Appendix G:
Justification of risk categories assigned in habitat risk assessment

This Appendix is provided in support to the following report:

Marine Planning Consultants Ltd. (2014). Lyme Bay Fisheries and Conservation Reserve: Integrated Fisheries Management Plan. A report produced for the Lyme Bay Fisheries and Conservation Reserve Working Group, UK.

The report, submitted 18/09/2014, addresses comments made by the wider Lyme Bay Fisheries and Conservation Reserve Working Group at a Workshop 09/09/2014.

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Overview

This Appendix justifies and describes the risk categories assigned to each feature-gear interaction. Below each feature title a summary table is presented of the risk category and confidence assigned, together with the references of literature used to assign the categories. Then follows a description of the sources of evidence per gear type; gear types are grouped together where of similar nature / similar results in risk and confidence.

At the end of this document is a section showing full references; and the confidence protocol used.

The allocation of risk categories was based upon review of approximately ~80 papers (of which ~50 are used as evidence here). This used 25 staff days, achieving review and risk category allocation of 18 species (/groups). This compares to the 83 days allocated by Cefas in the review of literature carried out (Breen, 2013) to inform 43 species (/groups) in the nationwide European Marine Sites (EMS) risk matrix undertaken for the revised approach to fisheries management in EMS sites. In recognition of the importance of the literature review in the Lyme Bay project outcomes, MPC sought additional input outside of the project budget through a student placement scheme (Vanessa Lloyd, University of the West of England), providing voluntary contributions to the project, in particular this Appendix.

Note that each feature-gear interaction review contains, where relevant, repeated evidence summaries; this has been done to ensure each review is a stand-alone evidence base.

Risk Categories

Pink Sea-fan

Fishing Gear Type	Matrix Risk Categorisation	Confidence	Source
Netting		High	Macdonald *et al*. 1996; Tillin *et al*. 2010; Tyler-Walters *et al*. 2008
Trawling		High	Jackson *et al*. 2009; Macdonald *et al*. 1996; Tillin *et al*. 2010; Tyler-Walters *et al*. 2008
Dredging		High	Jackson *et al*. 2009; Macdonald *et al*. 1996; Tillin *et al*. 2010; Tyler-Walters *et al*. 2008
Potting		High	Attrill & Sheehan 2012; Eno *et al*. 2001; Macdonald *et al*. 1996; Tillin *et al*. 2010; Tyler-Walters *et al*. 2008
Diving		High	Grieve *et al*. 2011; Devon Wildlife Trust 2007; Jackson *et al*. 2009; Macdonald *et al*. 1996; Tillin *et al*. 2010; Tyler-Walters *et al*. 2008

Fishing gear type: Netting

Matrix risk category: AMBER

Explanation for categorisation: Pink sea fan is long lived, fragile, slow growing and has low reproductive and dispersal abilities (Macdonald *et al*., 1996; Jackson *et al*., 2009); and Jackson *et al.* (2009) identified pink sea fan as a low recoverability species due to these traits. A sensitivity index for disturbance of benthic species by fishing activities was developed by Macdonald *et al*. (1996). Fishing gears were grouped according to the relative scale of disturbance they cause; gill nets and set nets, which are static fishing gears, were included as low intensity fishing gears, i.e. these gear types only exert a low level of pressure on the environment . A sensitivity score of 24 was assigned to pink sea fan for low intensity fishing gears which is comparatively lower than the sensitivity score of 181 for high intensity fishing gear. Despite this lower sensitivity to static fishing gear compared to high intensity mobile fishing gear, the possibility of significant damage to benthic species is increased by intensive use of nets in small areas (Macdonald *et al*., 1996). In contrast, the development of a sensitivity matrix for MCZ/MPA features by Tillin *et al*. (2010) identified pink sea fan as having a high sensitivity to physical damage and to the removal of features through pursuit of a target fishery at a commercial scale; whereas a sensitivity assessment of sedimentary communities to physical disturbance by Tyler-Walters *et al*. (2009) concluded a moderate sensitivity for pink sea fan. These sensitivities account for adverse impacts from human activities which results in an expected 10+ year recovery. An amber categorisation was chosen as the average was taken from the three sensitivity assessments reviewed and because Tillin *et al*. (2010) and Tyler-Walters *et al*. (2009) did not assess the species to a particular fishing gear.

Impacts: The weight and movement of nets may physically damage fragile organisms and intensive use of nets in a small area could cause significant damage to benthic communities (Macdonald *et al*., 1996).

Evidence: Macdonald *et al*. 1996; Tillin *et al*. 2010; Tyler-Walters *et al*. 2008

Fishing gear type: Trawling

Matrix risk category: RED

Explanation for categorisation: Pink sea fan is long lived, fragile, slow growing and has low reproductive and dispersal abilities (Macdonald *et al*., 1996; Jackson *et al*., 2009) and Jackson *et al.* (2009) identified pink sea fan as a low recoverability species due to these traits. A sensitivity index for disturbance of benthic species by fishing activities was developed by Macdonald *et al*. (1996). Fishing gears were grouped according to the relative scale of disturbance they cause. Otter trawls and Danish seines were included as medium intensity fishing gears and pink sea fan was given a sensitivity score of 67. Compared to beam trawls, which operate in the Lyme Bay AOI and were included as high intensity fishing gears, pink sea fan was given a sensitivity score of 181. Pink sea fan was identified as the second most sensitive benthic species assessed to fishing activities. The development of a sensitivity matrix for MCZ/MPA features by Tillin *et al*. (2010) identified pink sea fan as having a high sensitivity to physical damage and to the removal of features through pursuit of a target fishery at a commercial scale with a particular susceptibility to removal from trawling activities. Another sensitivity assessment of sedimentary communities to physical disturbance by Tyler-Walters *et al.* (2009) concluded a moderate sensitivity for pink sea fan; the species is adversely affected by external factors arising from human activities and is expected to take up to or more than 10 years to recover. Due to the high sensitivity assessed for the different types of trawling gears in the literature reviewed and the low recoverability of pink sea fan, a red risk category was chosen.

Impacts: Mobile fishing gear reduces habitat complexity, by removing plants and animals, changes community structure and consequently affects ecosystem processes (Jackson *et al*., 2009). Abrasion and physical disturbance by trawling is likely to affect the sessile pink sea fan particularly with damage to the coenenchyme, the skeletal tissue between the polyps. Where whole individuals are killed, recoverability is likely to be low as many colonies will be 20 or more years old and recruitment is likely to be sporadic (Tillin *et al*., 2010). In Lyme Bay, fishing has had a substantial impact on populations of pink sea fans, especially where the rock is relatively soft and vulnerable to structural damage resulting in changes to the substratum and, potentially the communities, as well as removal of epifauna (Jackson *et al*., 2009).

Evidence: Jackson *et al*. 2009; Macdonald *et al*. 1996; Tillin *et al*. 2010; Tyler-Walters *et al*. 2008

Fishing gear type: Dredging/Scalloping

Matrix risk category: RED

Explanation for categorisation: Pink sea fan is long lived, fragile, slow growing and has low reproductive and dispersal abilities (Macdonald *et al*., 1996; Jackson *et al*., 2009) and Jackson *et al.* (2009) identified pink sea fan as a low recoverability species due to these traits. A sensitivity index for disturbance of benthic species by fishing activities was developed by Macdonald *et al*. (1996). Fishing gears were grouped according to the relative scale of disturbance they cause; dredges were included as high intensity fishing gears and are commercially operated in the Lyme Bay AOI, but outside of the Designated Area. Pink sea fan was given a sensitivity score of 181 for high intensity fishing gears and was identified as the second most sensitive benthic species, of those assessed, to fishing activities. For a scallop dredge encountering Pink sea fan, fragility would be high, the intensity of impact by a dredge would be high and the recovery time required by pink sea fan would be long (Macdonald *et al*., 1996). The development of a sensitivity matrix for MCZ/MPA features by Tillin *et al*. (2010) identified pink sea fan as having a high sensitivity to physical damage and to the removal of features through pursuit of a target fishery at a commercial scale. Another sensitivity assessment of sedimentary communities to physical disturbance by Tyler-Walters *et al*. (2009) concluded a moderate sensitivity for pink sea fan; the species is adversely affected by external factors arising from human activities and is expected to take up to or more than 10 years to recover. Due to the high sensitivity assessed for dredging and physical disturbance in the literature reviewed and the low recoverability of pink sea fan, a red risk category was chosen.

Impacts: Mobile fishing gear reduces habitat complexity, by removing plants and animals, changes community structure and consequently affects ecosystem processes (Jackson *et al*., 2009).

Evidence: Jackson *et al*. 2009; Macdonald *et al*. 1996; Tillin *et al*. 2010; Tyler-Walters *et al*. 2008

Fishing gear type: Potting/Cuttle Potting/Whelking/Crabbing

Matrix risk category: AMBER

Explanation for categorisation: Pink sea fan is long lived, fragile, slow growing and has low reproductive and dispersal abilities (Macdonald *et al*., 1996). Potting activities are generally considered to cause minimal physical damage to non-target benthic species. However, erect and delicate organisms, such as pink sea fan, may become damaged or permanently detached on contact with pots (Eno *et al*., 2001). Five sites within Lyme Bay were studied for immediate effects of hauling pots on benthic species (Eno *et al*., 2001). Very few signs of an impact on benthic species were observed, however there may still be a gradual, cumulative deterioration in condition of organisms suffering from disturbance (Eno *et al*., 2001). A sensitivity index for disturbance of benthic species by fishing activities was developed by Macdonald *et al*. (1996). Fishing gears were grouped according to the relative scale of disturbance they cause; pots were included as low intensity fishing gears and are commercially deployed in the Lyme Bay AOI. A sensitivity score of 24 was assigned to pink sea fan for low intensity fishing gears which is comparatively lower than the sensitivity score of 181 for high intensity fishing gear. Despite a lower sensitivity to static fishing gear compared to mobile fishing gear, the possibility of significant damage to benthic species is increased by intensive use of pots in small areas (Macdonald *et al*., 1996). Since closure to bottom-towed fishing gear within the Lyme Bay Designated Area, concerns have been raised about the potential impact of the increased level of potting activity (Attrill & Sheehan, 2012). This has led to the development of the Lyme Bay experimental potting project to compare the impact of different potting densities. As this data is not available yet and due to the concerns of impacts from high intensity potting activities, an amber risk category has been given.

Impacts: The weight and movement of pots may physically damage fragile organisms (Macdonald *et al*., 1996; Eno *et al*., 2001).

