldock, 2022). Isolated nests are not often found and, if they are, are often small in size indicating exploratory excavations during a search for suitable nesting areas rather than an attempt to build a full nest (Doggett and Baldock, 2022).
- Depending on the type of surrounding/overlying sediment, the nest may or may not have an obvious boundary standing proud of the sediment, defining the limit of the nest (Doggett and Baldock, 2022).
- The use of boundaries and building of nests near to ledges, reefs or wrecks may provide shelter from prevailing currents and wave action or may increase the turbulence over the nest area to improve aeration (Doggett and Baldock, 2022).
- Net size may relate to the size and status of the male, with nests ranging from <1m with a single patch of eggs to over 2m in width and/or length with up to five patches of eggs, potentially from different females (Doggett and Baldock, 2022).
- Post-hatching of the eggs, nests may be erased as quickly as in 1-2 days by strong wind and wave events, or may persist throughout the summer and autumn as algae species readily colonise areas of bare rock left behind (Doggett and Baldock, 2022).

Specific to Southern IFCA District

- Nests have been noted to be made of novel materials, in Poole Bay (it is not known if this is within or outside of the two MCZs) nests have been noted to be excavated from dead slipper limpet habitat, with surface shells removed to expose compacted shell layers beneath on which the nest is built (Doggett and Baldock, 2022).
- At Poole Rocks, many bream nests are noted to surround the multiple patch reefs which occur in the area as the sediments are thinnest at the interface of the two substrates (Collins and Mallinson, 2012; Doggett and Baldock, 2022). This can result in spawning activity concentrating at the perimeter of the sandstone outcrops but not within the main sections of patch reef likely due to the presence of epifauna and flora (Doggett and Baldock, 2022).
- Nests in central Poole Bay are noted to be restricted by the presence of irregular rock surfaces and boulders (Collins and Mallinson, 2012).
- In Purbeck Coast MCZ, nests are established adjacent to the bedrock reef wall with examples of nests off Lulworth Banks and Ballard occurring where sediments run up

against bedrock with a short transition between the two leading to thin sediments (Doggett and Baldock, 2022).

- Nests near Kimmeridge Bay have been noted to occur in a band which varied in width from 20-30m at the base of a 3-4m high reef wall (Doggett and Baldock, 2022). Depending on the exact location, eggs were either attached to bedrock or flat boulders (Doggett and Baldock, 2022).
- At Kimmeridge Ledges and Lulworth Banks, nests have been observed at varying densities, from a narrow band which is 1-2 nests wide at the base of some reefs to being scattered between boulders to larger aggregations where more suitable habitat occurs (Doggett and Baldock, 2022).
- Nests near to Kimmeridge have been noted to be significantly larger than in other areas along the south coast, this is attributed to the presence of a wide extent of flat bedrock with shallow sediment cover (Collins and Mallinson, 2012).
- The Southbourne Rough MCZ is documented to have a patch reef composed of sizeable flat rock slabs and ridges, with the reef to the north covered with a thin layer of sandy shell gravel which is deemed to be important for nesting bream (DEFRA, JNCC, NE, 2019c).
- The shape and structure of nests around both Poole Rocks and Southbourne Rough MCZs can be dictated by the nature of surrounding bedrock (Doggett and Baldock, 2022).
- Nests occurring at Southbourne Rough and Dancing Ledge are thought to be limited by the size of the reef and the extent of sediment patches respectively (Collins and Mallinson, 2012).

1.2.7 Summary

- Nests are found in rocky areas where there are thin veneers of sediment over hard compacted layers of sones, shells or bedrock. The lower, harder habitat is used as the nest surface.
- A factor which may relate to the distribution of nest sites, but has not yet been fully tested is fluctuations in black seabream population numbers between years which may result in a certain area reaching a carrying capacity.
- The size of available area may influence a decision on where to build a nest, the less suitable habitat there is available the more likely it would be that nests would be isolated rather than grouped which increases the risk to the eggs and makes the area less desirable for females.
- Nest size may relate to the size and status of the male black seabream, ranging from <1m to over 2m in width.
- After the eggs have hatched, nests may be erased within 1-2 days by environmental conditions or may persist through the summer and autumn with opportunistic species colonising areas of bare rock.
- For Poole Rocks, nests surround multiple patch reefs within the site and are likely restricted by the presence of irregular rock surfaces and boulders.
- For Purbeck Coast, nests can be found adjacent to the bedrock reef wall with eggs either attached to bedrock or flat boulders. Nests in the Kimmeridge area of this site are noted to be significantly larger than in other areas along the south coast due to a wide extent of flat bedrock.
- For Southbourne Rough, the areas of reef covered by sandy shell gravel are deemed to be important for nesting black seabream with nest shape and structure dictated by surrounding bedrock.

1.3 Distribution

1.3.1 Geographical Distribution worldwide

- Black seabream are distributed through the northeast Atlantic shelf waters between Norway and Orkney, south to the Mediterranean Sea and Canary Islands (Pawson, 1995).
- Black seabream remain in the same geographic area throughout their life, therefore populations are thought to be discrete throughout their geographical range (Neves *et al.*, 2018).
- This is supported by studies of otolith chemistry have suggested that black seabream do not originate from a single stock, with a study in Portugal being able to discriminate between black seabream from three fishing grounds with a high level of accuracy (91%) suggesting distinct local population units (Correia *et al.*, 2012).
- This is also suggested from studies in the English Channel with differences in length-weight relationships identified for black seabream in the Western Channel and Bay of Biscay, although this is yet to be statistically tested (Seafish – unpublished).
- Black seabream return year after year to the same nesting areas, even when those areas are close but distinct (18 km apart). This behaviour suggests the population is split into smaller groups that stick to specific places, which could lead to genetic differences and local adaptations over time (Davies et al, 2024).

1.3.2 Distribution in the English Channel

- In the UK, black seabream are most abundant along the south coast and into the southern part of the North Sea (Rogers, 1998).
- The population is more dispersed until spring when they start to aggregate in preparation for their migration to the spawning grounds. During the months of April and May they migrate to areas such as Kimmeridge, Poole Bay, and Sandown Bay on the southern coast of the UK (Collins & Mallinson, 2012; Doggett & Baldock, 2022). They also migrate to other locations such as the Channel Islands along the French coastline (Blampied *et al.*, 2022; Mahe *et al.*, 2006; Soletchnik, 1982) and even the Bay of Biscay (Neves, 2018; Kopp *et al.*, 2018).
- Previous studies based on fish catches suggested that black seabream migrate across the English Channel in autumn (to the west of Alderney), then come back in spring. New evidence found that black seabream migrate across the Channel every year, based on both acoustic and external tags. It is suggested that the migration follows an eastward movement of the 9°C isotherm as the Channel warms in the spring (Pawson, 1995; Clark & Vause, 2011).
- Data from historical trawling between 1913 and 2003 in Cornwall appeared to indicate that 12°C is an annual temperature threshold above which black seabream are more abundant (Arkley and Caslake, 2004).
- In July, after the spawning season, they migrate to the south of the North Sea, feeding at inshore sites. They follow the isotherm in the English Channel in November, from east to west, returning to the deep waters in the western Channel in the Winter months, typically starting to appear in January (Pawson, 1995).

1.3.3 Distribution in Relation to Dorset Marine Conservation Zones

- For the past century during the spring months, specifically along the Southern coast of the UK, black seabream have been recorded within the following MCZs: Poole Rocks, Purbeck Coast, and Southbourne Rough (Baldock & Dipper, 2023; Collins & Mallinson, 2012; Doggett and Baldock, 2022).
- Within the Purbeck Coast MCZ, at Kimmeridge Bay, large shoals of black seabream are noted to arrive for the breeding season (Doggett *et al.*, 2016).

- Nests have been recorded near Kimmeridge Bay in multiple years (Doggett and Baldock, 2022) and the most extensive occurrence of bream nests in the area was found off Kimmeridge (Collins and Mallinson, 2012).
- Southbourne Rough MCZ has exhibited high site fidelity, with males recorded returning to the site for 14 years (DEFRA, JNCC, NE, 2019c).

1.3.4 Distribution in the Water Column

The information provided on distribution of black seabream in the water column relates to the population in the English Channel.

- Outside the breeding period, adults are typically located in deeper waters, they then migrate to shallower inshore waters in the spring (Ruiz, 2008; Sussex IFCA, 2020).
- During winter, adults have been found at depths of 50-500 metres in the west of the English Channel (Bourdaud *et al.*, 2017; Pawson, 1995). Pre-spawning adult concentrations have been found in waters from 50-100m depth west of a line from Alderney to Start Point (Pawson, 1995).In spring, following the seasonal migration to inshore areas, most spawning areas are less than 50m deep (Pawson, 1995) and nesting activity may occur in waters as shallow as 5m (Pawson, 1995; Collins and Mallinson, 2012).
- In the UK, black seabream are recorded to have spawned in waters of 5-25m depth (Doggett and Baldock, 2022).

1.4 <u>Population of Black Seabream</u>

1.4.1 General Population Trends

- Black seabream are not subject to ICES stock assessments or classed as a pressure stock for EU fisheries management, there is also no Total Allowable Catch prescribed (Collins and Mallinson, 2012).

1.4.2 UK Population Trends

- A report assessing black seabream from the English Channel in terms of sustainability as a food choice notes that there is currently little information on the abundance of black seabream in the English Channel but also no indication that the species is depleted (The Safina Center, 2014).
- It is thought that climate change has had a positive impact on black seabream stocks in the English Channel as the mean annual frequency of occurrence of black seabream has been documented to increase with rising sea temperatures from 1913 to 2003 (Arkley and Caslake, 2004).
- A Cefas eastern English Channel beam trawl survey suggested an upward trend in black seabream between 1993-2001 (Collins and Mallinson, 2012).

1.4.3 Summary of Distribution and Population of Black Seabream

- Black seabream remain in the same geographic area throughout their life, therefore populations are likely to be discrete.
- In the UK black seabream are most abundant along the south coast and into the southern part of the North Sea.
- The population is more dispersed until spring when the spawning aggregation occurs. Migration occurs to the south coast of the UK including Kimmeridge, Poole Bay and Sandown Bay on the Isle of Wight as well as the French coast and the Channel Islands.
- Migration may be temperature driven following isotherms within the English Channel.
- Following spawning, migration is noted to occur to the North Sea and deeper areas of the English Channel in the winter months.

- Site fidelity has been observed for Southbourne Rough MCZ and annual aggregations of black seabream are observed in Poole Rocks and Purbeck Coast MCZs.
- Distribution in the water column is related to the above seasonal movements, deeper waters being utilised in the winter and shallower areas, between 5-25m for spawning aggregations.
- Black seabream are currently not subject to a population assessment.
- Climate change may be having a positive impact on stocks in the English Channel with upward trends seen in two surveys between 1913-2003 and 1993-2001 respectively.

1.5 Relationship between Black Seabream and the Marine Environment

The following points relate to the general behaviours exhibited by black seabream and are relevant to the species across their geographic distribution.

- Black Seabream are seen as seabed engineers (Doggett *et al.*, 2016). The activity of building nests and the resultant nest structure involves the removal of any algae or sessile species from the immediate area, which temporarily changes the habitat. These alterations to the seabed allow for opportunistic benthic organisms, particularly predatory molluscs and crustaceans, to locate and move in on any unguarded or vulnerable nests (Clark & James, 2013).
- After the breeding season the nests are abandoned by the males, and the entire nesting area is vacated until next year when the bream return. During this time, the cleared seabed provides an excellent place for opportunistic algae to settle (Baldock & Dipper, 2023). The rapid colonisation by algal communities provides habitat and food source for juvenile bream and other fauna, as well as increasing overall habitat complexity for the area (Baldock & Dipper, 2023).
- Black Seabream are an indicator species associated with complex habitats, used to ascertain the health and resilience of a habitat and its ecosystem (Blampied *et al.*, 2022).
- Although adult bream are only seasonal at inshore areas, they can be considered a valuable part of the coastal ecosystem and a key feature for conservation due to their specific and returning necessity to these spawning grounds (Rees *et al.*, 2020). Their specific habitat requirements during key stages of their life cycle combined with their opportunistic diet make them an ideal indicator species for researching management of inshore areas and of different habitat types (Rees *et al.*, 2020).