Evidence: Attrill & Sheehan 2012; Eno *et al*., 2001; Macdonald *et al*. 1996; Tyler-Walters *et al*. 2008

Fishing gear type: Diving

Matrix risk category: GREEN

Explanation for categorisation: Pink sea fan is long lived, fragile, slow growing and has low reproductive and dispersal abilities (Macdonald *et al*., 1996; Jackson *et al*., 2009). It is identified as having a moderate to high sensitivity to physical damage and to human activities such as the removal of features through pursuit of a target fishery at a commercial scale (Tillin *et al*., 2010; Tyler-Walters *et al*., 2009). Commercial diving takes place within the Lyme Bay AOI; this is considered the most environmentally sustainable method of fishing, with the greatest control of the catch (Grieve *et al*., 2011). Commercial diving in the Lyme Bay AOI targets scallops and does not result in damage to other sessile organisms or habitats (Hiscox, 2007). Therefore diving should not pose a risk to pink sea fan and is given a green risk category.

Impacts: Commercial diving is very species selective and low intensity and therefore should not impact on pink sea fan. In addition, good diving practices (i.e. buoyancy control) should not lead to damage to the seabed. However, pink sea fan is sometimes taken illegally (Tillin *et al*., 2010).

Evidence: Grieve *et al*. 2011; Devon Wildlife Trust 2007; Jackson *et al*. 2009; Macdonald *et al*. 1996; Tillin *et al*. 2010; Tyler-Walters *et al*. 2008

Native Oyster

Fishing Gear Type	Matrix Risk Categorisation	Confidence	Source
Netting			Tillin *et al*. 2010; Tyler-Walters *et al*. 2008
Trawling			Tillin *et al*. 2000; Tyler-Walters *et al*. 2008
Dredging			Tillin *et al*. 2010; Tyler-Walters *et al*. 2008
Potting			Tillin *et al*. 2010; Tyler-Walters *et al*. 2008; Macdonald et al., 1996; Attrill & Sheehan, 2012
Diving			Grieve *et al*. 2011; Devon Wildlife Trust 2007; Tillin *et al*. 2010; Tyler-Walters *et al*. 2008

Fishing gear type: Netting

Matrix risk category: AMBER

Explanation for categorisation: Native oysters have a high conservation status and have been identified as having a moderate to high sensitivity to physical damage and to the removal of features through pursuit of a target fishery at a commercial scale (Tillin *et al*., 2010). A sensitivity assessment of sedimentary communities to physical disturbance by Tyler-Walters *et al*. (2009) also identified a very high sensitivity for native oysters; the species is adversely affected by external factors arising from human activities and is either not expected to recover at all or recover only over a prolonged period of time, i.e. > 25 years. Overfishing via dredging is a major contributing factor in the decline of native oyster beds (Tyler-Walters *et al*., 2008; Tillin *et al*., 2010) however the species are not commercially exploited in the Lyme Bay AOI or targeted using nets. Interactions with high densities of demersal nets and oyster beds could have negative impacts on the species and habitat and therefore an amber risk category is given for netting.

Impacts: Native oysters have not recovered from past losses due to a number of factors including poor effective recruitment, high juvenile mortality, continued impact and/or loss of habitat (Tillin *et al*., 2010). A high density of nets in a small area may damage or reduce the availability of suitable substrata for oyster recruitment and attachment.

Evidence: Tillin *et al*. 2010; Tyler-Walters *et al*. 2008

Fishing gear type: Trawling

Matrix risk category: RED

Explanation for categorisation: Native oysters have a high conservation status and have been identified as having a moderate to high sensitivity to physical damage and to the removal of features through pursuit of a target fishery at a commercial scale (Tillin *et al*., 2010). A sensitivity assessment of sedimentary communities to physical disturbance by Tyler-Walters *et al*. (2009) also identified a very high sensitivity for native oysters; the species is adversely affected by external factors arising from human activities and is either not expected to recover at all or recover only over a prolonged period of time, i.e. > 25 years. Overfishing by dredging is a major contributing factor in the decline of native oyster beds (Tyler-Walters *et al*., 2008; Tillin *et al*., 2010) however the species are not commercially exploited in the Lyme Bay AOI. Beam trawlers, which are operated in the Lyme Bay AOI (but outside of the Designated Area), cause damage to non-target oysters (Tillin *et al*., 2010) and associated habitat and therefore, along with the high sensitivity assessed by Tyler-Walters *et al*. (2009), this fishing gear is given a red risk category.

Impacts: Dramatic declines in stock abundance are attributed mainly to overfishing by dredging, and oysters are damaged by beam trawlers targeting other species (Tillin *et al*., 2010). Trawling damages both the oysters and associated epibenthic species, as well as altering/degrading the seabed habitat.

Evidence: Tillin *et al*. 2010; Tyler-Walters *et al*. 2008

Fishing gear type: Dredging/Scalloping

Matrix risk category: RED

Explanation for categorisation: Native oysters have a high conservation status and have been identified as having a moderate to high sensitivity to physical damage and to the removal of features through pursuit of a target fishery at a commercial scale (Tillin *et al*., 2010). A sensitivity assessment of sedimentary communities to physical disturbance by Tyler-Walters *et al*. (2009) also identified a very high sensitivity for native oysters; the species is adversely affected by external factors arising from human activities and is either not expected to recover at all or recover only over a prolonged period of time, i.e. > 25 years. Overfishing by dredging is a major contributing factor in the decline of native oyster beds (Tyler-Walters *et al*., 2008; Tillin *et al*., 2010) however the species are not commercially exploited in the Lyme Bay AOI. Scallop dredges, which are operated in the Lyme Bay AOI (but outside of the Designated Area), cause considerable damage to benthic habitats and pose a high risk to this species.

Impacts: A scallop dredge is likely to remove a significant proportion of the population from an oyster bed and on mixed sediments may remove the underlying substrata, which would affect recruitment as this is dependent on suitable available substratum (Tillin *et al*. 2010). Dredging damages both the oysters and associated epibenthic species, as well as altering/degrading the seabed habitat.

Evidence: Tillin *et al*. 2010; Tyler-Walters *et al*. 2008

Fishing gear type: Potting/Cuttle Potting/Whelking/Crabbing

Matrix risk category: AMBER

Explanation for categorisation: Native oysters have a high conservation status and have been identified as having a moderate to high sensitivity to physical damage and to the removal of features through pursuit of a target fishery at a commercial scale (Tillin *et al*., 2010).Potting activities are generally considered to cause minimal physical damage to non-target benthic species. Overfishing by dredging is a major contributing factor in the decline of native oyster beds (Tyler-Walters *et al*., 2008; Tillin *et al*., 2010) however the species are not commercially exploited in the Lyme Bay AOI or targeted using pots. There is a possibility of significant damage to benthic species by intensive use of pots in small areas (Macdonald *et al*., 1996). Since the closure to bottom-towed fishing gear within the Lyme Bay Designated Area concerns have been raised about the potential impact of the increased level of potting activity (Attrill & Sheehan, 2012). This has led to the development of the Lyme Bay experimental potting project to compare the impact of different potting densities. As this data is not available yet and there are concerns of impacts from high intensity potting activities, an amber risk category has been given.

Impacts: A high density of pots in a small area may damage or reduce the availability of suitable substrata for oyster recruitment and attachment, preventing growth of oyster beds.

Evidence: Attrill & Sheehan 2012; Macdonald *et al*. 1996; Tillin *et al*. 2010; Tyler-Walters *et al*. 2008

Fishing gear type: Diving

Matrix risk category: GREEN

Explanation for categorisation: Native oysters have a high conservation status and have been identified as having a moderate to high sensitivity to physical damage and to the removal of features through pursuit of a target fishery at a commercial scale (Tillin *et al*., 2010). A sensitivity assessment of sedimentary communities to physical disturbance by Tyler-Walters *et al*. (2009) also identified a very high sensitivity for native oysters; the species is adversely affected by external factors arising from human activities and is either not expected to recover at all or recover only over a prolonged period of time, i.e. > 25 years. Overfishing is a major contributing factor in the decline of native oyster beds (Tyler-Walters *et al*., 2008; Tillin *et al*., 2010) however commercial diving is considered the most environmentally sustainable method of fishing, with the greatest control of the catch (Grieve *et al*., 2011). The species are not commercially exploited in the Lyme Bay AOI; divers target scallops and this method does not result in damage to other sessile organisms or habitats (Hiscox, 2007). Therefore diving should not pose a risk to native oysters.

Impacts: Commercial diving is very species selective and low intensity compared to other mobile fishing gear types. Good diving practices (i.e. buoyancy control) should not result in damage to the seabed or native oysters.

Evidence: Grieve *et al*. 2011; Devon Wildlife Trust 2007; Tillin *et al*. 2010; Tyler-Walters *et al*. 2008

Ocean Quahog

Fishing Gear Type	Matrix Risk Categorisation	Confidence	Source
Netting			Macdonald *et al*. 1996; Tillin *et al*. 2010; Tyler-Walters *et al*. 2008
Trawling			Gubbay & Knapman, 1999; Macdonald *et al*. 1996; Tillin *et al*. 2010; Tyler-Walters *et al*. 2008
Dredging			Macdonald *et al*. 1996; Tillin *et al*. 2010; Tyler-Walters *et al*. 2008
Potting			Attrill & Sheehan 2012; Macdonald *et al*. 1996
Diving			Grieve *et al*. 2011; Devon Wildlife Trust 2007; Macdonald *et al*. 1996; Tillin *et al*. 2010; Tyler-Walters *et al*. 2008

Fishing gear type: Netting

Matrix risk category: AMBER

Explanation for categorisation: The ocean quahog has a high conservation status, slow growth rate and long lifespan. It has been identified as having a moderate to high sensitivity to physical damage and to human disturbances, e.g. the removal of features through pursuit of a target fishery at a commercial scale, with an expected recovery of up to or more than 10 years (Tillin *et al*., 2010; Tyler-Walters *et al*., 2008). A sensitivity index for disturbance of benthic species by fishing activities was developed by Macdonald *et al*. (1996). Fishing gears were grouped according to the relative scale of disturbance they cause; gill nets and set nets were included as low intensity fishing gears. The ocean quahog was concluded to have a medium fragility, long recovery time and low sensitivity to low impact fishing gears. Despite a lower sensitivity to static fishing gear compared to mobile fishing gear the possibility of significant damage to benthic species is increased by intensive use of nets in small areas (Macdonald *et al*., 1996).

Impacts: This species is considered to have a medium fragility and long recovery time; the weight and movement of nets may physically damage fragile organisms (Macdonald *et al*., 1996).

Evidence: Macdonald *et al*. 1996; Tillin *et al*. 2010; Tyler-Walters *et al*. 2008

Fishing gear type: Trawling

Matrix risk category: **AMBER**

Explanation for categorisation: The ocean quahog has a high conservation status, slow growth rate and long lifespan. It has been identified as having a moderate to high sensitivity to physical damage and to human disturbances, e.g. the removal of features through pursuit of a target fishery at a commercial scale, with an expected recovery of up to or more than 10 years (Tillin *et al*., 2010; Tyler-Walters *et al*., 2008). A sensitivity index for disturbance of benthic species by fishing activities was developed by Macdonald *et al*. (1996). The ocean quahog was concluded to have a medium fragility, long recovery time and medium sensitivity to impact of otter trawls and Danish seines and high sensitivity to impact of beam trawls (Macdonald *et al*., 1996). Ocean quahog live buried in primarily sand and muddy sand and therefore are not targeted by trawls but could get caught up in the trawl nets and are commonly taken as bycatch in beam trawls, a fishing gear operated in the Lyme Bay AOI (outside of the Designated Area). Along with this and their slow recovery time, this species is considered to be at moderate risk.

Impacts: This species is commonly taken as bycatch in beam trawls, are slow to recover and have high mortality rates when discarded (Gubbay & Knapman, 1999; Tillin *et al*., 2010).

Evidence: Gubbay & Knapman 1999; Macdonald *et al*. 1996; Tillin *et al*. 2010; Tyler-Walters *et al*. 2008

Fishing gear type: Dredging/Scalloping

Matrix risk category: **AMBER**

Explanation for categorisation: The ocean quahog has a high conservation status, slow growth rate and long lifespan. It has been identified as having a moderate to high sensitivity to physical damage and to human disturbances, e.g. the removal of features through pursuit of a target fishery at a commercial scale, with an expected recovery of up to or more than 10 years (Tillin *et al*., 2010; Tyler-Walters *et al*., 2008). A sensitivity index for disturbance of benthic species by fishing activities was developed by Macdonald *et al*. (1996). The ocean quahog was concluded to have a medium fragility, long recovery time and high sensitivity to the impact of dredges (Macdonald *et al*., 1996). Ocean quahog live buried in primarily sand

and muddy sand and are targeted by clam dredges although not in the Lyme Bay AOI. However, scallop dredges are operated in the Lyme Bay AOI and ocean quahog could be bycaught in this gear type and disturbance would occur to its habitat. Therefore a red risk category is given.

Impacts: Ocean quahog live infaunally in muddy/sandy sediments and so dredging of the substratum will disturb the species and its habitat; and they are known to be vulnerable to physical abrasion (Tillin *et al*. 2010).

Evidence: Macdonald *et al*. 1996; Tillin *et al*. 2010; Tyler-Walters *et al*. 2008

Fishing gear type: Potting/Cuttle Potting/Whelking/Crabbing

Matrix risk category: AMBER

Explanation for categorisation: The ocean quahog has a high conservation status, slow growth rate and long lifespan. Potting activities are generally considered to cause minimal physical damage to non-target benthic species. A sensitivity index for disturbance of benthic species by fishing activities was developed by Macdonald *et al*. (1996). Fishing gears were grouped according to the relative scale of disturbance they cause; pots were included as low intensity fishing gears. The ocean quahog was concluded to have a medium fragility, long recovery time and low sensitivity to the impact of pots. Despite a lower sensitivity to static fishing gear compared to mobile fishing gear the possibility of significant damage to benthic species is increased by intensive use of pots in small areas (Macdonald *et al*., 1996). Since the closure to bottom-towed fishing gear within the Lyme Bay Designated Area, concerns have been raised about the potential impact of the increased level of potting activity (Attrill & Sheehan, 2012). This has led to the development of the Lyme Bay experimental potting project to compare the impact of different potting densities. As this data is not available yet and there are concerns of impacts from high intensity potting activities, an amber risk category has been given.

Impacts: This species is considered to have a medium fragility and long recovery time; the weight and movement of pots may physically damage fragile organisms (Macdonald *et al*. 1996).

Evidence: Attrill & Sheehan, 2012; Macdonald *et al*. 1996

Fishing gear type: Diving

Matrix risk category: GREEN

Explanation for categorisation: The ocean quahog has a high conservation status, slow growth rate and long lifespan. It has been identified as having a moderate to high sensitivity to physical damage and to human disturbances, e.g. the removal of features through pursuit of a target fishery at a commercial scale, with an expected recovery of up to or more than

10 years (Tillin *et al*., 2010; Tyler-Walters *et al*., 2008). Commercial diving takes place within the Lyme Bay AOI; this is considered the most environmentally sustainable method of fishing, with the greatest control of the catch (Grieve *et al*., 2011). Commercial diving in the Lyme Bay AOI targets scallops and does not result in damage to other sessile organisms or habitats (Hiscox, 2007). Therefore this fishing method should not pose a risk to ocean quahog.

Impacts: Commercial diving is very species selective and low intensity compared to other mobile fishing gear types. Good diving practices (i.e. buoyancy control) should not result in damage to the seabed or benthos.

Evidence: Grieve *et al*. 2011; Devon Wildlife Trust 2007; Macdonald *et al*. 1996; Tillin *et al*. 2010; Tyler-Walters *et al*. 2008

Turtles

Fishing Gear Type	Matrix Risk Categorisation	Confidence	Source
Netting		Medium	Gerosa & Casale 1999; Lewison & Crowder 2007; Lewison *et al.* 2013; Nel *et al*. 2013; Wallace *et al.* 2011
Trawling		Medium	Gerosa & Casale 1999; Lewison *et al.* 2013; Nel *et al*. 2013; Pears *et al*. 2012
Dredging		Medium	Finkbeiner *et al*. 2011; Murray 2010; Norden 2012
Potting		Medium	Hinz *et al*. Nd; Shester & Micheli 2011
Diving		Low	Grieve *et al*. 2011

Fishing gear type: Netting

Matrix risk category: RED

Explanation for categorisation: Whilst turtle bycatch rates are highly variable within and among gears and regions, no studies assessing the impacts of fishing gears on turtles have been identified within UK waters. In addition there are few records of turtles in Lyme Bay . Studies overseas are not directly comparable as the inshore use of gillnets in the UK would not be as extensive as the offshore deployment of nets in Atlantic and Pacific oceans, where impacts of turtles have been assessed (Lewison & Crowder, 2007; Lewison *et al*., 2013; Nel *et al*., 2013; Wallace *et al*., 2011). However, a risk and threat assessment of global Regional Management Units for sea turtles determined that nets may be the gear category of highest risk to sea turtles (Lewison *et al*., 2013; Wallace *et al*., 2011). A risk assessment of turtles in the Indian Ocean by Nel *et al*. (2013) also identified gillnets as the greatest concern with the total turtle catch much higher than turtles interacting with longlines and a higher mortality compared to longline or purse seine fishing. In addition the probability of mortality from gillnet entanglement has been reported as higher than longline fishing gears: 50% mortality compared to 4% (Lewison & Crowder, 2007). Whilst there are no records of turtle interaction with fishing nets in the UK, gillnets are deployed in the Lyme Bay AOI and have the potential to interact with turtles. The evidence for interactions worldwide is therefore used as proxy and as part of the risk assessments precautionary approach.

Impacts: The primary threat to sea turtles is entanglement in the net mesh, which can result in injury or death from drowning. Gillnets can be considered as passive fishing gear with turtles being caught by chance, however it has been reported that turtles actively try to feed on fish entangled in trammel nets (Gerosa & Casale, 1999). Therefore, turtles may be attracted to these nets increasing the probability of bycatch.

Evidence: Lewison & Crowder 2007; Lewison *et al.* 2013; Wallace *et al.* 2011; Gerosa & Casale 1999; Nel *et al*. 2013

Fishing gear type: Trawling

Matrix risk category: **AMBER**

Explanation for categorisation: Whilst turtle bycatch rates are highly variable within and among gears and regions, no studies assessing the impacts of fishing gears on turtles have been identified within UK waters. Within a risk and threat assessment of Regional Management Units (RMUs) worldwide for sea turtles, trawls were identified as the primary bycatch gear for 13 RMUs out of 43 compared to gillnets which represent the primary bycatch gear for 18 RMUs (Lewison *et al*., 2013). Mortality data available within the Mediterranean suggests quite a low number of deaths caused by trawling compared to other gears (Gerosa & Casale, 1999). A risk assessment of an otter trawl fishery in the Great Barrier Reef marine park assessed all turtles to be at intermediate to low risk of exceeding an acceptable level of interaction with trawling (Pears *et al*., 2012). Despite the low number of records of turtles in Lyme Bay and the lack of evidence of turtle interaction with trawls in the UK, trawling is operational in the Lyme Bay AOI (outside of the Designated Area) and the evidence for interactions worldwide is used as proxy and as part of the risk assessments precautionary approach.

Impacts: Turtles can be drowned from entrapment in the trawl net, suffer broken appendages or shell and experience stress and exhaustion from capture and release (Lewison *et al*., 2013). In the case of demersal trawling, fishing operations can also destroy sensitive feeding habitat, e.g Loggerhead turtles feed primarily on benthic shellfish. (Nel *et al*., 2013).

Evidence: Lewison *et al.* 2013; Gerosa & Casale 1999; Nel *et al*. 2013; Pears *et al*. 2012

Fishing gear type: Dredging/Scalloping

Matrix risk category: AMBER

Explanation for categorisation: The impacts of dredging on turtles is primarily represented in relation to the US Atlantic scallop dredging industry, with loggerhead turtles observed as bycatch. Although the Mid-Atlantic Scallop Dredge fishery accounted for fewer overall loggerhead interactions relative to other fisheries in the Atlantic, it exhibited the fifth highest mean annual loggerhead mortality and serious injuries among fisheries (Finkbeiner *et al*., 2011). Murray (2010) also assessed the interactions of turtles within the US sea scallop fishery between 2001 and 2008; 12% mortality from dredge gear was observed. However, sea turtle bycatch is primarily being addressed through gear modifications and regulated turtle deflectors (Norden, 2012). Despite the low number of turtles recorded in Lyme Bay and the lack of evidence of turtle interaction with dredges in the UK, scallop dredging is operational in the Lyme Bay AOI (outside of the Designated Area) and has the potential to interact with turtles. The evidence for interactions worldwide is therefore used as proxy and as part of the risk assessments precautionary approach.

Impacts: Turtles can be caught in the dredge bag resulting in drowning, crushing or injury to appendages or shell (Norden, 2012).