1.5.1 Summary

- Black seabream can act as seabed engineers through their nest building behaviour.
- Nesting areas are abandoned at the end of the spawning period and vacated until the following year, the clear areas of seabed provide habitat for opportunistic species to colonise providing a habitat and food source for juvenile black seabream and other species.
- Black seabream are an indicator species for complex habitats used to help assess a habitat's health and resilience.
- The specific habitat requirements of black seabream during key life stages combined with an opportunistic diet makes them a good indicator species for reviewing management of inshore areas and different habitat types.

2. Fishing for Black Seabream

2.1 General

The following points relate to black seabream across their geographic distribution.

- Black seabream are a highly valued sport fish and important commercial species throughout much of their geographic range (Pinder *et al.*, 2016).
- Black seabream are a non-quota species and are landed in varying quantities by multiple fishing gear types along the southern UK coastline (MMO).
- In the English Channel, it is noted that black seabream are caught with mid-water trawls, bottom trawls, bottom gillnets (including gillnets, tangle nets and trammel nets) and handline gears (The Safina Center, 2014).
- There is currently no formal stock assessment for black seabream in the English Channel (Collins and Mallinson, 2012), therefore the only assumptions on the status of populations currently are those inferred from data on commercial and recreational fishing activities (Southern IFCA, 2014).

2.2 Commercial Fisheries

2.2.1 General

The following points relate to black seabream across their geographic distribution.

- In the face of changing availability of historically targeted species, it is noted that inshore fishers are adapting by identifying new fishing grounds, developing innovative fishing techniques and targeting different species (Prosperi *et al.*, 2016).
- There also appears to be an increasing popularity to fish for non-quota species, and as such, black seabream are becoming a more globally commercialised species with fishing pressure reducing on more traditional species like cod and hake (Silva *et al.*, 2021).
- Commercial fisheries for black seabream are known to occurs in Boulogne (July to December), Dieppe (July to November), Port en Bessin (July to October) and the Isle of Wight and Sussex coasts (May to November) (Peroudou and Nedelec, 1980) in addition to Dorset based fisheries.

Evidence from the UK

- Communities in Cornwall have been observed to alter their traditional fisheries to target under-exploited species like black seabream, whiting (*Merlangius merlangus*) and cuttlefish (*Sepia officinalis*) (Arkley & Caslake, 2004).

2.2.2 Southern IFCA District

- In the Southern IFCA District the species has historically been targeted by trawl fishing, net fishing and commercial and recreational rod and line fishing, the latter encompassing private anglers and charter vessels (Southern IFCA, 2014).
- Data on the level of commercial fishing in English waters is compiled by the Marine Management Organisation (MMO) in the form of landings data. Due to the spatial level at which the data is recorded it cannot be attributed specifically to the Dorset MCZs where black seabream is a designated feature, however general landings into ports within the Southern IFCA District can be collated from this data.
- Annex 1 provides the MMO landings data for 2016-2020 showing the quantity landed for all ports in the Southern IFCA District and those within Dorset only and the associated value[2]. The data has been provided in this literature review as it does not represent site-

[2] Data provided via request to the Marine Management Organisation.

specific records for the Dorset MCZs and therefore are not suitable for inclusion in the **Black Seabream Site Specific Evidence Packages**.

- Data is split by gear type into bottom towed fishing gear, nets, pots and traps and lines. It must be noted that the reporting mechanism for the MMO landings data uses the classification of 'black seabream' but also 'sea breams', the latter being the only category used from 2018 onwards thus quantities may represent other bream species, but it is thought that black seabream is likely to form the majority of the landings.
- For all gear types, Dorset ports account for the majority of commercial landings in the Southern IFCA District.
- Removal of BSB as target species is documented in the data for demersal fixed nets. Recorded catches of BSB in nets from landings data in 30E7 (Purbeck Coast) and 30E8 (Poole Rocks and Southbourne Rough) show general consistency in last 5 years (2020-2024), some increase in landings during breeding season in 30E7 but larger catches are outside breeding season in 30E8. Use of these gear types through documented activity (<12m vessels) is low in all three sites, average landings per year for 30E7 vary from 0.13 to 0.016 tonnes (2020-2024), and for 30E8 from 0.034 to 0.013 tonnes (2020-2024). Monthly averages (2020-2024) for 30E7 0.003-0.26 tonnes, peak in February, less than 0.05 tonnes (April to November), for 30E8 0.0067-0.08 tonnes, peak in April (less than 0.05 tonnes June to March.
- Landings based on MMO data for BSB for Dorset Ports within District for demersal fixed nets (highest resolution available and therefore likely overestimate of fishing within MCZs specifically) shows low levels of landings in 2024 (average 0.199 tonne) and for last 3 years (average all less than 0.1 tonne) and generally for last 9 nine years (average all less than 0.5 tonne), broken down by month for last three years higher levels of landings have occurred primarily outside the period April to July.
- BSB are a target species for commercial rod & line, however landings data into Dorset Ports indicates fluctuating and generally low levels. Catch levels on average remain low between 0.7 tonne and 0.06 tonne (2016-2024). No consistent pattern in MMO landings data into Dorset ports that suggests activity is focused on April to July breeding season, for most recent three years (2022-2024), highest landings per month limited to an average of 0.2 tonne maximum which occurred in November. Landings between April to July (2022-2024) varied from an average of 0.1 to 0.01 tonne.
- For wider areas 30E8 and 30E7 for commercial rod & line, vessels <12m, the average weight landed from 2020-2024 ranges from 0.026 to 0.048 tonnes per year, max weight 0.12-0.38 tonnes in 2024 (30E7), the average weight from 2020-2024 ranges from 0.018 to 0.027 tonnes per year, max weight 0.11-0.24 tonnes in 2024 (30E8). 30E7 highest target month March, 30E8 January.

2.3 Recreational Fisheries

2.3.1 General

The following points relate to black seabream across their geographic distribution.

- Fish of the family Sparidae (including breams) are a preferred fish for recreational fishing as they are found in coastal waters and can be fairly easily caught using rod and line (Herfaut *et al.*, 2013).
- Black seabream are fished recreationally by sea anglers using rod and line and also recreational spear fishers, as they are a highly prized sport and competition species to catch and are a good eating fish (Jiménez-Alvarado *et al.*, 2019).
- Recreational fishing is a popular sport across the world, with black bream having been recorded through trophy photographs as being landed by recreational anglers as far back as the 1940s (Pinder et al, 2016).

Evidence from the UK

- It was previously estimated from data collected in 2013, that of an estimated total annual catch by anglers of black seabream in the English Channel of >100,000 individuals (~70 tonnes), over 65% were removed (Pinder *et al.*, 2016). For this same time period and area, commercial landing records equalled 203 tonnes making the recreational catch ~25% of the total annual catch for that year (Pinder *et al.*, 2016).
- A review undertaken by the MMO to map recreational sea angling activity in England found seabream species (primarily black seabream) to be the second most valued species for charter boats within the South Marine Plan area (MMO, 2020).
- The species can be caught by anglers throughout the year but with a focus in the period between April and June (Collins and Mallinson, 2012).
- There are often limits advised by charter vessels to ensure the majority of fish are returned to the breeding stock (Small, 2021).

2.3.2 Southern IFCA District

- The majority of activity is vessel based with many charter boats providing specific trips to target black seabream, however the species can also be targeted from the shore but to a lesser extent (Small, 2021).
- Patch reefs within Poole Bay were noted to be the focus of intensive sport angling between April and June specifically targeting black seabream (Collins and Mallinson, 2012).
- It is difficult to obtain large datasets on bream fishing from the recreational angling sector as activities are not regulated to the extent of commercial fisheries, i.e., requirements for the submission of catch data (Southern IFCA, 2014).
- Data was provided to the Southern IFCA in 2014 from the Angling Trust, representing data collated periodically between 1990 and 2013. This data was originally provided in the 2014 Southern IFCA Black Seabream Status Report (Southern IFCA, 2014) and is reproduced here directly from that report.
- Due to the variation in timescales between different data sources, the different locations of data collection and the number of anglers involved, it is difficult to infer any definitive trends in the data which is representative mainly of Hampshire based angling clubs.
- The data have been provided as Annex 2 to this literature review as they do not represent site-specific records for the Dorset MCZs and therefore are not suitable for inclusion in the **Black Seabream Site Specific Evidence Packages**.

3. Impacts of Fishing Activities

3.1 General

The following points relate to black seabream across their geographic distribution.

- FishBase has given a vulnerability score for black seabream of 52 out of 100, indicating black seabream have a medium inherent vulnerability to fishing (The Safina Center, 2014).
- Life history characteristics of black seabream make the species particularly vulnerable to overexploitation, as it is a protogynous hermaphrodite, slow-growing, long-lived and shows habitat specificity during spawning seasons with spawning aggregations and male nest guarding behaviour (Neves *et al.*, 2020).
- Whilst aggregated around nesting sites, black seabream are particularly vulnerable to exploitation by both commercial and sport fishing (Collins and Mallinson, 2012; Pinder, *et al.*, 2016) as spawning aggregations are predictable in space and time providing an easy opportunity to catch large numbers of reproductively active fish.

3.1.1 Removal of black seabream as a target or non-target species

In considering the potential impacts of fishing activities on black seabream, the removal of black seabream as either a target or non-target species results in potential impacts which would be applicable regardless of the specific gear type involved. Evidence relating to these impacts has been presented in this section.

Gear specific impacts related to the removal of black seabream as either a target or non-target species consider the potential impacts for mortality and delayed mortality specific to each gear type, in this case relevant evidence is provided in the gear specific section (S3.2).

In each section, it is indicated whether the evidence relates generally to potential impacts to the species which are relevant across their geographic distribution. Where specific survey data is referenced, information is provided on the location of that survey and split into evidence from work in the UK and from outside the UK.

3.1.1.1 General Impacts

The following points relate to black seabream across their geographic distribution.

- Fisheries that target aggregating spawning populations risk hyperstability, where CPUE remains stable but true abundance declines (Erisman *et al.*, 2011). Aggregations tend to occur at predictable times and sites, and the high concentrations of fish provide an increased ability to harvest greater quantities over smaller time scales. CPUE can therefore remain high or increase whilst overall abundance decreases if fishers are able to repeatedly locate aggregations and target them (Erisman *et al.*, 2011). In the event of hyperstability, it is only if a population gets close to collapse that the effect stops being masked (Erisman *et al.*, 2011).
- It is noted from a wide range of studies that fish escaping or released from fishing gears can suffer immediate as well as delayed mortalities, resulting from physical injury, predation and disease (Chopin *et al.*, 1995; Chopin *et al.*, 1996).
- Modelling cumulative mortality has indicated that the mortality risk rises rapidly in response to repeated catch and release events from fishing activities. This is increased further where there are high recapture rates and short recapture intervals (Bartholomew and Bohnsack, 2005).
- It is noted that the removal of fish species may impact food webs and habitats associated with the target species if removals are of a sufficient magnitude. The removal of carnivorous sea breams may result in increased survival of certain benthic invertebrates which may result in the competitive exclusion of other species (ABPmer, 2020).

3.1.1.2 Size and sex related Impacts

The following points relate to black seabream across their geographic distribution.

- Species which undergo a sex change may be particularly vulnerable to overexploitation by size-selective fishing (Lloret *et al.*, 2012).
- It has been noted that species such as black seabream which employ a female-first sex-changing reproductive model are more likely to benefit more consistently, in terms of abundance, from protection through management than species which employ other reproductive models (Lloret *et al.*, 2012).
- The use of a minimum size limit tends to protect juvenile females rather than males due to the protogynous hermaphrodite strategy of black seabream where the transition from female to male can occur up to 30-40cm in length, in addition the absence of a maximum size limit could skew targeting only to males (Sussex IFCA, 2013).

- This is noted in other studies which note that as males are dominant in upper length classes for black seabream and take on the parental care and nest guarding duties, overfishing of larger size classes is likely to adversely affect the spawning stock unless the species is able to increase its sexual inversion rate to compensate (Goncalves and Erzini, 2000).
- Overexploitation of smaller size classes of black seabream however is likely to affect predominantly the females within a population, also resulting in a potential negative impact on reproductive potential (Goncalves and Erzini, 2000).