Evidence: Finkbeiner *et al*. 2011; Murray 2010; Norden 2012

Fishing gear type: Potting/Cuttle Potting/Whelking/Crabbing

Matrix risk category: GREEN

Explanation for categorisation: Pots and traps are highly selective for the species they target with low incidental bycatch (Hinz *et al*., no date). Crab and lobster pot incidental bycatch is primarily composed of undersized target species and are generally returned to the sea alive (Hinz *et al*., no date). Pots have a much lower impact on species bycatch compared to nets and mobile fishing gears (Shester & Micheli, 2011) and there is no evidence of turtles interacting with pots. Unless there were high densities of pots in a small area the deployment of pots would not have a significant impact on turtles or potential turtle feeding habitat.

Impacts: No records were identified of a negative impact on turtles from potting activities.

Evidence: Hinz *et al*. no date; Shester & Micheli 2011.

Fishing gear type: Diving

Matrix risk category: GREEN

Explanation for categorisation: Commercial diving harvests scallops within the Lyme Bay AOI; this is considered the most environmentally sustainable method of fishing, with the greatest control of the catch (Grieve *et al.*, 2011).

Impacts: No records were identified of a negative impact on turtles from commercial diving.

Evidence: Grieve *et al*. 2011

Dolphins & Porpoise (excluding bottlenose dolphin[1])

Fishing Gear Type	Matrix Risk Categorisation	Confidence	Source
Netting		High	Brown et al. 2013; Deaville 2011; Gubby & Knapman 1999; Nunny 2011; Ross & Isaac 2004; Parsons *et al*. 2010
Trawling		High	Brown *et al*. 2013; Fertl & Leatherwood 1997; Gubby & Knapman 1999; Nunny 2011
Dredging		Medium	Parsons *et al*. 2010; Woolmer 2010
Potting		Medium	Gubby & Knapman 1999; Hinz *et al*. Nd; Ross 2004; Shester & Micheli 2011
Diving		Low	Grieve *et al*. 2011

Fishing gear type: Netting

Matrix risk category: RED

Explanation for categorisation: Dolphins and porpoise are large animals with slow reproductive rates and low fecundity which make them vulnerable to overexploitation. There is some grey literature describing the impacts and extent of bycatch of dolphins and porpoises in the UK, including those from strandings data. In addition, Brown *et al.* (2013) carried out an Ecological Risk Assessment for the effects of fishing in the Irish EEZ to determine how vulnerable different cetacean species may be to direct interactions with fishering gears. The assessment determined that set gillnets targeting demersal species generated the largest potential mean risk score of all gear types assessed (gillnets, longlines, pots, pelagic trawl, bottom otter trawl and seines); bottlenose dolphin, harbour porpoise and white-beaked dolphin were assessed at particularly high risk (Brown *et al.*, 2013). Harbour porpoises are highly prone to incidental capture in bottom-set gillnets, which is explained largely by their feeding behaviour on or near the seabed (Ross & Isaac, 2004). It is also believed that the echolocation clicks of harbour porpoise are unable to detect

[1] See sepearte entry below

monofilament gill nets (Parsons *et al*., 2010). Of the recorded strandings from 1990 – 2011 in the UK, 17% of necropsied (autopsy performed on an animal) harbour porpoise were victims of bycatch; their injuries were consistent with monofilament net fishing gear and pelagic trawls (Deaville, 2011). Nunny (2011) estimated that 1430 harbour porpoise were bycaught in trammel net, gillnet and tangle net UK fisheries from 2005-2008 in the north-east Atlantic. Also, for this same region, an estimate for common dolphins was made at 708 bycaught animals in trammel net, gillnet and tangle net UK fisheries from 2004-2008.

Impacts: Dolphins and porpoise are bycaught in net fisheries resulting in, e.g. drowning, injury (such as cuts and amputations), or blunt trauma from being dropped on deck (Nunny, 2011).

Evidence: Brown et al. 2013; Deaville 2011; Nunny 2011; Ross & Isaac 2004; Parsons *et al*. 2010

Fishing gear type: Trawling

Matrix risk category: AMBER

Explanation for categorisation: Dolphins and porpoise are large animals with slow reproductive rates and low fecundity which make them vulnerable to overexploitation. Pelagic trawls, targeting small pelagic species, generated the largest risk score of the mobile gears within a risk assessment by Brown *et al*. (2013) in the Irish EEZ, strongly influenced by high spatial and temporal overlap. Striped and common dolphins were assessed as being at moderate risk. Bottom otter trawls, and seines, targeting demersal species, were scored as posing low risk. This high to low risk scoring for different trawl gear types justifies assigning trawling with an amber categorisation. Nunny (2011) estimated that 460-730 harbour porpoise were bycaught in UK fisheries from 2005-2006 in pelagic trawls and static nets; and approximately 800 common dolphins are bycaught in EU pelagic trawl fisheries in the north-east Atlantic each year.

Impacts: Dolphins and porpoise are bycaught in trawl fisheries; they can get caught in nets and ropes of the trawl resulting in injury or drowning. Cetaceans are often attracted to trawling activities because they make it easier for the animals to exploit a concentrated food source (Fertl & Leatherwood, 1997).

Evidence: Brown *et al*. 2013; Fertl & Leatherwood 1997; Nunny 2011

Fishing gear type: Dredging/Scalloping

Matrix risk category: AMBER

Explanation for categorisation: Dolphins and porpoise are large animals with slow reproductive rates and low fecundity (number of live offspring produced) which make them vulnerable to overexploitation. There is no evidence of dolphins and porpoise interacting with dredges, however scallop dredging does occur within the Lyme Bay AOI (outside of the

Designated Area) and this could impact them through disturbance, displacement, injury and reduction of prey availability when their ranges overlap.

Impacts: High dredging activity could expect to cause considerable noise disturbance and also affect prey availability when dolphins and porpoise are present (Woolmer, 2010; Parsons *et al*., 2010). Loss of habitats and communities which provide shelter and refuge for demersal prey species, as a result of dredging activity, could present a risk to prey availability (Woolmer, 2010).

Evidence: Woolmer 2010; Parsons *et al*. 2010

Fishing gear type: Potting/Cuttle Potting/Whelking/Crabbing

Matrix risk category: GREEN

Explanation for categorisation: Pots and traps are highly selective for the species they target with low incidental bycatch (Hinz *et al*., no date). There is no evidence of interactions between pots and dolphins and porpoise, in fact traps and pots are a popular alternative gear type for mitigation measures against cetacean bycatch. The plan for the recovery of harbour porpoise in the Baltic Sea following a recent decline recommends the trial of fish traps and fish pots with the goal of replacing gillnets in the cod fishery (Ross, 2004). Whilst, it is suggested that any static gear with lines extending into the water column poses a risk to cetaceans (Brown *et al*., 2013), the records of entanglements in such lines have been of larger baleen whale species and seem to be attributed to their size and habit of feeding due to attachment / entangelment of fishing gear to the mouth as they filter feed. This is not considered to take place in smaller mammals such as dolphins and porpoise.

Impacts: No records were identified of impacts to dolphins and porpoise from potting activity. However this gear type would overlap with the habitat used by dolphins and porpoises, especially inshore shallow water species such as the harbour porpoise.

Evidence: Hinz *et al*. no date; Ross 2004

Fishing gear type: Diving

Matrix risk category: GREEN

Explanation for categorisation: Commercial diving harvests scallops within the Lyme Bay AOI; this is considered the most environmentally sustainable method of fishing, with the greatest control of the catch (Grieve *et al*., 2011).

Impacts: No records were identified of commercial diving impacting on dolphins or porpoise.

Evidence: Grieve *et al*. 2011

Bottlenose dolphin

Fishing Gear Type	Matrix Risk Categorisation	Confidence	Source
Netting		High	Brown *et al*. 2013; Fertl & Leatherwood 1997; Gubby & Knapman 1999; Nunny 2011
Trawling		High	Brown *et al*. 2013; Chilvers & Corkeron 2001; Fertl & Leatherwood 1997; Gubby & Knapman 1999; Svane 2005
Dredging		Medium	Parsons *et al*. 2010; Woolmer 2010
Potting		Medium	Hinz *et al*. Nd; Shester & Micheli 2011
Diving		Low	Grieve *et al*. 2011

Fishing gear type: Netting

Matrix risk category: RED

Explanation for categorisation: Bottlenose dolphins are large animals with slow reproductive rates and low fecundity (number of live offspring produced) which makes bycatch of this species unsustainable. Bottlenose dolphins were assessed as being at high risk from set gillnets targeting demersal species in a risk based approached by Brown *et al*. (2013). Bottlenose dolphins are not bycaught regularly in UK fisheries, but there are incidents recorded. For example, in 2008 (and for the second year in a row) a single bottlenose dolphin was caught in set nets in the western English Channel (Nunny, 2011). Bottlenose dolphins have been recorded to exploit gillnets for food, removing fish from nearshore gillnets (Fertl & Leatherwood, 1997) and hence increases their chances of becoming bycaught. It has been suggested there is a from records collected from Marinelife and Devon and Dorset Wildlife Trusts (Edwards, 2010), though the species is very under-recorded throughout the English Channel. Along with their high conservation status and that demersal gillnets are deployed in the Lyme Bay AOI, a red risk category is assigned to this fishing gear.

Impacts: Bottlenose dolphins can be bycaught in net fisheries.

Evidence: Brown et al. 2013; Nunny 2011; Fertl & Leatherwood 1997

Fishing gear type: Trawling

Matrix risk category: RED

Explanation for categorisation: Bottlenose dolphins are large animals with slow reproductive rates and low fecundity which makes bycatch of this species unsustainable.

Trawl fisheries exploit similar food resources to cetaceans and so result in overlapping areas; this could have implications in reducing prey availability, disturbance and/or displacement and bycatch. Bottlenose dolphins were assessed as being at high risk from pelagic trawls with high spatial and temporal overlap within a risk assessment by Brown *et al*. (2013). Bottlenose dolphins are the most documented cetacean species to feed in association with trawls and there are implications of a risk of becoming bycaught. It is clear, however that studies on the effects of trawls on the population status of cetaceans is required and there is a lack of studies within the UK (Svane, 2005; Chilvers & Corkeron, 2001; Fertl & Leatherwood, 1997). It has been suggested there is a semi-resident couth coast population of bottlenose dolphin from records collected from Marinelife and Devon and Dorset Wildlife Trusts (Edwards, 2010), though the species is very underrecorded throughout the English Channel. Along with their high conservation status and that trawling occurs in the Lyme Bay AOI, a red risk category is assigned to this fishing gear.

Impacts: Bottlenose dolphins are at risk from bycatch in trawl fisheries.