Evidence from the UK

- Between 1977 and 1979, the modal size of black seabream in the English Channel was seen to decrease from 37-38cm to 28-30cm due to the expansion of fishing activities which selectively targeted larger fish thus selectively targeting male fish (Pawson, 1995; Sussex IFCA, 2013). It was noted that the selective removal of larger males had the potential to skew the sex-ratio and thus reproduction (Sussex IFCA, 2013)

3.1.1.3 Impacts relating to nests and eggs

The following points relate to black seabream across their geographic distribution.

- The act of removing an individual male from a spawning aggregation may not be comparable to removing that same individual outside of the spawning period due to the secondary effect on reproductive output (Pinder *et al.*, 2016).
- Complex reproductive behaviours may accelerate rates of population decline seen from harvesting and a reduction in subsequent rates of recovery. Nest building is considered a complex strategy and if a nesting male is harvested, rapid and total brood loss is likely due to the brood being left defenceless against predators (Lloret *et al.*, 2012).
- The temporary displacement of a male from the nest potentially results in an immediate risk on conspecific nest invasion and brood predation (Pinder *et al.*, 2016) as well as predation from other species including wrasse, blenny, goby and crustacean species (Doggett *et al.*, 2016).
- When males are removed from nests, sediment can also accumulate without the male present to remove it, potentially resulting in the smothering of eggs reducing viability (Westerberg *et al.*, 1996).
- Sediment accumulating to a level in excess of the thickness that black seabream are able to excavate may lead to the male being deterred away from the nest site reducing the area of suitable nesting habitat (Strain *et al.*, 2012).

Evidence from the UK

- A study of black seabream on the Dorset coast found that the stomachs of five male fish (15% of all males captured) contained eggs of conspecifics, suggesting an immediate risk of brood loss regardless of whether the captured male was then released and navigated back to its nest (Pinder *et al.*, 2016).

Evidence from outside the UK

- For the black seabream fisheries in France, it is determined that as the majority of individuals are removed from the fishery during the spawning season when they are accessible within inshore fisheries, both mature black seabream and the embryos are at risk of direct mortality (Herfaut *et al.*, 2013).

3.1.1.4 Impacts relating to stress response and fitness

The following points relate to black seabream across their geographic distribution.

- Physical or environmental disturbances that are severe enough to cause stress require compensatory action by the fish in the form of a stress response which enables the fish to avoid or overcome the stressor (Chopin *et al.*, 1996).
- There are a variety of stressors associated with capture and escape, such as fatigue, damage and barotrauma. The reaction of a particular species to stress is dependent on the fish's condition, the magnitude of the stressor (which for fishing is a function of gear type) and the way in which the gear is operated (depth, retrieval rate etc.) (Chopin *et al.*, 1996).
- Stress from catch and release from any fishing gear can cause physiological disturbance, physical injuries and behavioural impairments. Injuries such as soft tissue damage, fin abrasion and bleeding can result in mortality or reduced fitness (Cooke *et al.*, 2013; Brownscombe *et al.*, 2016).
- In returning to a nest, if sediment has been allowed to build up by an extended absence of the male, excessive fanning behaviour would be undertaken by the male to remove the excess sediment requiring a greater energy expenditure which could adversely affect the health of the guarding male (Westerberg *et al.*, 1996).

3.1.1.5 Summary
The following points are noted as general impacts from the removal of black seabream as target or non-target species irrespective of gear type:

- Black seabream exhibiting spawning aggregations puts the species at risk of targeted exploitation with impacts to the population potentially being masked.
- There is a risk of direct or indirect/delayed mortality as a result of capture.
- The risk of mortality may increase with repeated capture events and shortened time between capture events which is a risk when an aggregation is targeted.
- The reproductive strategy of black seabream of female first then male introduces risks to the population of skewing the sex ratio by selective removal of only larger individuals. The Southern IFCA minimum conservation size for black seabream of 23cm provides protection to the mature females in the population reducing the risk of skewing sexes based on female removal.
- Catch and release of black seabream by any gear type can result in a stress response causing a variety of negative effects on the individual that may affect reproductive, nest building or nest guarding behaviours.
- The selective removal of more male fish increases the risk to nests and egg survival, nests may suffer predation by either black seabream or other species or become subject to sedimentation which results in either extra energetic expenditure for the male bream on returning to the nest or nest abandonment and smothering of the eggs.

3.1.2 Abrasion/disturbance of the substrate on the surface of the seabed
The impact of abrasion/disturbance of the substrate on the surface of the seabed tends to be more gear specific, therefore there are fewer general points which apply across all gear types. The potential for impact is based on gear construction, deployment and operation as well as the spatial footprint of the gear on the seabed.

The main impact from this pressure is from BTFG, literature on this gear type was reviewed as part of the Southern IFCA BTFG Review: Phase I, under which a Part B MCZ Assessment was carried out for BTFG for Black Seabream at Southbourne Rough MCZ. This Assessment and the corresponding literature review is available on the Southern IFCA website here: Southbourne-Rough-BTFG-Bream.pdf.

There are no studies which look specifically at potential abrasion impacts of pots/traps, nets or lines specifically on black seabream nests. Therefore, evidence to indicate potential impacts for this pressure is taken from studies of these gear types on impacts to benthic environments. Gear specific evidence is provided in section 3.2.1. It is noted that any impact to habitats will be less for static gear fisheries such as those being considered here when compared to bottom towed fishing gears, however there are potential impacts which may occur to impact the nests of black seabream, particularly when eggs are present which need to be considered.

3.1.2.1 General Impacts

The following points relate to black seabream across their geographic distribution.

- Where species spawn in specific habitats, the risk of damage to that habitat directly affects reproductive success and can affect the future use of that area by the species (van Overzee and Rijnsdorp, 2014).
- Due to the nature of certain fisheries to follow spawning aggregations, the risk of damage to spawning habitat occurs primarily during the spawning period (van Overzee and Rijnsdorp, 2014).
- For species which lay eggs that are directly attached to the substrate rather than the eggs being released in the pelagic zone, the risk of direct impact by fishing gears is increased (van Overzee and Rijnsdorp, 2014).
- Black seabream eggs need to remain adhered to the nest substrate during their development, the use of fishing gear which has the potential to rub along the seabed could result in eggs being squashed or completely removed (Clark *et al.*, 2013).

3.1.2.2 Summary

- For species such as black seabream that use specific habitats for spawning, any damage to that spawning habitat can have an impact on reproductive potential and spawning success.
- Impacts to spawning habitat may alter or reduce the area of appropriate habitat available in a given year.
- The risk posed by abrasion of disturbance of the seabed in relation to spawning success is seen to occur only during the spawning period.
- The main risk for black seabream is to the eggs which are attached to the substrate within a nest. This strategy puts the eggs at greater risk from abrasion impacts as the eggs need to remain adhered to the nest surface.
- Any gear type which has the potential to cause abrasion can impact eggs through damage or complete removal.

3.2 <u>Gear Specific Impacts</u>

The evidence presented in this section looks at information and studies specific to certain gear types.

3.2.1 Abrasion/disturbance of the substrate on the surface of the seabed

3.2.1.1 Pots/Traps

The following points relate to black seabream across their geographic distribution.

- Direct impacts of pot/trap fishing gear on the benthic environment may occurring during deployment, with pots landing on sensitive species, during soak, with underwater pot movement by tides and/or waves causing abrasion, and during retrieval, where gear can be dragged along the seabed including both the pots and associated ropes (Stephenson *et al.*, 2017; Gall *et al.*, 2020).

- It is noted in multiple studies that it is very unlikely for pots to land, soak and haul in exactly the same location on successive trips (Stephenson *et al.*, 2017; Gall *et al.*, 2020).
- Individual pots are noted to have a small footprint and thus a small area for interaction, however the specific location of an impact is hard to identify within the total area covered by a string/fleet of pots (Stephenson *et al.*, 2017).
- Dragging of pots/traps on retrieval is noted to occur due to a number of conditions including a mismatch between the speed of the vessel and the distance between traps (Stevens, 2021). In addition to the trap, there is potential for the lines connecting traps to cause damage with the cumulative impact from lines having the potential to exceed that of the traps (Stevens, 2021).
- Anchor weights are often used on the ends of strings of pots to prevent dragging when fishing in dynamic areas (Coleman *et al.*, 2013).

Evidence from the UK

- In a study of potting impacts on UK reef habitats, using singularly deployed pots, it was found that there were no changes in species abundance at intensive levels of potting, however there were no dragging elements introduced by virtue of the hauling of a single pot rather than a string (Stephenson *et al.*, 2017).
- A further study from the Lyme Bay area of Dorset, UK, exposed reef to different levels of pot fishing over a period of four years (Rees *et al.*, 2021). The study utilised normal commercial pot fishing trips to replicate normal practice with trips occurring 2-3 times per week during stable weather, typically in the summer, and 1 time per week during less stable weather, typically in the winter. This study identified that high densities of pot fishing can negatively affect sessile reef building taxa in a partially protected MPA and that a threshold could be established with effects likely to occur when densities of pots exceed 15-25 pots per 0.25km^2. It was thought that declines in reef building species were a result of repeated hauling and deployment of gear in addition to movements of pots related to weather and tides, with the biggest impact noted on species with slower recovery rates (Rees *et al.*, 2021).
- A second study in Lyme Bay, Dorset, UK, found that when wind and tidal streams were strong, the incidence of pots dragging on the seabed increased, especially when the wind blew across the tide (Eno *et al.*, 2001). It was also noted that when there was insufficient line during deployment, the lead pot could bounce up and down during periods of strong tides and larger swells (Eno *et al.*, 2001).
- A study in south Devon, UK, found that uneven topography in rocky areas resulted in pots being likely to make some contact with the seabed but not at the footprint of the entire base therefore the area of impact based on total possible contact area would result in an overestimation (Gall *et al.*, 2020). This study found that pots took an average of 3.46 seconds to settle from the point of first contact with the seabed with pots tending to land upright. Pots were noted to be relatively stable, but some movement was noted with occasional movement in 8.08% of soaks, small movements throughout soak in 4.04% of soaks and large movements in 1.52% of soaks (Gall *et al.*, 2020). The total time that pots moved across the seabed on hauling was 20.71 seconds, therefore being in contact with the seabed for approximately half the time taken for them to be lifted clear. Rope movement occurred but 45.91% of the time this did not result in any scour impacts. The data was used to calculate the total possible contact area of 6.20m^2 ± 0.61 and the length of the seabed contact area as 3.04m^2 ± 0.24 (49.07% of the total contact area) (Gall *et al.*, 2020). There was a significantly greater spatial footprint for inkwell pots compared to parlour pots (Gall *et al.*, 2020).
- The same study noted impacts to sensitive reef taxa, with 25-30% of individuals damaged (through tissue abrasion) or removed (Gall *et al.*, 2020). The greatest concern over impacts is in relation to long-lived, slow growing taxa (Gall *et al.*, 2020).

- A study in Northumberland, UK, found no change in community structure at experimental and non-fished sites, however the method involved setting and recovering single pots and it was recognised that this would not allow for the dragging of pots which is found when strings are retrieved (Stevens, 2021).

Evidence from outside the UK

- A study on fish traps in the Bay of Biscay soaking over an 8-hour period showed no movement in either 'light' (199kg) or 'heavy' (209kg) sets of gear during the soak time and a swept area of less than $2m^2$ during retrieval. It was noted that although the movement is small, the movement of the trap during retrieval could damage sessile organisms such as gorgonians, sponges or algae (Kopp *et al.*, 2020).
- Setting lobster traps on coral reef flats resulted in a reduction in percentage of benthic cover from 45% to 31% in quadrats along the movement path of the trap. In the same habitat, the mean distance moved by the trap was 3.6m affecting an area of $4.6m^2$ in shallow depths. However, there were no assemblage changes noted in areas subject to potting compared to non-fished areas in temperate rocky habitats (Kopp *et al.*, 2020).
- A review of trap fishing in the USA found that the likelihood of encounters with epibenthic organisms increased 50% during retrieval due to the traps being dragged along the seafloor (Stevens, 2021). The drag time and number of interactions increased with the position of the trap, ranging from 10 seconds for the first on the string to 60 seconds for the last (Stevens, 2021).