Evidence: Brown et al. 2013; Fertl & Leatherwood 1997; Svane 2005; Chilvers & Corkeron 2001

Fishing gear type: Dredging/Scalloping

Matrix risk category: AMBER

Explanation for categorisation: Bottlenose dolphins are large animals with slow reproductive rates and low fecundity which makes bycatch of this species unsustainable. Bottlenose dolphins target demersal as well as pelagic species and therefore overlap in areas of this species and dredges is very likely to occur. There is some grey literature describing potential threats to cetaceans from dredging, particularly scallop dredging in Cardigan Bay where there is a resident population of bottlenose dolphins (Woolmer, 2010); however there is a lack of data indicating a negative impact between dredges and bottlenose dolphins. It has been suggested there is a semi-resident couth coast population of bottlenose dolphin from records collected from Marinelife and Devon and Dorset Wildlife Trusts (Edwards, 2010), though the species is very underrecorded throughout the English Channel. Along with the high conservation status of this species and the operation of scallop dredges in the Lyme Bay AOI, this gear type is assigned an amber risk category.

Impacts: High dredging activity could be expected to cause considerable noise disturbance, possible displacement or injury and also affect prey availability (Woolmer, 2010; Parsons *et al*., 2010). Loss of habitats and communities from dredging activity which provide shelter and refuge for demersal prey species could present a risk to prey availability; harder ground habitats are less likely to recover from an encounter with scallop gear (Woolmer, 2010).

Evidence: Woolmer 2010; Parsons *et al*. 2010

Fishing gear type: Potting/Cuttle Potting/Whelking/Crabbing

Matrix risk category: GREEN

Explanation for categorisation: Pots and traps are highly selective for the species they target with low incidental catch (Hinz *et al*., no date). There is no evidence identified of interactions between pots and bottlenose dolphins, although it is suggested that any static gear with lines rising into the water column pose a risk to cetaceans (Brown *et al*., 2013). The records of entanglements in such lines however have been of larger baleen whale species and seem to be attributed to their size and habit of feeding due to attachments in the mouth as they filter feed, which is not so relevant to bottlenose dolphins.

Impacts: No records were identified of impacts to bottlenose dolphins from potting activity.

Evidence: Hinz *et al*. no date; Shester & Micheli 2011

Fishing gear type: Diving

Matrix risk category: GREEN

Explanation for categorisation: Commercial diving harvests scallops within the Lyme Bay AOI; this is considered the most environmentally sustainable method of fishing, with the greatest control of the catch (Grieve *et al*., 2011).

Impacts: No records were identified of commercial diving impacting on bottlenose dolphins.

Evidence: Grieve *et al*. 2011

Whales

Fishing Gear Type	**Matrix Risk Categorisation**	**Confidence**	**Source**
Netting		Medium	Brown *et al*. 2013; Johnson *et al*. 2005; Song et al. 2009
Trawling		Medium	Brown *et al*. 2013; Fertl & Leatherwood 1997; Song et al. 2009
Dredging		Medium	Brown *et al*. 2013
Potting		Medium	Johnson *et al*. 2005; Kot *et al*. 2012; Parsons *et al*. 2010; Song et al. 2009
Diving		Low	Grieve *et al.* 2011

Fishing gear type: Netting

Matrix risk category: AMBER

Explanation for categorisation: Whales are large, long lived animals with slow reproductive rates and low fecundity which make them vulnerable to overexploitation. The assessment by Brown *et al*. (2013) determined that fin whales, humpback whale, minke whale and sperm whale were at moderate risk from gillnets. The high rate of scarring on living animals suggests entanglement may occur more frequently than is documented in bycatch statistics (Brown *et al*., 2013). An assessment of fishing gear entanglement of right whales and humpback whales by Johnson *et al*., (2005) identified that 89% of the entanglements were attributed to pot and gill net gear. Also an assessment of fishing gear entanglement of minke whales by Song *et al*. (2009) identified that 35% and 30% of entanglements were from set nets and gill nets respectively. The distribution of whales is under recorded in the UK; along with their high conservation status and that demersal gillnets are deployed in the Lyme Bay AOI, an amber risk category is assigned to this fishing gear.

Impacts: A number of large whale species, including minke and humpback whales, have been documented in gillnets, becoming entangled in the gears' float line and it is suggested that any static gear with lines rising into the water column poses a risk to cetaceans (Brown *et al*., 2013). The records of entanglements in such lines however have been of larger baleen whale species and seem to be attributed to their size and habit of feeding due to attachments in the mouth as they filter feed. Entanglement is the primary source of anthropogenic mortality of minke and humpback whales in the northwest Atlantic and, although arguably documented less frequently in the northeast Atlantic, a small number of entanglements may be biologically significant for small populations (Brown *et al*., 2013). The impact of bycatch may not be immediate as entangled animals may swim away taking months to die.

Evidence: Brown *et al*. 2013; Johnson *et al*. 2005; Song *et al*. 2009

Fishing gear type: Trawling

Matrix risk category: AMBER

Explanation for categorisation: Whales are large, long lived animals with slow reproductive rates and low fecundity which make them vulnerable to overexploitation. Minke and northern bottlenose whales have been assessed as at low risk from pelagic trawls (Brown *et al*., 2013). Fertl & Leatherwood (1997) reported bycatch in trawl fisheries of Minke whale as well as reports of bycatch and feeding association with trawl nets by fin whales. A study by Song et al., (2009) identified a small number (3%) of entanglements of minke whales associated with bottom trawls, purse seines and trawls, which were considerably less compared to nets and pots (96.7%). The distribution of whales is under recorded in the UK; along with their high conservation status and that trawls are operated in the Lyme Bay AOI, an amber risk category is assigned to this fishing gear.

Impacts: Whales can become bycaught in trawls and it has also been reported that trawl gear has been discarded due to entanglement with whales.

Evidence: Brown *et al*. 2013; Fertl & Leatherwood 1997; Johnson *et al*. 2005; Song *et al*. 2009

Fishing gear type: Dredging/Scalloping

Matrix risk category: AMBER

Explanation for categorisation: Whales are large, long lived animals with slow reproductive rates and low fecundity which make them vulnerable to overexploitation. In the risk assessment by Brown *et al.* (2013) demersal fishing gear types were attributed a low to intermediate risk category to whale species; dredging could pose a risk to whales but at a lower level compared to pots and nets. There is no evidence of whales interacting with dredges. However, because the distribution of whales is under recorded in the UK and they have a high conservation status, as well as scallop dredging operating within the Lyme Bay AOI, impacts could occur from disturbance, displacement and/or injury.

Impacts: No records were identified of impacts to whales from dredging. However dredges are operated in Lyme Bay (outside of the Designated Area) and therefore there is potential for a spatial overlap with this gear type and whales.

Evidence: Brown *et al*. 2013

Fishing gear type: Potting/Cuttle Potting/Whelking/Crabbing

Matrix risk category: AMBER

Explanation for categorisation: Whales are large, long lived animals with slow reproductive rates and low fecundity which make them vulnerable to overexploitation. A single report of a minke whale found entangled in a kreel (lobster pot) line was reported in western Scotland; these lines have also been reported to have caused entanglement of minke whale in other areas (Parsons *et al*., 2010). An assessment of fishing gear entanglement of right and humpback whales by Johnson *et al*. (2005) identified that 89% of the entanglements were attributed to pot and gill net gear, and were associated with bouylines and groundlines of crab and lobster pots. Also an assessment of fishing gear entanglement of minke whales by Song *et al*. (2009) identified that 31% of entanglements were from pots. Whilst the records of entanglements are of larger baleen whale species (filter-feeders)- with attachments occurring at the tail and mouth which can be attributed to the size and habit of feeding as they filter water to obtain prey – these are considered comparable to the species of whale found in Lyme Bay. There are records of minke, fin and humpback whales in Lyme Bay and these are all large baleen whales. All pots including crab, whelk and cuttle pots deployed in Lyme Bay are fished in strings so have the potential of causing entanglement in their buoylines and groundlines. The distribution of whales is under recorded in the UK; along with their high conservation status and that pots are deployed in the Lyme Bay AOI, an amber risk category is assigned to this fishing gear.

Impacts: There have been several reports of whales entangled in pot ropes (Parsons *et al*., 2010, Kot *et al*., 2012). Entanglement can occur by the buoy line and/or groundline, with the most common point of attachment at the mouth and tail (Johnson *et al*., 2005).

Evidence: Johnson *et al*. 2005; Kot *et al*. 2012; Parsons *et al*. 2010; Song *et al*. 2009

Fishing gear type: Diving

Matrix risk category: GREEN

Explanation for categorisation: Commercial diving harvests scallops within the Lyme Bay AOI; this is considered the most environmentally sustainable method of fishing, with the greatest control of the catch (Grieve *et al*., 2011).

Impacts: No records were identified of commercial diving impacting on whales.

Evidence: Grieve *et al*. 2011

Sharks

Fishing Gear Type	Matrix Risk Categorisation	Confidence	Source
Netting		Medium	Arrizabalaga *et al*. 2011; Astles *et al*. 2009; Baeta *et al*. 2009; Hobday *et al.* 2011; Shester & Micheli 2011; Zhou *et al*. 2011
Trawling		Medium	Arrizabalaga *et al*. 2011; Astles *et al*. 2009; Baeta *et al*. 2009; Hobday *et al.* 2011; Stobutzki *et al*. 2002; Zhou *et al*. 2011
Dredging		Medium	Astles *et al*. 2009; Craven *et al*. 2013
Potting		Medium	Astles *et al*. 2009; Jennings & Kaiser, 1998; Shester & Micheli 2011
Diving		Low	Grieve *et al*. 2011

Fishing gear type: Netting

Matrix risk category: RED

Explanation for categorisation: Chondrichthyans or elasmobranches, which include sharks, skate and rays, are less able to sustain their populations under fishing pressures that target teleost and invertebrate species, due to their slow growth, long lifespans, late maturity, and low fecundity; and are therefore extremely vulnerable to over-exploitation (Baeta *et al*., 2009). Among ecological risk assessment studies elasmobranches were considered the most at risk and sensitive of groups of targeted and bycaught marine species (Arrizabalaga *et al*., 2011; Hobday *et al.,* 2011; Zhou *et al*., 2011). Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling. These can be applied to other fishing gears; sharks in general have the biological characteristics described above, and are commercially targeted by gillnets. In addition, gillnets have high discard rates and are commercially used in Lyme Bay, therefore sharks can be considered risk prone to this type of fishing gear. Studies of shark bycatch and vulnerability to fishing in the UK are sparse and evidence is used from overseas fisheries as proxy. Arrizabalaga *et al*. (2011) analysed the susceptibility of bycatch species caught in Atlantic tuna fisheries which included longline, gillnets, purse seine and traps; gillnets were only second to longline fisheries in the most species caught. Sharks had a high susceptibility to bycatch in gillnets and coastal sharks showed the highest intrinsic vulnerability values. Zhou *et al*. (2011) assessed sustainability risk for non-target species in a multi-sector and multi-gear fishery. Of the non-target species assessed in the shark gillnet sub-fishery 48 chondrichthyan species were assessed at precautionary medium to high risk (Zhou *et al*., 2011**)**. Shester & Micheli (2011) compared bycatch rates between trap and net fishing gears and found that set gillnets had the highest mean bycatch rates; with a quarter of the bycatch representing elasmobranches.