3.2.1.2 Summary

- Impacts to the seabed from pots/traps may occur during deployment, soak time or retrieval, with the latter seen to create the most movement of gear along the seabed.
- The pot, the lines and any associated weights have the potential to interact with the seabed.
- Whilst individual pots are noted to have a small footprint, the specific location of any impact is hard to identify within the total area covered by a string.
- The effect on the seabed during retrieval is dependent on the fisher's activity.
- Studies in the UK have shown that the possible contact area for pots on the seabed is small.
- Uneven topography in rocky areas results in pots being likely to make some contact with the seabed but not at the footprint of the entire base, therefore the area of impact based on the total possible contact area would be an overestimation.

3.2.1.3 Nets (Pelagic and Demersal)

The following points relate to black seabream across their geographic distribution.

- For bottom-set gillnets, the parts of the fishing gear in contact with the seabed are the lead line, the anchors and the lines connecting the anchors to the net (Savina *et al.*, 2018).
- Gillnets may be dragged along the seabed and become entangled in bottom features either during deployment/retrieval or with water flow when fishing (Polet & Depestele, 2010; Savina *et al.*, 2018).
- Impacts from net fishing where the net interacts with the seabed occur mainly during retrieval, when anchors and ground lines can drag along the seabed (Grieve *et al.*, 2014). This also increases the footprint over which an effect may be seen (Grieve *et al.*, 2014).
- It has been noted that the complex effects of water, waves and wind can change over small scales influencing the behaviour of net fishing gear (Savina *et al.*, 2018).
- Removal of seaweeds and algal plants could impact the hydrodynamics of the area as vertically growing species reduce impacts from wave energy (Coleman and Williams, 2002; Denny, 2021). At nesting sites this may result in eggs being exposed to higher wave

energy which could either dislodge eggs, cause damage to eggs from debris or introduce sediments into the nest area.

Evidence from the UK

- Reviewing net fishing in the English Channel, it was noted that where nets are fixed to the ground with anchors or weights, there is the potential for small amounts of habitat damage (The Safina Center, 2014).
- In a study in the Welsh part of the Irish Sea, UK, it was found that habitats consisting mostly of rock with associated branching species has a sensitivity of high to medium to net fishing at a high to low fishing intensity respectively (Savina *et al.*, 2018).

Evidence from outside the UK

- A study on bottom set gillnets along the Danish coastline indicated that sweeping movements of the gear could be up to 2m (Kopp *et al.*, 2020).
- A second study off the Danish coast found that the lead line of a bottom-set gillnet fully deployed could sweep the seabed in sandy habitats up to approximately 2m, the majority of the time being around 10cm. Movements were noted to be both continuous or in a sudden step (Savina *et al.*, 2018). It was noted that any potential damage to the benthos would arise from this movement.
- A study in Mexico found that set gillnets impacted 22% of benthic gorgonian corals and removed 17% within 1m of the net (Stevens, 2021).
- A further study in Mexico found that kelp plants and gorgonian corals were entangled and removed when the net was being hauled. It was determined that the impact from hauling is likely to be larger than soaking due to more power being exerted by a net hauler, however it was noted that fisher's methods of handling the gear can significantly reduce potential habitat damage, i.e., by hauling in the direction of the current (Shester and Micheli, 2011).

3.2.1.4 Summary

- The effect of abrasion/disturbance to the seabed is most likely to arise from bottom-set nets/fixed nets.
- The impact could arise from contact between the seabed and the lead line, anchors and lines associated with the net.
- Contact with the seabed can occur during setting, soak time and retrieval although the latter is noted as having the greatest potential for movement and the greatest footprint for interaction with the seabed.
- The magnitude of an effect can be affected by fisher experience and hauling practice.
- The behaviour of a net during soak time can be affected over small spatial areas by environmental factors such as wind and tide movements.
- Nets can remove seabed plant life, potentially reducing the potential for an area of seabed to be protected from wave energy.
- Studies from Europe have indicated that the sweep of a set gillnet could be up approximately 2m but the majority of the time was found to be around 10cm.

3.2.1.5 Lines (Pelagic and Demersal)

The following points relate to black seabream across their geographic distribution.

- For longlines, the principal components that can produce affects on the seabed are the anchors/weights and the mainline (Polet & Depestele, 2010).
- The effect is determined by how far the longline travels over the seabed during the setting or retrieval processes, with the distance likely to be greater during retrieval (Polet & Depestele, 2010). If the vessel hauling the gear is not above the part of the line being

lifted, the line, anchors/weights can be pulled across the seabed before ascending which can cause injury or detachment of exposed seabed organisms (Polet & Depestele, 2010).

Evidence from the UK

- A review of fishing in the English Channel noted that there is the potential for small lead weights at the end of lines to come into contact with the seabed (The Safina Center, 2014).

Evidence from outside the UK

- An assessment of the effect of longlining in deep sea environments in the north-east Atlantic (Spain) found that there was a bycatch of corals and small sponge species in certain areas indicating a degree of interaction with seabed organisms (Duran Munoz *et al.*, 2010).

3.2.1.6 Summary

- The main effect from lines on the seabed comes from longlining activity where there are associated anchors and lines which may come into contact with the seabed.
- There is the potential for interaction during the setting, soak or retrieval processes with the latter having the largest potential impact based on how the gear is hauled and the potential for dragging on the seabed.
- Evidence from outside the UK indicates there is the potential for longlining gear to remove benthic organisms from the seabed.

3.2.2 Removal of black seabream as a target species or non-target species

3.2.2.1 Pots/Traps

The following points relate to black seabream across their geographic distribution.

- Discards from pot fishing can be removed quicker and with less handling than other methods (such as nets) resulting in a higher probability of survival (Petetta *et al.*, 2020)

Evidence from the UK

- There is little research on bycatch of pot fisheries in the UK, although the general assumption is that bycatch is low relative to other fishing methods (Southern IFCA, 2017).
- An assessment of the crab and lobster fishery around the Isle of Man found that bycatch was relatively low, with fish species representing 20% of the bycatch composition (although this did not include black seabream) (Öndes *et al.*, 2018). It was noted that bycatch varied significantly between areas and at a small scale between local fisheries (Öndes *et al.*, 2018).

3.2.2.2 Summary

- The risk of bycatch of black seabream by pots is low.
- Should any bycatch arise individuals can be returned quickly with minimal handling.

3.2.2.3 Nets (Pelagic and Demersal)

The following points relate to black seabream across their geographic distribution.

- Compared to pot fishing, discards from nets are seen to be greater with an increased discard mortality. The cleaning of a net implies additional time on deck as discards must be released or untangled manually (Petetta *et al.*, 2020).
- Gillnets are noted to have both direct and indirect mortality for fish species, the latter defined as 'non-catch fishing mortality' (Potter and Pawson, 1991). This includes:
    - Predation mortality where fish caught in nets are removed or damaged by a predator to a point where they cannot be landed or a returned to the sea dead or injured (Potter and Pawson, 1991).
    - Escapement mortality where a fish which encounters a net and is temporarily caught escapes and subsequently dies from injuries, stress, disease or a heightened risk of predation. It is thought that the degree to which this happens relates to the range in size of the caught species relative to the size of the gear being used (Potter and Pawson, 1991).
    - Drop-out mortality where fish are caught and killed by nets but drop out before the net is hauled. This can be related to the construction of the fishing gear (Potter and Pawson, 1991).
    - Haul-back or fall out mortality, where fish are caught and killed by fishing gear but are lost as the gear is hauled which can be heavily influenced by fisher operations (Potter and Pawson, 1991).
    - Discard mortality where fish are caught and then discarded dead or are discarded and suffer delayed mortality from injuries or stress, influenced by the species composition in the area where the gear is set and the soak time (Potter and Pawson, 1991).
    - Unreported catch mortality where fish are taken as bycatch, for personal consumption or are illegally landed (Potter and Pawson, 1991).
- In fishing gears where fish must pass through net meshes, it is likely that damage will be caused when the fish passing through the mesh has an opercular circumference of the same size or larger than the mesh and thus there is a high probability that the fish will become wedged (Chopin *et al.*, 1995).
- For species caught in trammel nets, it was noted that there is an increased risk of predation for entangled fish, the risk increasing with the soak time of the net (Sardo *et al.*, 2023).

Evidence from the UK

There are no studies from the UK on the specific impacts of catching black seabream as a target or non-target species by nets.

Evidence from outside the UK

- A study looking at the impacts of trammel nets on the sea bream *Pagrus major*, found that the severity and degree of injuries increased with the length of time the fish was trapped in the net and included disruption of the mucus layer, removal of scales from the opercula, superficial cuts to the pectoral and tail fins and deeper cuts into the dermal tissue in front of the dorsal fin and in the belly. For all fish captured for less than 1 hour, there were only superficial injuries observed, for all fish captured for >1hr there were cuts into the dermis which developed into open wounds within 8 days (Chopin *et al.*, 2016).
- In the same study, 28% of fish suffered mortality in the net, 5% within 48 hours of release, and 11% between 8-18 days after release. All mortalities in the net occurred after more than 3 hours, any fish dying in the following period had developed wounds as a result of net capture (Chopin *et al.*, 2016). It was noted that stress increased with capture duration, and that water flow over the gills was severely restricted when the fish was caught round the opercula (Chopin *et al.*, 2016).
- A study on the southern black bream *Acanthopagrus butcheri* targeted in a gill net fishery in Australia looked at estimating post-release survival rates based on a combination of estimates of initial survival from observations and delayed survival from field trials (Grixti *et al.*, 2011). The estimated post-survival rate was high at greater than 90%, however

based on the methods used it was postulated that delayed mortality could have been underestimated (Grixti *et al.*, 2011).

3.2.2.4 Summary

- There is thought to be an increased risk of delayed mortality from net fishing compared to pot fishing due to increased handling if the fish has to be removed from the net before being returned.
- There are different types of secondary mortality noted to occur from net fishing involving an increased predation risk, injury and stress from net capture and illegal harvesting.
- Mesh size is seen to be linked to the degree of damage which could be sustained by an individual caught in a net.
- For trammel net fishing, studies point to the soak time being directly related to the severity of injuries and an increased risk of predation.
- Post-survival rates of other bream species have been noted to be high following capture in gill nets as part of targeted fisheries, with individuals suffering post-release mortality being limited to those that suffered injury in the net.
- Stress is noted to increase with capture duration, particularly when the gills are restricted by the net.

3.2.2.5 Lines (Pelagic and Demersal)

The following points relate to black seabream across their geographic distribution.

- In light of the aggressive and courtship behaviours exhibited by male black seabream, it is noted that fitter (more aggressive) individuals and those exhibiting strong territorial behaviour are more susceptible to capture by recreational angling (Pinder *et al.*, 2016).
- Unquantified hooking mortality can mean that other management measures such as a minimum size or a bag limit become less effective than intended (Coggins *et al.*, 2007).

Evidence from the UK

- A study on black seabream in Dorset, UK, stated that, based on nesting behaviour, males become aggressive to anything entering into their territory, this can include baited hooks (Pinder *et al.*, 2016).
- A study on black seabream caught by anglers (private recreational and charter vessels) operating out of Poole, Swanage and Weymouth on the south coast of the UK, between May and June 2015 found that a total of 40 black seabream were captured with a mean length of 306 ± 10mm, all being sexually mature and with significantly more males captured than females (Pinder *et al.*, 2016).
- It is noted from anecdotal evidence by a number of operators within Dorset that male black seabream do not take baited hooks during the period when they are nest guarding due to the absence of feeding behaviour, whilst there may be some aggressive displays towards hooks, the catch levels become much lower during this period as hooks are not fully taken by individual fish.

Evidence from outside the UK

- A study from a Portuguese longline fishery identified that the method was not highly species specific through the use of bait which is widely consumed by a variety of fish species (Erzini *et al.*, 1996). It was determined that the species selectivity of this gear type would require consideration of local fish distributions, competition between species, hook size, hook design, gangion length, gangion accessories (floats and swivels), gangion diameter, colour and type (monofilament or braided), mainline diameter, mainline colour and material, bait type, bait size, bait shape, bait combinations, time of fishing and soak time (Erzini *et al.*, 1996).

- In a small-scale Portuguese longline fishery, it was noted that the average length at capture was larger for males than females which is thought to be a consequence of the sequential hermaphroditism exhibited by black seabream (Goncalves and Erzini, 2000).
- For sea bream (*Pagrus major*) it was noted that cortisol levels were significantly elevated in captured fish from longlines compared to resting levels but that levels did peak rather than increase exponentially (Chopin *et al.*, 2016). It is thought this may be a result of adaptive behaviour and that with increased time of capture on a longline, the fish regulates its swimming to maintain position with the line rather than fight against it. In this way the fish reduced becoming fatigued and the extent of injuries associated with struggling behaviours as well as reducing the tension on the line allowing the fish to regain an upright position (Chopin *et al.*, 2016).