Impacts: Overexploitation of target species and incidentally caught bycatch.

Evidence: Arrizabalaga *et al*. 2011; Astles *et al*. 2009; Baeta *et al*. 2009; Hobday *et al.* 2011, Shester & Micheli 2011; Zhou *et al*. 2011

Fishing gear type: Trawling

Matrix risk category: RED

Explanation for categorisation: Chondrichthyans or elasmobranches, which include sharks, skate and rays, are less able to sustain their populations under fishing pressures that target teleost and invertebrate species, due to their slow growth, long lifespans, late maturity, and low fecundity; and are therefore extremely vulnerable to over-exploitation (Baeta *et al*., 2009). Among ecological risk assessment studies elasmobranches were considered the most at risk and sensitive of groups of targeted and bycaught marine species (Arrizabalaga *et al*., 2011; Hobday *et al.,* 2011; Zhou *et al*., 2011). Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling. Sharks in general have the biological characteristics described above, and certain types are commercially targeted by trawling globally. In addition, trawling has high discard rates and is commercially used in Lyme Bay, particularly stern and beam trawls; therefore sharks can be considered risk prone to this type of fishing gear. Studies of shark bycatch and vulnerability to fishing in the UK are sparse and evidence is used from overseas fisheries as proxy. Arrizabalaga *et al*. (2011) analysed the susceptibility of species caught in Atlantic tuna fisheries which included longline, gillnets, purse seine and traps; sharks had an intermediate susceptibility to bycatch in purse seines and coastal sharks showed the highest intrinsic vulnerability values. Zhou *et al*. (2011) assessed sustainability risk for non-target species in a multi-sector and multi-gear fishery; of the non-target species assessed in the otter trawl fishery eight species of chondrichthyans were at high risk and two at unsustainable risk level.

Impacts: Over-exploitation from targeted fisheries and bycatch; demersal species are particularly susceptible to bottom-towed gear and by-catch is often not recorded or there is limited life history information available for specific species (Stobutzki *et al*., 2002).

Evidence: Arrizabalaga et al. 2011; Astles et al. 2009; Baeta et al. 2009; Hobday et al. 2011; Stobutzki et al. 2002; Zhou et al. 2011

Fishing gear type: Dredging/Scalloping

Matrix risk category: RED

Explanation for categorisation: Chondrichthyans or elasmobranches, which include sharks, skate and rays, are less able to sustain their populations under fishing pressures that target teleost and invertebrate species, due to their slow growth, long lifespans, late maturity, and low fecundity; and are therefore extremely vulnerable to over-exploitation (Baeta *et al*., 2009). Among ecological risk assessment studies elasmobranches were considered the most at risk and sensitive of groups of targeted and bycaught marine species (Arrizabalaga *et al*., 2011; Hobday *et al.,* 2011; Zhou *et al*., 2011). Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling. These can be applied to other fishing gears; sharks in general have the biological characteristics described above and although not targeted by dredges can potentially be bycaught; scallop dredges are operated in the Lyme Bay AOI therefore sharks can be considered risk prone to this type of fishing gear. Analysis of scallop dredging in the Isle of Man found the main bycatch species predominately consisted of juveniles (Craven *et al*., 2013) and due to the late maturity and low fecundity of sharks this makes them particular vulnerable to this type of fishing activity.

Impacts: Dredging cause's changes in overall biomass, species composition and size structure of demersal communities and demersal sharks are vulnerable to bycatch (Craven *et al*., 2013).

Evidence: Astles *et al*. 2009; Craven *et al*. 2013

Fishing gear type: Potting/Cuttle Potting/Whelking/Crabbing

Matrix risk category: GREEN

Explanation for categorisation: Chondrichthyans or elasmobranches, which include sharks, skate and rays, are less able to sustain their populations under fishing pressures that target teleost and invertebrate species, due to their slow growth, long lifespans, late maturity, and low fecundity; and are therefore extremely vulnerable to over-exploitation (Baeta *et al*., 2009). Among studies elasmobranches were considered the most at risk and sensitive of groups of targeted and bycaught marine species (Arrizabalaga *et al*., 2011; Hobday *et al.,* 2011; Zhou *et al*., 2011). Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling. These can be applied to other fishing gears; despite sharks in general having the biological characteristics described above they are not targeted by pots or significantly bycaught in this type of fishing gear. Therefore, this is considered a lower risk compared to other fishing gears. Pots for crab, lobster, whelks and cuttlefish are all deployed within the Lyme Bay AOI. Pots or traps are generally lower impact compared to gillnets (Shester & Micheli 2011), trawls and dredges (Jennings & Kaiser, 1998) and the majority of records of bycatch include crustaceans and molluscs rather than elasmobranch or teleost species.

Impacts: The impact of static fishing gears, such as pots are likely to be insignificant compared to mobile fishing gears, however if a high density of pots are utilised in a small area with long lived fauna the impacts may be greater (Jennings & Kaiser, 1998). Lost pots can continue to fish in the marine environment for several years, and due to their robust structure pots are likely to maintain higher capture efficiency compared to nets (Jennings & Kaiser, 1998). However, compared to the number of species removed by mobile fishing gears the number of organisms removed by lost pots is likely to be small.

Evidence: Astles *et al*. 2009; Jennings & Kaiser 1998; Shester & Micheli 2011

Fishing gear type: Diving

Matrix risk category: GREEN

Explanation for categorisation: Chondrichthyans or elasmobranches, which include sharks, skate and rays, are less able to sustain their populations under fishing pressures that target teleost and invertebrate species, due to their slow growth, long lifespans, late maturity, and low fecundity; and are therefore extremely vulnerable to over-exploitation (Baeta *et al*., 2009). Commercial diving harvests scallops within the Lyme Bay AOI; this is considered the most environmentally sustainable method of fishing, with the greatest control of the catch (Grieve *et al*., 2011). Therefore, this is considered a low risk compared to other fishing gear.

Impacts: No records were identified of commercial diving impacting on sharks.

Evidence: Grieve *et al*. 2011

Rays

Fishing Gear Type	Matrix Risk Categorisation	Confidence	Source
Netting		Medium	Arrizabalaga *et al*. 2011; Astles *et al*. 2009; Baeta *et al*. 2009; Hobday *et al*. 2011; Shester & Micheli 2011; Stobutzki *et al*. 2002; Zhou *et al*. 2011
Trawling		Medium	Astles *et al*. 2009; Stevens *et al*. 2000; Stobutzki *et al*. 2002
Dredging		Medium	Astles *et al*. 2009; Craven *et al*. 2013
Potting		Medium	Astles *et al*. 2009; Jennings & Kaiser 1998; Shester & Micheli 2011
Diving		Low	Grieve *et al.* 2011

Fishing gear type: Netting

Matrix risk category: RED

Explanation for categorisation: Chondrichthyans or elasmobranches, which include sharks, skate and rays, are less able to sustain their populations under fishing pressures that target teleost and invertebrate species, due to their slow growth, long lifespans, late maturity, and low fecundity; and are therefore extremely vulnerable to over-exploitation (Baeta *et al*., 2009). Among ecological risk assessment studies elasmobranches were considered the most at risk and sensitive of groups of targeted and bycaught marine species (Arrizabalaga *et al*., 2011; Hobday *et al.,* 2011; Zhou *et al*., 2011). Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling. These can be applied to other fishing gears; rays in general have the biological characteristics described above and are targeted by gillnets and set nets, therefore they are considered risk prone to this type of fishing gear. Spotted, starry, thornback, small-eyed and blonde rays are all commercially targeted within the Lyme Bay AOI and spotted ray have a high conservation status. Studies of ray bycatch and vulnerability to fishing in the UK are sparse and evidence is used from overseas fisheries as proxy. Arrizabalaga *et al*. (2011) analysed the susceptibility of species caught in Atlantic tuna fisheries including gillnets; skates and rays showed high intrinsic vulnerability values. Stobutzki *et al*. (2001) described this group of elasmobranches as highly sensitive to non-selective fishing practices, due to their small size at time of capture and high rates of in-net mortality.

Impacts: Overexploitation of target species and incidentally caught bycatch from gillnets and set nets (Shester & Micheli, 2011).

Evidence: Arrizabalaga *et al*. 2011; Astles *et al*. 2009; Baeta *et al*. 2009; Hobday *et al.* 2011; Shester & Micheli, 2011; Stobutzki *et al*. 2002; Zhou *et al*. 2011

Fishing gear type: Trawling

Matrix risk category: RED

Explanation for categorisation: Chondrichthyans or elasmobranches, which include sharks, skate and rays, are less able to sustain their populations under fishing pressures that target teleost and invertebrate species, due to their slow growth, long lifespans, late maturity, and low fecundity; and are therefore extremely vulnerable to over-exploitation (Baeta *et al*., 2009). Among ecological risk assessment studies elasmobranches were considered the most at risk and sensitive of groups of targeted and bycaught marine species (Arrizabalaga *et al*., 2011; Hobday *et al.,* 2011; Zhou *et al*., 2011). Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling. Rays in general have the biological characteristics described above and are bycaught in otter and beam trawls. In addition they are targeted in Lyme Bay and beam trawls are operated here; rays are therefore considered risk prone to this type of fishing gear. A serious decline has been documented for a number of ray species; the common skate is close to extinction due to trawling activities in the Irish Sea (Stevens *et al.,* 2000).

Impacts: Over-exploitation from bycatch in otter and beam trawls; demersal species are particularly susceptible to bottom-towed gear and by-catch is often not recorded or there is limited life history information available for specific species (Stobutzki *et al*., 2002).

Evidence: Astles *et al*. 2009; Stevens *et al.* 2000; Stobutzki *et al*. 2002

Fishing gear type: Dredging/Scalloping

Matrix risk category: RED

Explanation for categorisation: Chondrichthyans or elasmobranches, which include sharks, skate and rays, are less able to sustain their populations under fishing pressures that target teleost and invertebrate species, due to their slow growth, long lifespans, late maturity, and low fecundity; and are therefore extremely vulnerable to over-exploitation (Baeta *et al*., 2009). Among ecological risk assessment studies elasmobranches were considered the most at risk and sensitive of groups of targeted and bycaught marine species (Arrizabalaga *et al*., 2011; Hobday *et al.,* 2011; Zhou *et al*., 2011). Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling. These can be applied to other fishing gears; rays in general have the biological characteristics described above and are bycaught in dredges. Spotted, starry, thornback, small-eyed and blonde rays are all commercially targeted within the Lyme Bay AOI and spotted ray have a high conservation status. In addition, scallop dredges are operated in Lyme Bay and therefore rays are considered risk prone to this type of fishing gear. Analysis of scallop dredging in the Isle of Man found high numbers of spotted and thornback rays were bycaught and the main bycatch species predominately consisted of juveniles (Craven *et al*., 2013).

Impacts: Over-exploitation from bycatch. Dredging also causes changes in overall biomass, species composition and size structure of demersal communities (Craven *et al*., 2013).

Evidence: Astles *et al*. 2009; Craven *et al*. 2013

Fishing gear type: Potting/Cuttle Potting/Whelking/Crabbing

Matrix risk category: **AMBER**

Explanation for categorisation: Chondrichthyans or elasmobranches, which include sharks, skate and rays, are less able to sustain their populations under fishing pressures that target teleost and invertebrate species, due to their slow growth, long lifespans, late maturity, and low fecundity; and are therefore extremely vulnerable to over-exploitation (Baeta *et al*., 2009). Among ecological risk assessment studies elasmobranches were considered the most at risk and sensitive of groups of targeted and bycaught marine species (Arrizabalaga *et al*., 2011; Hobday *et al.,* 2011; Zhou *et al*., 2011). Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling. These can be applied to other fishing gears; despite rays in general having the biological characteristics described above they are not targeted by pots and there is no evidence of bycatch from this type of fishing gear. Therefore, this is considered a low risk compared to other fishing gears. Pots or traps are generally a lower impact compared to gillnets (Shester & Micheli, 2011), trawls and dredges (Jennings & Kaiser, 1998) and the majority of records of bycatch include crustaceans and molluscs rather than elasmobranch or teleost species.

Impacts: No records were identified of pots impacting on ray species.

Evidence: Astles *et al*. 2009; Jennings & Kaiser 1998; Shester & Micheli 2011

Fishing gear type: Diving

Matrix risk category: **GREEN**

Explanation for categorisation: Chondrichthyans or elasmobranches, which include sharks, skate and rays, are less able to sustain their populations under fishing pressures that target teleost and invertebrate species, due to their slow growth, long lifespans, late maturity, and low fecundity; and are therefore extremely vulnerable to over-exploitation (Baeta *et al*., 2009). Commercial diving harvests scallops within the Lyme Bay AOI; this is considered the most environmentally sustainable method of fishing, with the greatest control of the catch (Grieve *et al*., 2011). Therefore, this is considered a low risk compared to other fishing gear.

Impacts: No records were identified of commercial diving impacting on sharks.

Evidence: Grieve *et al*. 2011

Dogfish

Fishing Gear Type	Matrix Risk Categorisation	Confidence	Source
Netting		Medium	Arrizabalaga *et al*. 2011; Astles *et al*. 2009
Trawling		Medium	Astles *et al*. 2009; Craven *et al*. 2013; Stevens *et al*. 2000
Dredging		Medium	Astles *et al*. 2009; Craven *et al*. 2013; Gubbay & Knapman 1999; Stevens *et al*. 2000
Potting		Low	Astles *et al*. 2009; Jennings & Kaiser 1998; Shester & Micheli 2011
Diving		Low	Grieve *et al*. 2011

Fishing gear type: Netting

Matrix risk category: RED

Explanation for categorisation: Chondrichthyans or elasmobranches, which include sharks, skate and rays, are less able to sustain their populations under fishing pressures that target teleost and invertebrate species, due to their slow growth, long lifespans, late maturity, and low fecundity; and are therefore extremely vulnerable to over-exploitation (Baeta *et al*., 2009). Among ecological risk assessment studies elasmobranches were considered the most at risk and sensitive of groups of targeted and bycaught marine species (Arrizabalaga *et al*., 2011; Hobday *et al.,* 2011; Zhou *et al*., 2011). Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling. These can be applied to other fishing gears; dogfish in general have the biological characteristics described above, are targeted (infrequently) by gillnets and the small spotted catshark (a species of dogfish, also known as the lesser spotted dogfish) are commercially targeted in the Lyme Bay AOI. Dogfish are therefore considered risk prone to this type of fishing gear. Studies of dogfish bycatch and vulnerability to fishing in the UK are sparse and evidence is used from overseas fisheries as proxy. Arrizabalaga *et al*. (2011) analysed the susceptibility of bycatch species caught in Atlantic tuna fisheries including gillnets; gillnets were only second to longline fisheries in the most species caught and sharks had a high susceptibility to bycatch in gillnets. Dogfish have similar life history traits to sharks and are therefore considered highly susceptible to gillnets.

Impacts: Overexploitation of target species and incidentally caught bycatch.

Evidence: Arrizabalaga *et al*. 2011; Astles *et al*. 2009

Fishing gear type: Trawling

Matrix risk category: RED

Explanation for categorisation: Chondrichthyans or elasmobranches, which include sharks, skate and rays, are less able to sustain their populations under fishing pressures that target teleost and invertebrate species, due to their slow growth, long lifespans, late maturity, and low fecundity; and are therefore extremely vulnerable to over-exploitation (Baeta *et al*., 2009). Among ecological risk assessment studies elasmobranches were considered the most at risk and sensitive of groups of targeted and bycaught marine species (Arrizabalaga *et al*., 2011; Hobday *et al.,* 2011; Zhou *et al*., 2011). Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling. Dogfish in general have the biological characteristics described above, are targeted and bycaught in otter and beam trawls and the small spotted catshark (a species of dogfish, also known as the lesser spotted dogfish) are commercially targeted in the Lyme Bay AOI. In addition beam trawls are operated in Lyme Bay and dogfish are therefore considered risk prone to this type of fishing gear. Lesser spotted dogfish are commonly caught in both scallop dredges and trawls but due to their limited commercial value are generally discarded (Craven *et al*., 2013). Despite this they have demonstrated high post-discard survival rates of up to 98% and so have not been affected by high levels of fishing disturbance (Craven *et al*., 2013). In contrast, the spiny dogfish is highly unproductive and was grouped amongst the larger, slow growing, late-maturing and long-lived species and hence characterised with the lowest recovery potential from exploitation (Stevens *et al*., 2000).

Impacts: Over-exploitation of target species and bycatch.

Evidence: Astles *et al*. 2009; Craven *et al*., 2013; Stevens *et al*., 2000

Fishing gear type: Dredging/Scalloping

Matrix risk category: RED

Explanation for categorisation: Chondrichthyans or elasmobranches, which include sharks, skate and rays, are less able to sustain their populations under fishing pressures that target teleost and invertebrate species, due to their slow growth, long lifespans, late maturity, and low fecundity; and are therefore extremely vulnerable to over-exploitation (Baeta *et al*., 2009). Among ecological risk assessment studies elasmobranches were considered the most at risk and sensitive of groups of targeted and bycaught marine species (Arrizabalaga *et al*., 2011; Hobday *et al.,* 2011; Zhou *et al*., 2011). Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling; this can be applied to other fishing gears. Dogfish in general have the biological characteristics described above, are bycaught in dredges, and the small spotted catshark (a species of dogfish, also known as the lesser spotted dogfish) are commercially targeted in the Lyme Bay AOI. In addition, scallop dredges are operated in Lyme Bay and dogfish are therefore considered risk prone to this type of fishing gear. Lesser spotted dogfish are commonly caught in both scallop dredges and trawls but due to their limited commercial value are generally discarded (Craven *et al*., 2013). Despite this they have demonstrated high post-discard survival rates of up to 98% and so have not been affected by high levels of fishing disturbance (Craven *et al*., 2013).Furthermore, lesser spotted dogfish are often observed preying on dead or damaged individuals left behind in the dredge tracks and as a result could be benefiting from dredge fisheries (Craven *et al*., 2013; Gubbay & Knapman, 1999). In contrast, the spiny dogfish is highly unproductive and was grouped amongst the larger, slow growing, late-maturing and long-lived species and hence characterised with the lowest recovery potential from exploitation (Stevens *et al*., 2000).

Impacts: Over-exploitation from bycatch. Dredging also causes changes in overall biomass, species composition and size structure of demersal communities (Craven *et al*., 2013).

Evidence: Astles *et al.* 2009; Craven *et al*. 2013; Gubbay & Knapman 1999; Stevens *et al*. 2000

Fishing gear type: Potting/Cuttle Potting/Whelking/Crabbing

Matrix risk category: AMBER

Explanation for categorisation: Chondrichthyans or elasmobranches, which include sharks, skate and rays, are less able to sustain their populations under fishing pressures that target teleost and invertebrate species, due to their slow growth, long lifespans, late maturity, and low fecundity; and are therefore extremely vulnerable to over-exploitation (Baeta *et al*., 2009). Among ecological risk assessment studies elasmobranches were considered the most at risk and sensitive of groups of targeted and bycaught marine species (Arrizabalaga *et al*., 2011; Hobday *et al.,* 2011; Zhou *et al*., 2011). Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling. These can be applied to other fishing gears; despite dogfish in general having the biological characteristics described above they are not targeted by pots and there are no records of bycatch in this type of fishing gear. Therefore, this is considered a lower risk compared to other fishing gears. Pots or traps are generally lower impact compared to gillnets (Shester & Micheli, 2011), trawls and dredges (Jennings &

Kaiser, 1998) and the majority of records of bycatch include crustaceans and molluscs rather than elasmobranch or teleost species.

Impacts: No records were identified of impacts to dogfish from potting fishing gear.

Evidence: Arrizabalaga *et al*. 2011; Astles *et al.* 2009; Jennings & Kaiser, 1998; Shester & Micheli 2011

Fishing gear type: Diving

Matrix risk category: GREEN

Explanation for categorisation: Chondrichthyans or elasmobranches, which include sharks, skate and rays, are less able to sustain their populations under fishing pressures that target teleost and invertebrate species, due to their slow growth, long lifespans, late maturity, and low fecundity; and are therefore extremely vulnerable to over-exploitation (Baeta *et al*., 2009). Commercial diving harvests scallops within the Lyme Bay AOI; this is considered the most environmentally sustainable method of fishing, with the greatest control of the catch (Grieve *et al*., 2011). Therefore, this is considered a low risk compared to other fishing gear.