3.2.2.6 Catch and Release from Lines

The following points relate to black seabream across their geographic distribution.

- In a general review of catch and release angling, the following factors were identified as being related to the incidence of mortality. Anatomical hook location, type of lure, type of hook, hook size, whether the hook was treble, single, modified, barbed or barbless, active vs passive fishing, playing time, handling time, angler experience, removal of deep hooks, venting swim bladders, capture depth and temperature (Bartholomew and Bohnsack, 2005; Viega *et al.*, 2011; Cooke *et al.*, 2013; Pinder *et al.*, 2016; Morfin *et al.*, 2017).
- Reflex indicators (i.e., ability to maintain equilibrium, escape response) are also considered in assessing the vitality of a fish, with determinations made by researchers that such reflexes can be indicative of future individual performance and post-release mortality (Pinder *et al.*, 2016).
- The desired conservation benefits of catch and release rely on the assumption that a high proportion of the fish will survive, with any impacts on behaviour or physiology not compromising the reproductive potential of an individual fish (Pinder *et al.*, 2016).
- Attributes of catch and release events such as water temperature, fight time and air exposure have been shown to induce a physiological stress response from which a fish may or may not recover (Cooke *et al.*, 2013).
- Physiological changes which may occur in a fish during an angling event result primarily from burst exercise during capture where an energetic expenditure is required in white muscle which exceeds the ability of the tissue to respire aerobically, leading to anaerobic respiration to fuel activity (Cooke *et al.*, 2013).
- The burst exercise is often accompanied by activation of a primary stress response, where the stress hormones adrenaline, noradrenaline and cortisol can be released into the bloodstream. This initiates changes including the release of glucose to fuel the heart or gills, splenic contractions to release red blood cells, elevated cardiac output and a recruitment of gill lamellae (Cooke *et al.*, 2013).
- The magnitude of a physiological disturbance is seen to increase with angling duration and both cardiac and blood-based changes increase with duration of air exposure. These effects can then be further exacerbated at sub- or surpaoptimal temperatures, in larger compared to smaller fish and in fish that have not been feeding relative to well-fed fish (Cooke *et al.*, 2013).
- The ability to recover from catch and release stressors has ecological outcomes, as swimming performance can be limited during the time required to clear metabolites from the blood and restore mussel energy. The time required is species specific and can scale proportionately with the duration and magnitude of the stressor. (Cooke *et al.*, 2013).
- Failure of a fish to recover homeostasis efficiently can result in metabolic collapse and increase the risk of post-capture predation (Cooke *et al.*, 2013; Ruiz-Jarabo *et al.*, 2021).

- Post-release survival has been strongly linked to the position where the hook penetrates the tissue, shallow (lip, mouth) and foul (outside the mouth) hooking are usually associated with higher survival rates than deep hooking (throat, gills, oesophagus, gut) (Bartholomew and Bohnsack, 2005; Grixti *et al.*, 2008; Viega *et al.*, 2011). It has been suggested that this is the most important factor affecting hooking mortality (Viega *et al.*, 2011).
- It is noted that hooking mortality rates can be highly variable between species (Viega *et al.*, 2011). The complexity of factors affecting hooking mortality and the variability in mortality rates amongst species suggest that nation-wide management may be less appropriate, with species-specific guidelines on catch and release being preferable, but only if the appropriate data for specific species is available (Viega *et al.*, 2011).
- Where there is no major tissue damage to vital organs, it is suggested that some fish can shed hooks, survive until a hook dissolves or grow new tissue around a hook (Grixti *et al.*, 2008).
- Long air exposure times are likely to be detrimental to the fish, especially following a long fight time. Studies linking handling time and fight time to mortality are limited however it is thought that these elements add to the overall stress for the fish (Grixti *et al.*, 2008). However, there are studies which show that air exposure only results in mortality where there is an unrealistically large exposure time employed and where the species is particularly sensitive (Cooke *et al.*, 2013).
- Using natural bait may increase the risk of deep hooking as a fish is more likely to ingest natural bait than an artificial lure (Bartholomew and Bohnsack, 2005).
- Many of the elements associated with reducing the risk of catch and release mortality are under the direct control of the angler, however it is noted that anglers differ greatly in handling skill and catch and release behaviour making the physiological impacts of catch and release highly context dependent (Cooke *et al.*, 2013).

Evidence from the UK

- A study on black seabream in Dorset UK, stated that although the ability of a male to return to the nest was not quantified, it appeared that, due to the mechanics of angling from an anchored vessel in depths of approximately 20m and strong tidal currents, that it was not untypical to catch and release fish 50m or more up-tide of their nests (Pinder *et al.*, 2016). On this basis it was suggested that males who are released who can overcome the challenge of navigating back to their nest may have to decide to either continue guarding or abandon based on predation rates during the male's absence (Pinder *et al.*, 2016).
- The same study noted that, although in limited numbers, females captured by hook and line were observed shedding eggs during the process of unhooking and handling which could have an immediate impact on reproductive potential (Pinder *et al.*, 2016).
- The same study noted that larger fish had significantly longer fight times and extended air exposure but that significantly more fish were easy to unhook than difficult and most fish incurred only minimal damage from being hooked (Pinder *et al.*, 2016). Seven fish had the hook located in the oesophagus with attempts to remove resulting in considerable damage including bleeding from the gills in five fish (Pinder *et al.*, 2016). Only one fish was deep hooked on a circle hook, the remainder of deep hooking occurred with J-hooks (Pinder *et al.*, 2016).
- The same study applied reflex impairment tests and found that 32% of the fish sampled had an impairment score of 0.25 or higher, with the rest assessed as having no impairment (Pinder *et al.*, 2016). However, correlations between increased lactate with increased fight time did not demonstrate increased impairment (Pinder *et al.*, 2016). It was noted that the method used would not have accounted for all stress responses and therefore was a likely underestimate of the post-release physiology and behaviour impacts of catch and release on black seabream (Pinder *et al.*, 2016).

- It was noted from this study that while hook damage was a significant predictor of impairment, there were interacting variables which make a single cause of impairment hard to identify, for example individual variability in angler behaviour, the gear used and the distance down the side of the boat from which the fish were captured (Pinder *et al.*, 2016). It was postulated that all these factors could have either individual or additive effects on changes in blood chemistry concentrations and the extent of reflex impairment (Pinder *et al.*, 2016).

Evidence from outside the UK

- Handling times for southern black bream in Australian rod and line fisheries were found to be significantly shorter for shallow-hooked fish than deep-hooked fish with fish who were deep hooked having displayed longer fight times during the fishing process (Grixti *et al.*, 2008).
- The same study found that initial and delayed survival was significantly higher for shallow hooked fish than deep hooked fish and, for the latter, where hooks were not removed or the fish did not bleed, and was higher in warmer compared to colder water. The study also found that survival decreased with an increase in fish length as the instance of shallow hooking decreased with increased size (Grixti *et al.*, 2008). Scale loss was found for 18% of fish and survival was lowest when the hook penetrated the throat or gill region (Grixti *et al.*, 2008).
- It is noted that for southern black bream, longer term implications from deep hooking (dependent on hook location) such as interrupted hormone production, infections and impacts on feeding and digestion may not been seen within 72 hours leading to mortality or other sublethal effects including weight loss and reduced reproductive success (Grixti *et al.*, 2008).
- When waters are warmer, mortality is generally seen to increase as at higher temperatures, dissolved oxygen concentrations decrease whilst the respiratory demands of the fish increase. For catch and release fishing, this combination can increase physiological stress (Bartholomew and Bohnsack, 2005).
- Increased handling times and playing/fight times increase physiological stress, depriving the fish of oxygen during a critical period following heavy exertion resulting in increased recovery time to normal function once released (Bartholomew and Bohnsack, 2005). During this recovery time, the fist may exhibit reduced fitness and altered behaviour increasing susceptibility to predation and/or disease (Bartholomew and Bohnsack, 2005).
- A study on blackspot seabream (*Pagellus bogaraveo*) in Spain found that longline capture induced an acute stress response including changes in plasma cortisol, lactate, glucose and osmoregularity. However, it was found that 90.6% of individuals captured survived in post-capture recovery tanks, with evidence of physiological recovery responses 5 hours after capture and complete homeostatic recovery within the first 24 hours (Ruiz-Jarabo *et al.*, 2021). It was noted that survival in the wild may be greater due to the artificial conditions employed during this study, however that survival in the wild may also be less as post-capture predation could not be quantified (Ruiz-Jarabo *et al.*, 2021).
- A study on hook and line impacts, using three different hook sizes, for three species of sea bream was carried out in an aquaculture facility in Portugal (Viega *et al.*, 2011). It was noted that fish were hooked in the mouth or jaw more often than in the stomach or gills and that short-term hooking mortality for black seabream was 2.8% (Viega *et al.*, 2011).
- A study on largemouth bass (*Micropeterus salmoides*), a species which exhibits solo parental care, found that catch and release impaired locomotory activity and subsequently reduced the care response for offspring for up to 24 hours (Cooke *et al.*, 2000).

3.2.2.7 Summary

- During the spawning period male black seabream are noted to be more aggressive, with those exhibiting this characteristic strongly, along with increased fitness, noted to be more susceptible to capture by rod and line due to aggressive behaviours towards hooks.
- Anecdotal evidence by a number of operators within Dorset is that male black seabream do not take baited hooks during the period when they are nest guarding due to the absence of feeding behaviour.
- If hooking mortality is unknown, then other management measures such as bag limits and size related measures can become less effective.
- Longlining can be more indiscriminate in terms of species captured, the construction, operation, soak time and removal of any fish not to be retained will all impact on the degree of post-capture mortality.
- Fish may be able to minimise impacts related to stress induced responses if able to regulate their position relative to longlining gear when hooked. The degree to which this will be effective will be dependent on the initial hooking impact to the fish.
- Hooking location is seen to be a key variable in the degree of injury and thus post-capture mortality suffered by an individual.
- Many of the elements which contribute to post-capture mortality are seen to be under angler control, the main ones being related to handling time and practice and hook use with circle hooks resulting in lower mortality than J-hooks.
- There are varying physiological changes which could occur as a result of the stress response initiated during capture. The stress response is seen to increase with duration of the angling event, however recovery times can be variable occurring within a few hours to 24 hours. During that recovery period the fish may exhibit altered behaviours which could involve alterations to parental care behaviours or affect the ability to avoid predators.
- Study from Dorset, UK found that impairments were not found in the majority of fish caught and that increased fight time did not correlate with increased risk of impairment.
- A single cause of impairment is hard to identify, variations in angler behaviour, gear used etc. could have individual or additive effects.
- The ability for a black seabream male to navigate back to its nest following capture is not yet known, there is the potential based on angling practice to capture a fish up to 50m away from its nest and there is a risk to the eggs on the nest during the time that a male would need to navigate back to that nest.
- Females captured by hook and line have been observed to shed eggs during handling.
- Whilst larger fish had longer fight times and air exposure, they tended to be easier to unhook and suffer less damage.
- There is the potential for temperature to influence post-capture mortality rates with warmer temperatures positively correlated with increased mortality.

4. Mitigation

The following section details mitigation methods described in studies from both the UK and outside of the UK relevant to all fishing methods.

Seasonal management

- Management for species with complex reproductive strategies such as nest building and parental care should consider limiting or banning the catching of those species through seasonal closures that align with the spawning season (Lloret *et al.*, 2012).

Zonal management

- Catch and release zones can be used to provide recreational fishing opportunities whilst providing some protection for exploited fish if fishing mortality can be reduced compared to areas with normal extractive fishing practices (Bartholomew and Bohnsack, 2005).

Hook use

- A review of factors influencing mortality from catch and release angling highlighted the following general points related to improved survivability which can be related to multiple fish species; fish not being hooked in critical body areas, use of circle hooks rather than J-hooks, use of barbless hooks, active fishing and thus setting the hook quickly prior to retrieval, reduced air exposure, reducing handling time, more experienced anglers, cutting deep hook lines rather than removing the hook, and lower water temperatures (Bartholomew and Bohnsack, 2005).
- Circle hooks are more likely to lodge in the fish's mouth and cause less damage than J-hooks which are more likely to reach the gut. Even in the event that the bait is swallowed, circle hooks are less likely to do damage until the eye of the hook clears the mouth, they are usually easy to remove involving reduced handling time and thus reduced stress on the fish (Bartholomew and Bohnsack, 2005).
- The pattern of deep hooking and shallow hooking in relation to circle and J-hooks in a study of black seabream on the Dorset coast indicated that a change in behaviour to using circle hooks could limit deep-hooked black seabream and thus reduce post-release mortality (Pinder *et al.*, 2016).
- Barbed hooks are consistently associated with a high CPUE, most likely due to the ability to remain secure within the fish and therefore, reducing the likelihood of loss of catch (Huehn and Arlinghaus, 2011; DuBois and Dubielzig, 2024; Shaeffer and Hoffman, 2022). A 22% increase in CPUE was seen when using barbed hooks, opposed to barbless alternatives in an angling fisher in St. Petersburg, Florida (Schaeffer and Hoffman, 2022).
- However, increase retention of fish has also raised concerns over fish welfare. Barbed hooks have been seen to significantly increase dehooking time and risk of tissue tearing, therefore leading to higher rates of anoxia and post-release mortality of different fish species (Cooke *et al. 1a,* 2022; Cooke *et al* 1b, 2022; Cowx, *et al.* 2017; Meka, 2004). The use of barbed hooks have been found to increase tissue tears up to 65%, reflex impairment increase mortality by 24%, increase dehooking times and increase reflex impairment (Cooke *et al.* 1a, 2022; Cooke *et al.* 1b, 2022).
- Barbed J hooks displayed the highest injury rates, due to increased dehooking and handling time, in a rainbow trout fishery in the Alagnak River, Alaska. The study emphasized the requirement for proper angler education to improve fish welfare in catch and release fisheries (Meka, 2004).
- Barbless hooks are generally favoured for reducing handling time and minimising tissue damage, thus improving post-release survival (Casselman, 2005; Cowx *et al.*, 2017; Diggles and Ernst, 1997), however, some concerns remain that the absence of a barb may allow the hook to lodge deeper or move within the fish, therefore potentially increasing risk of injury (Cowx *et al.*, 2017). Beyond biological considerations, the barbed vs. barbless hook debate has also been referred to as a social issue, particular referring to the impact of gear restrictions have impacted anglers (Schill & Scarpella, 1997).
- The use of barbless hooks is recommended, and in some cases, mandated in several fisheries worldwide, including regions in the United States and river systems within south west England, due to their benefits in reducing injury and facilitating quicker release (Cowx *et al.*, 2017).
- Mixed conclusions have been drawn from investigations into hooks size on fish injury and catch efficiency, with some research stating hooks size is the sot important predictor of deep hooking, with larger hooks limiting risk (Alos *et al.*, 2008), while others suggest that

larger hooks increase risk of tissue tearing, bleeding and the potential for visual impairment of individual species (Mapleston *et al.*, 2008).

- For yellowfin bream in Australia, it is identified that anatomical hook location is a major predictor of mortality, with fewer than 4% of mouth or jaw hooked fish suffering mortality compared to more than 45% of fish which ingest hooks (Broadhurst *et al.*, 2007). In addition, the removal of ingested hooks resulted in 88% mortality compared to 0% when hook-ingested fish were released with the line cut (Broadhurst *et al.*, 2007). The cutting of lines rather than removal of hooks has also been noted as improving survivability for black seabream in Portugal (Viega *et al.*, 2011) and southern black bream in Australia (Grixti *et al.*, 2008).
- For smallmouth bass, it was found that mortality was associated with the site and depth of hook penetration, with an 11% mortality for fish caught on live bait and swallowing the hook compared to 0% for fish caught with artificial lures and hooked in the mouth (Chopin *et al.*, 1995).
- It is noted that anglers in recreational fisheries tend to apply larger or greater amounts of bait as the hook size increases. The risk of deep-hooking can be decreased significantly as the hook and bait size increases, however if a fish is deep-hooked with a larger hook the likelihood of significant injury is greater (Grixti *et al.*, 2007).
- Studies indicate that the impact of gear type and hook size on both fish welfare and catch efficiency is highly dependent on species-specific factors, including fishing method, feeding behaviour, and mouth morphology.
- Employing methods related to hook size, bait and fishing with a tight line may only come through voluntary measures, given that most fisheries are mixed species and require different gears and techniques as well as variations in angler experience (Grixti *et al.*, 2007).

Handling and Fishing Practice

- Analyses of multiple sources indicated that angler education on proper catch and release techniques could reduce mortality. Practices to encourage included: fishing actively and setting a hook as soon as possible, avoiding playing a fish for long periods of time, the use of de-hooking tools, leaving a fish in the water when removing hooks, avoiding touching the gills and the soft underbelly of the fish and leaving hooks in deep-hooked fish (Bartholomew and Bohnsack, 2005).
- For angling, gear choices, for example gear with extends fight duration can influence the physiological stress experienced by a fish (Cooke *et al.*, 2013).
- In a study looking at the mortality of fish released from trawls and seines, it was noted that the mortalities of 16% and 17% respectively were reduced to around 1% with improved handling practices (Chopin et al, 1995).
- When handling fish, it is recommended that anglers avoid touching the gills to reduce the risk of breaking the gill arches (Grixti *et al.*, 2008).
- A fundamental element to catch and release is the ability to inform anglers on how they can minimise impacts to ensure that recovery is as rapid as possible (Cooke *et al.*, 2013).

Maximum landing size

- The establishment of a maximum landing size could be beneficial in lowering the fishing mortality of larger individuals particularly for species which exhibit sex change behaviours (Lloret *et al.*, 2012).

Other Management Measures

- Size and bag limit related management measures will be most effective when the level of post-release survival is high. Techniques and fishing gears which increase survival rates need to be prioritised in fisheries using these management strategies (Grixti et al, 2007).
- It is noted that management measures designed to promote the survivability of larger individuals are only likely to be successful if the level of release mortality can be understood and limited (Bartholomew and Bohnsack, 2005).

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Annex 1: Commercial fishing data from Southern IFCA District, Dorset Specific Ports from MMO Landings Data

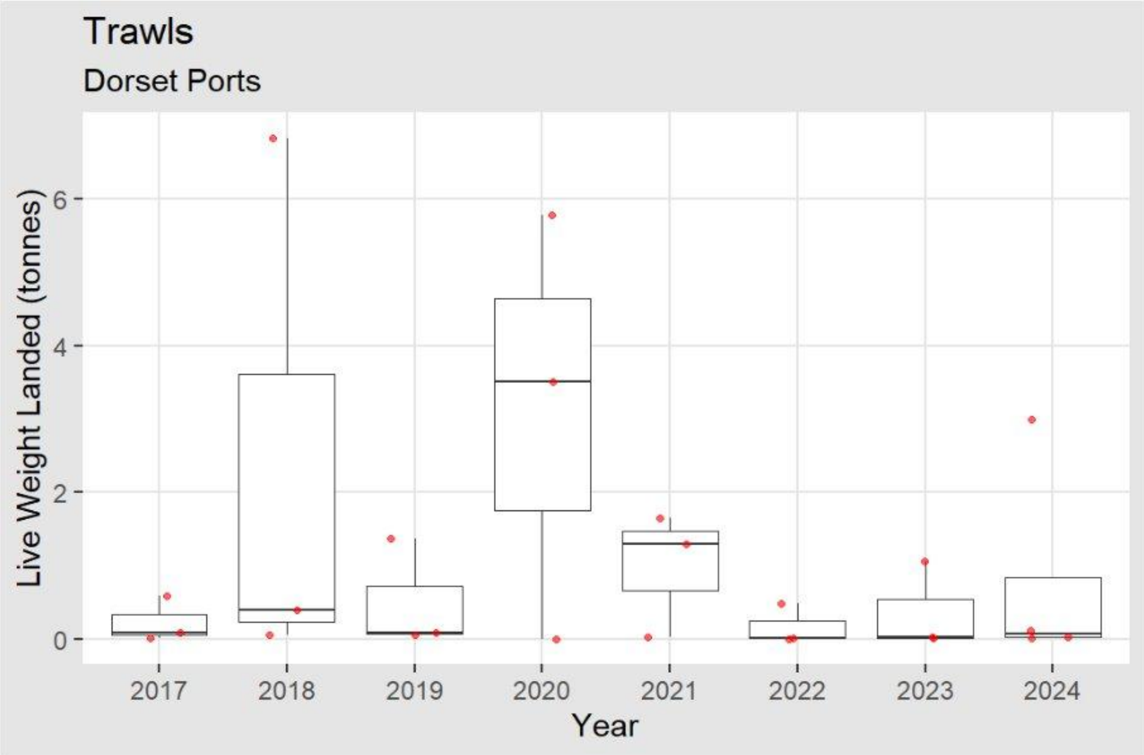

Figure A1: Quantity (tonnes) of black seabream landed by commercial trawls for 2017-2024 into Dorset ports within the Southern IFCA District Data was obtained from the Marine Management Organisation.

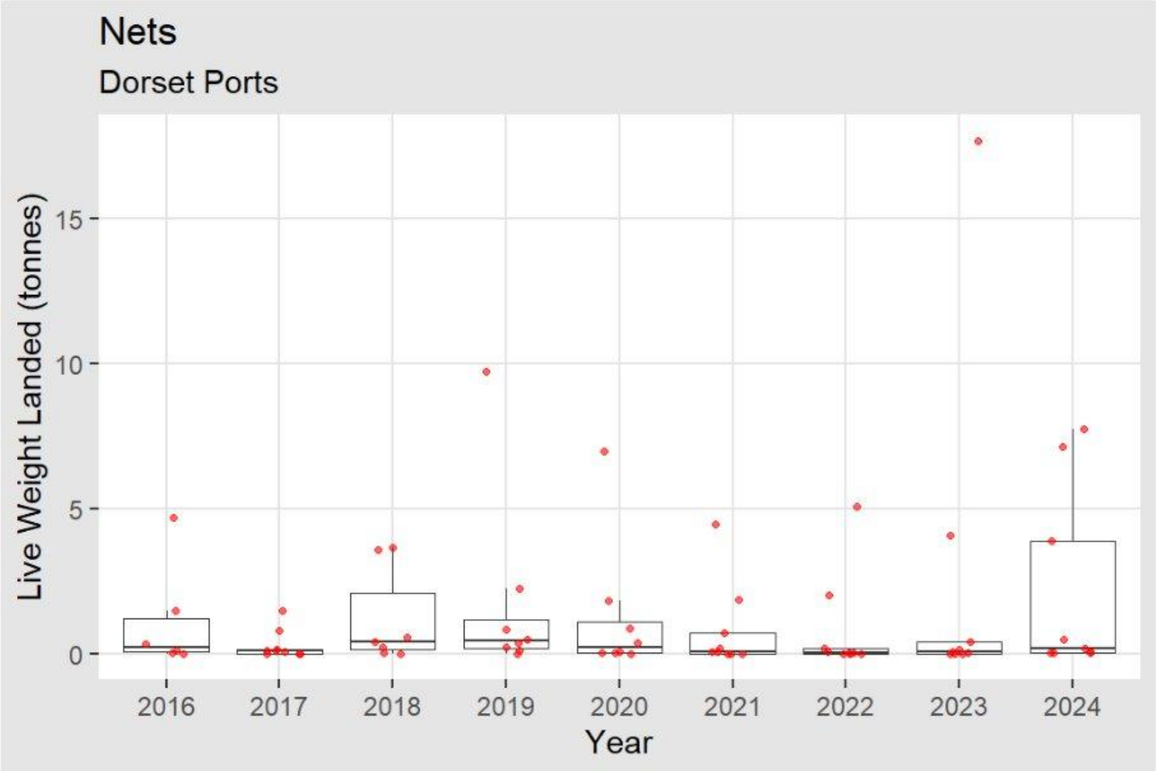

Figure A2: Quantity (tonnes) of black seabream landed by commercial net fishing vessels for 2016-2024 into Dorset ports within the Southern IFCA District. Data was obtained from the Marine Management Organisation.

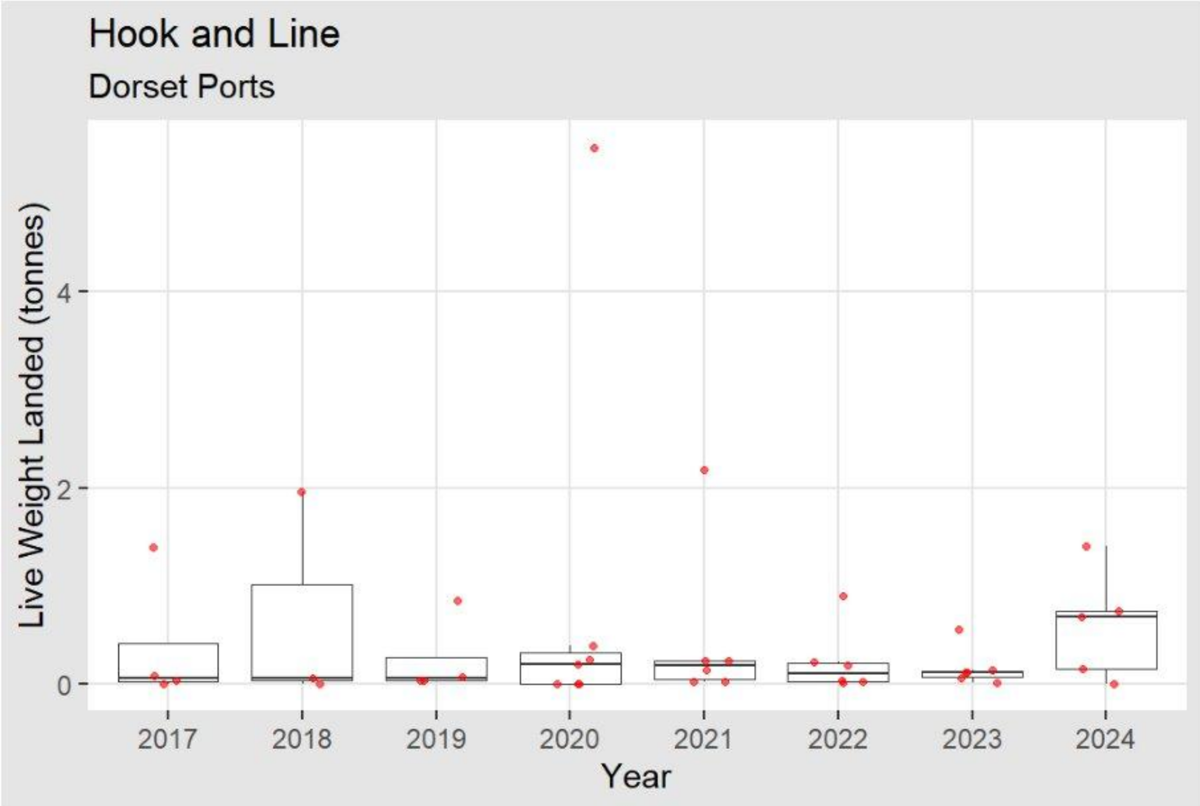

Figure A3: Quantity (tonnes) of black seabream landed by commercial Hook and Line fishing vessels for 2017-2024 into all Dorset ports within the Southern IFCA. Data was obtained from the Marine Management Organisation.

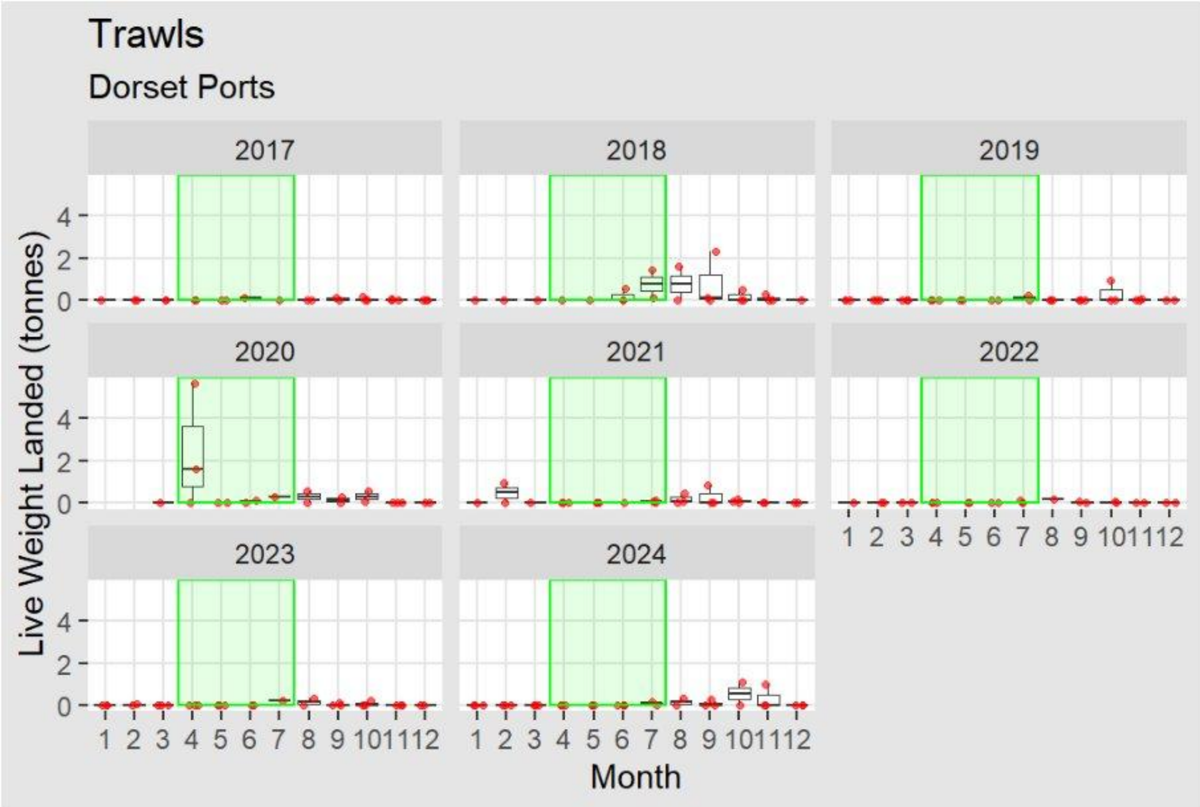

Figure A4: graphs highlighting the monthly landings data of black sea bream from 2017 – 2024 for commercial trawlers from within Dorset Ports. Green boxes highlight the breeding season determined by literature. recorded for each year based on landings data.

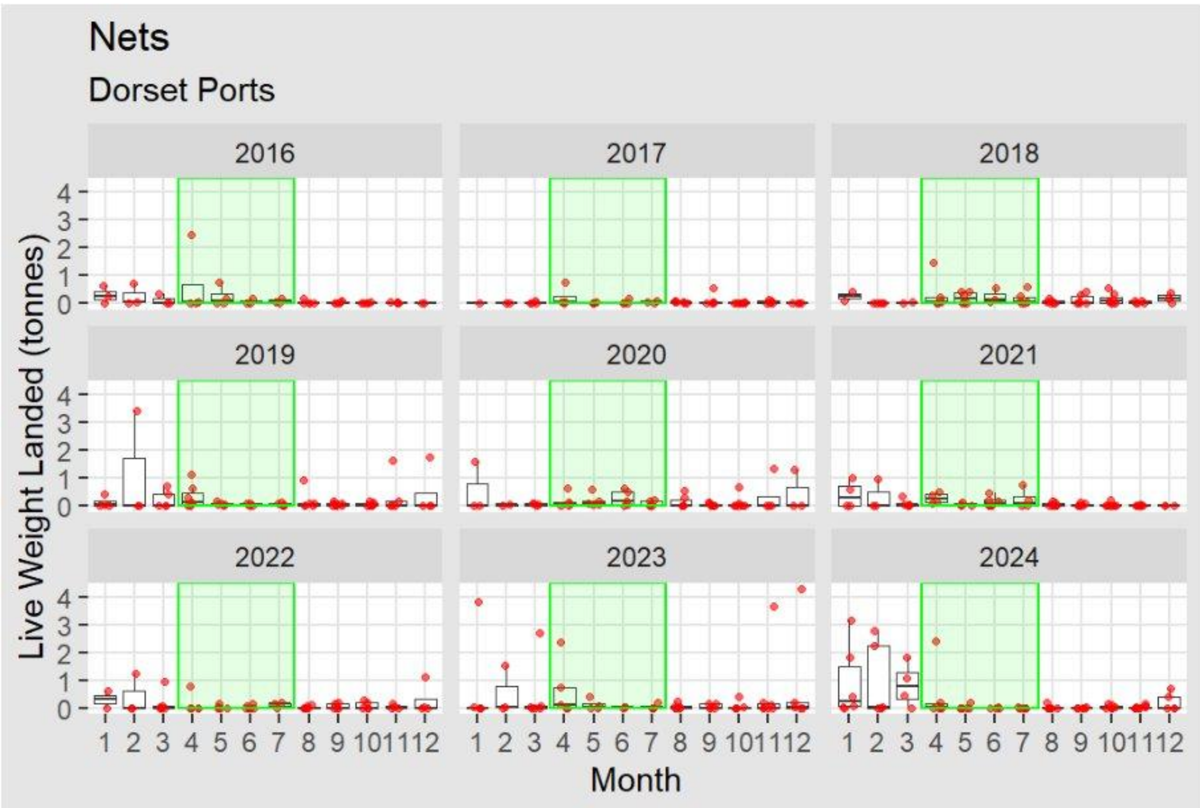

Figure A5: graphs highlighting the monthly landings data of black sea bream from 2017 – 2024 for commercial Net fishing from within Dorset Ports. Green boxes highlight the breeding season determined by literature. recorded for each year based on landings data.

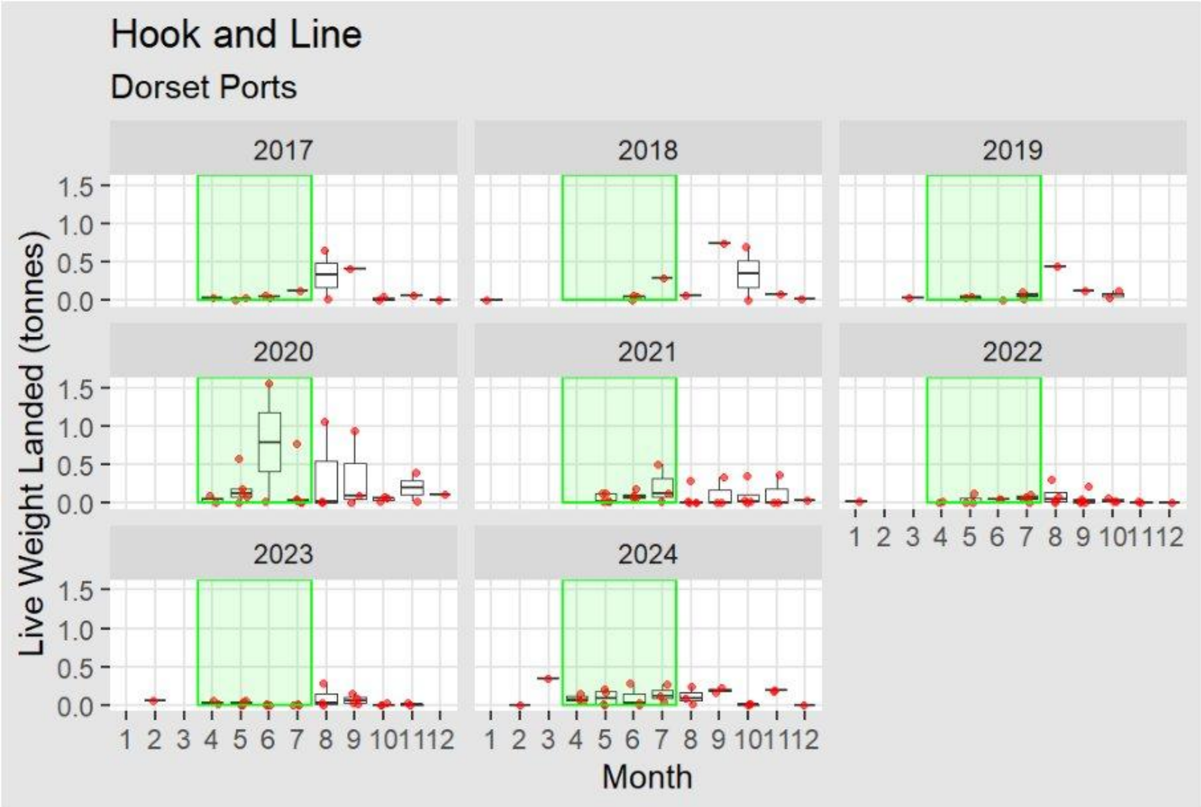

Figure A5: graphs highlighting the monthly landings data of black sea bream from 2017 – 2024 for commercial Hook and Line fishing from within Dorset Ports. Green boxes highlight the breeding season determined by literature. recorded for each year based on landings data.

Annex 2: Data provided to Southern IFCA in 2014 from records held by the Angling Trust

This data is reproduced from the 2014 Southern IFCA Black Bream Status Report (Southern IFCA, 2014).

Table A1. The 'Black Bream Competition' records caught by anglers in Hampshire, between 2009 and 2013 (data provided by the Angling Trust).

Year	No. of Entrants	No. of Fish Weighed-in	Top Weight (kg)	Average Weight (kg)
2009	38	36	1.79	1.13
2010	27	34	1.56	1.16
2011	36	32	1.67	1.02
2012	14	10	1.96	1.05
2013	27	17	1.19	0.88

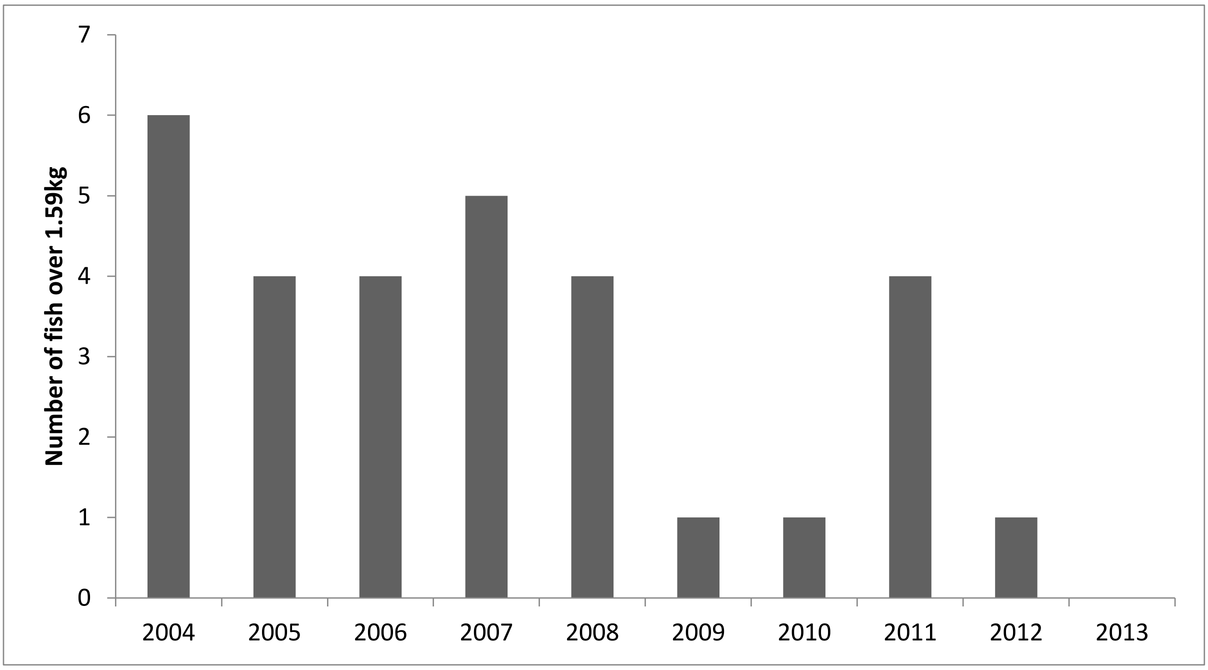

Figure A5. The number of black bream caught by anglers at the Eastney Cruising Association between 2004 and 2013 over 1.59kg (data provided by the Angling Trust)

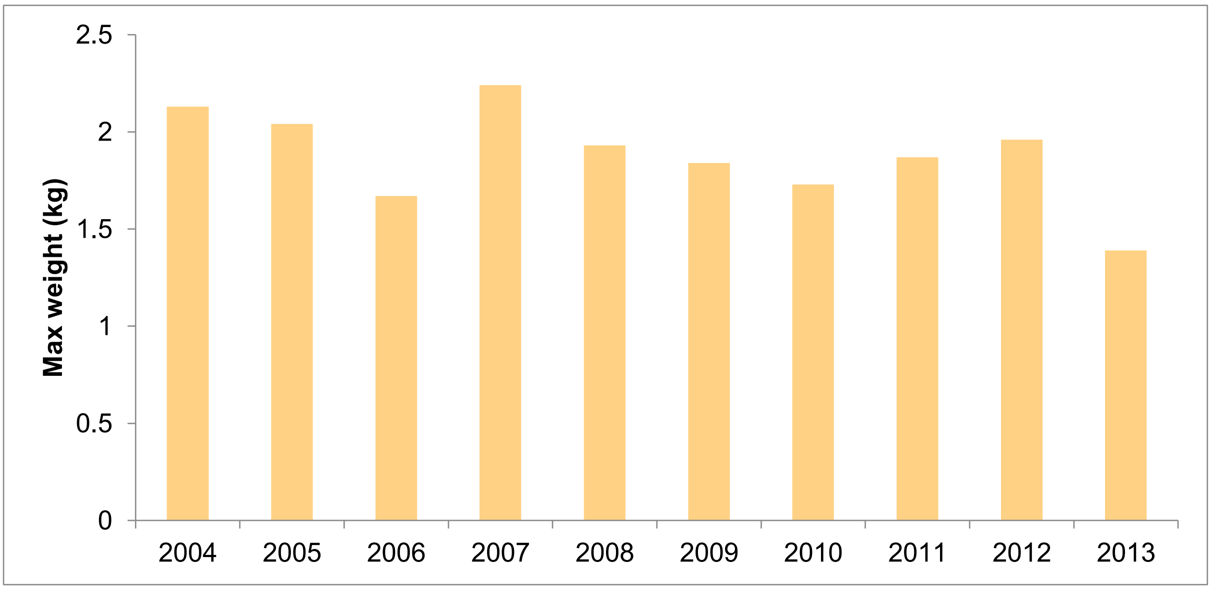

Figure A6: The 'fish of the month' maximum weight (kg) records caught by anglers at the Eastney Cruising Association between 2004 and 2013 for black seabream (data provided by the Angling Trust)

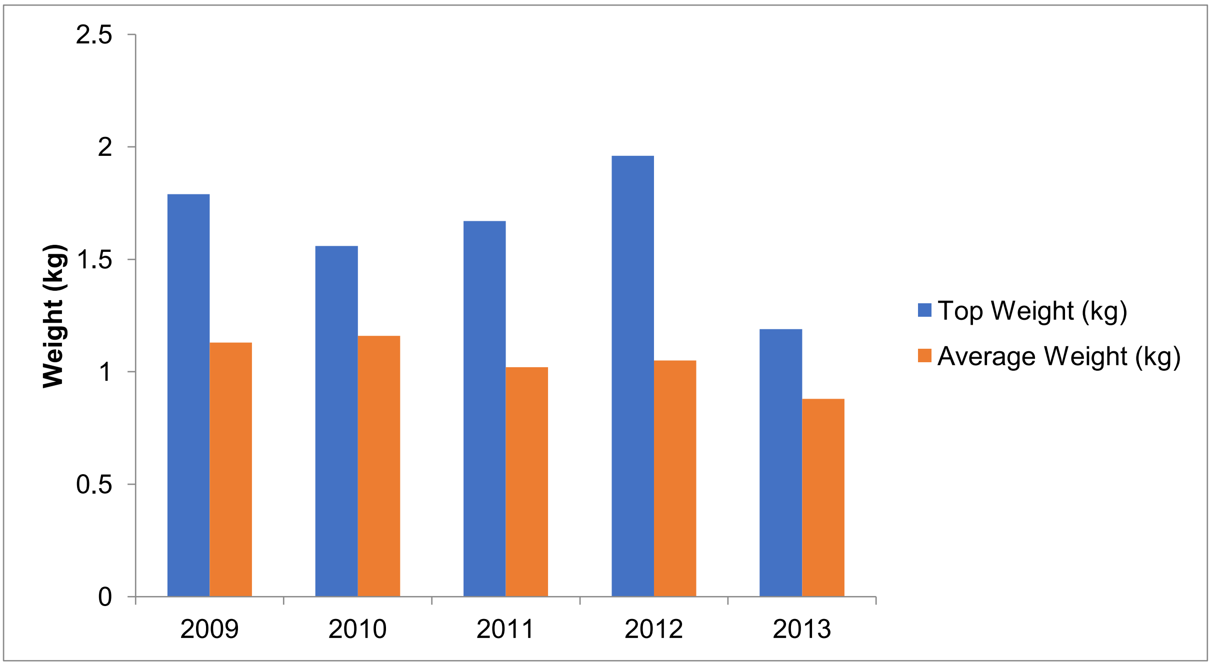

Figure A7: The 'Black Bream Competition' weight (kg) records caught by anglers in Hampshire between 2009 and 2013 for black seabream (data provided by the Angling Trust)

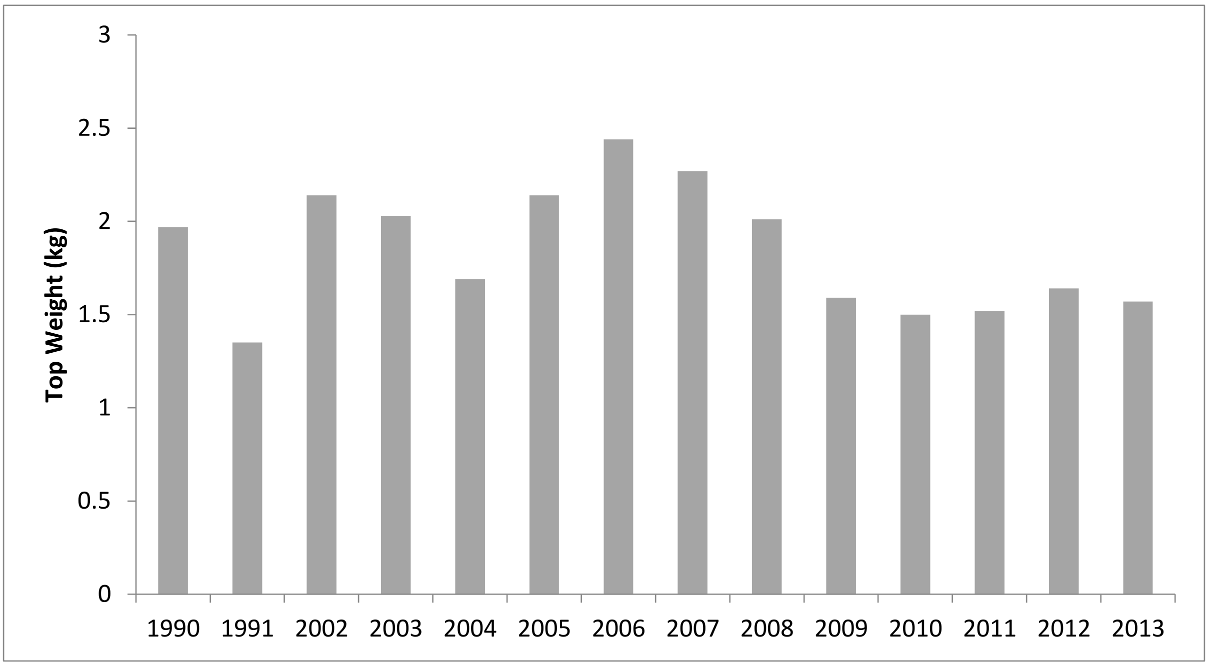

Figure A8: The Bembridge Angling Club top weight (kg) of a black bream specimen caught by anglers between 1990-1991 and 2002-2013 (data provided by the Angling Trust)