Impacts: No records were identified of commercial diving impacting on dogfish.

Evidence: Grieve *et al*. 2011

Basking Shark

Fishing Gear Type	Matrix Risk Categorisation	Confidence	Source
Netting		Medium	Astles *et al*. 2009; Bloomfield & Solandt nd; Speedie, Johnson & Witt 2009
Trawling		Medium	Astles *et al*. 2009; Bloomfield & Solandt nd; Speedie, Johnson & Witt 2009
Dredging		Medium	Astles *et al*. 2009; Bloomfield & Solandt nd; Speedie, Johnson & Witt 2009
Potting		Low	Astles *et al*. 2009
Diving		Low	Grieve *et al.* 2011

Fishing gear type: Netting

Matrix risk category: RED

Explanation for categorisation: Chondrichthyans or elasmobranches, which include sharks, skate and rays, are less able to sustain their populations under fishing pressures that target teleost and invertebrate species, due to their slow growth, long lifespans, late maturity, and low fecundity; and are therefore extremely vulnerable to over-exploitation (Baeta *et al*., 2009). Among ecological risk assessment studies elasmobranches were considered the most at risk and sensitive of groups of targeted and bycaught marine species (Arrizabalaga *et al*., 2011; Hobday *et al.,* 2011; Zhou *et al*., 2011). Basking sharks have been exploited by targeted fisheries historically in the North Atlantic for several hundred years (Bloomfield & Solandt, 2006), but the species now has full legal protection in the EU and is designated a Prohibited Species under the Common Fisheries Policy. Bycatch, however, is still a major threat to the species and is mainly reported in set nets, gillnets and trawls, most commonly in coastal waters (Bloomfield & Solandt, 2006; Speedie, Johnson & Witt, 2009). Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling and these can be applied to other fishing gears. Basking sharks in general have the biological characteristics described above and are of a large size; although they are not targeted in EU waters they are still caught as bycatch in set nets and gillnets, which are deployed in the Lyme Bay AOI, therefore they are considered a high risk to this type of fishing gear.

Impacts: Overexploitation from bycatch; catch is mainly reported in nets and trawls (Bloomfield & Solandt, 2006).

Evidence: Astles et al. 2009; Bloomfield & Solandt 2006; Speedie, Johnson & Witt 2009

Fishing gear type: Trawling

Matrix risk category: RED

Explanation for categorisation: Chondrichthyans or elasmobranches, which include sharks, skate and rays, are less able to sustain their populations under fishing pressures that target teleost and invertebrate species, due to their slow growth, long lifespans, late maturity, and low fecundity; and are therefore extremely vulnerable to over-exploitation (Baeta *et al*., 2009). Among ecological risk assessment studies elasmobranches were considered the most at risk and sensitive of groups of targeted and bycaught marine species (Arrizabalaga *et al*., 2011; Hobday *et al.,* 2011; Zhou *et al*., 2011). Basking sharks have been exploited by targeted fisheries historically in the North Atlantic for several hundred years (Bloomfield & Solandt, 2006), but the species now has full legal protection in the EU and is designated a Prohibited Species under the Common Fisheries Policy. Bycatch, however, is still a major threat to the species and is mainly reported in nets and trawls, most commonly in coastal waters (Bloomfield & Solandt, 2006; Speedie, Johnson & Witt, 2009). Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling. Basking sharks in general have the biological characteristics described above and are of a large size. Although they are not targeted in EU waters they are still caught as bycatch particularly in trawls, and beam trawls are operated in Lyme Bay, therefore they are considered a high risk to this type of fishing gear.

Impacts: Overexploitation from bycatch; catch is mainly reported in nets and trawls (Bloomfield & Solandt, 2006).

Evidence: Astles et al. 2009; Bloomfield & Solandt 2006; Speedie, Johnson & Witt 2009

Fishing gear type: Dredging/Scalloping

Matrix risk category: AMBER

Explanation for categorisation: Chondrichthyans or elasmobranches, which include sharks, skate and rays, are less able to sustain their populations under fishing pressures that target teleost and invertebrate species, due to their slow growth, long lifespans, late maturity, and low fecundity; and are therefore extremely vulnerable to over-exploitation (Baeta *et al*., 2009). Among ecological risk assessment studies elasmobranches were considered the most at risk and sensitive of groups of targeted and bycaught marine species (Arrizabalaga *et al*., 2011; Hobday *et al.,* 2011; Zhou *et al*., 2011). Basking sharks have been exploited by targeted fisheries historically in the North Atlantic for several hundred years (Bloomfield & Solandt, 2006), but the species now has full legal protection in the EU and is designated a Prohibited Species under the Common Fisheries Policy. Bycatch, however, is still a major threat to the species and is mainly reported in nets and trawls, most commonly in coastal waters (Bloomfield & Solandt, 2006; Speedie, Johnson & Witt, 2009). Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling and these can be applied to other fishing gears. Basking sharks in general have the biological characteristics described above and are of a large size. They are also pelagic and near surface feeding species and are unlikely to be bycaught in dredges therefore, dredging is considered a lower risk compared to other fishing gears.

Impacts: No records were identified of impacts to basking sharks from dredges.

Evidence: Astles et al. 2009; Bloomfield & Solandt 2006; Speedie, Johnson & Witt 2009

Fishing gear type: Potting/Cuttle Potting/Whelking/Crabbing

Matrix risk category: AMBER

Explanation for categorisation: Chondrichthyans or elasmobranches, which include sharks, skate and rays, are less able to sustain their populations under fishing pressures that target teleost and invertebrate species, due to their slow growth, long lifespans, late maturity, and low fecundity; and are therefore extremely vulnerable to over-exploitation (Baeta *et al*., 2009). Among ecological risk assessment studies elasmobranches were considered the most at risk and sensitive of groups of targeted and bycaught marine species (Arrizabalaga *et al*., 2011; Hobday *et al.,* 2011; Zhou *et al*., 2011). Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling. These can be applied to other fishing gears; despite basking sharks in general having the biological characteristics described above there is no evidence of bycatch in this type of fishing gear. Therefore, potting is considered a lower risk compared to other fishing gears. Larger cetaceans however, have been reported entangled in pot ropes and this could present a risk to basking sharks.

Impacts: No records were identified of impacts to basking sharks from potting activities. However, larger cetaceans have been reported entangled in pot ropes and this could present a risk to basking sharks.

Evidence: Astles et al. 2009

Fishing gear type: Diving

Matrix risk category: GREEN

Explanation for categorisation: Chondrichthyans or elasmobranches, which include sharks, skate and rays, are less able to sustain their populations under fishing pressures that target teleost and invertebrate species, due to their slow growth, long lifespans, late maturity, and low fecundity; and are therefore extremely vulnerable to over-exploitation (Baeta *et al*., 2009). Commercial diving harvests scallops within the Lyme Bay AOI; this is considered the most environmentally sustainable method of fishing, with the greatest control of the catch (Grieve *et al*., 2011). Therefore, this is considered a low risk compared to other fishing gear.

Impacts: No records were identified of commercial diving impacting on basking sharks.

Evidence: Grieve *et al*. 2011

European eel

Fishing Gear Type	Matrix Risk Categorisation	Confidence	Source
Netting		Medium	Astles *et al*. 2009; Bevacqua, D., *et al*. 2009; Ginneken & Maes 2005
Trawling		Medium	Astles *et al*. 2009; Bevacqua *et al*. 2009; Ginneken & Maes 2005; Piet, Hal & Greenstreet 2009
Dredging		Low	Astles *et al*. 2009; Bevacqua *et al*. 2009; Ginneken & Maes 2005
Potting		Low	Astles *et al*. 2009; Bevacqua *et al*. 2009; Ginneken & Maes 2005
Diving		Low	Grieve *et al.* 2011

Fishing gear type: Netting

Matrix risk category: **RED**

Explanation for categorisation: Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling and these can be applied to other fishing gears. European eel are commercially targeted in the Lyme Bay AOI and due to their complex life history and slow maturity are considered a high risk. Eel populations have declined worldwide with overfishing one of many factors contributing to this (Ginneken & Maes 2005; Bevacqua *et al.*, 2009); the main fisheries for eel take place while they are migrating, when they are trapped and netted in estuaries and inshore waters.

Impacts: Overexploitation from targeted fisheries and bycatch.

Evidence: Astles *et al.* 2009; Bevacqua *et al.*, 2009; Ginneken & Maes 2005

Fishing gear type: Trawling

Matrix risk category: **RED**

Explanation for categorisation: Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling and these can be applied to other fishing gears. Eel populations have declined worldwide with overfishing one of many factors contributing to this (Ginneken & Maes 2005; Bevacqua *et al.*, 2009); the main fisheries for eel take place while they are migrating, when they are trapped and netted in estuaries and inshore waters. A model developed by Piet, Hal & Greenstreet (2009) concludes that many of the non-target species in the demersal fish community of the North Sea are impacted by bottom trawling to an extent as high, and in some cases higher, than target species. In this study there was a high mortality rate for European eel as a non-target species in otter trawls (Piet, Hal & Greenstreet, 2009). There have also been reports of silver phase European eels bycaught in the eastern North Atlantic by pelagic trawls (Ginneken & Maes 2005). Along with this and their complex life history, slow maturity and pelagic migration trawling is considered a high risk.

Impacts: Overexploitation from targeted fisheries and bycatch.

Evidence: Astles *et al.* 2009; Bevacqua *et al.*, 2009; Ginneken & Maes 2005; Piet, Hal & Greenstreet, 2009

Fishing gear type: Dredging/Scalloping

Matrix risk category: **AMBER**

Explanation for categorisation: Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling and these can be applied to other fishing gears. Eel populations have declined worldwide with overfishing one of many factors contributing to this (Ginneken & Maes 2005; Bevacqua *et al*., 2009). Due to the species critically endangered status and complex life history this fishing gear has been given an amber risk category.

Impacts: No records were identified of bycatch from dredges and this fishing gear does not target European eel, intensive fishing could impact on food availability.

Evidence: Astles *et al.* 2009; Bevacqua *et al*., 2009; Ginneken & Maes 2005

Fishing gear type: Potting/Cuttle Potting/Whelking/Crabbing

Matrix risk category: AMBER

Explanation for categorisation: Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling and these can be applied to other fishing gears. Eel populations have declined worldwide with overfishing one of many factors contributing to this (Ginneken & Maes 2005; Bevacqua *et al*., 2009). The species are critically endangered and have complex life histories. Potting does not target European eel and there is no evidence of bycatch from this fishing gear.

Impacts: No records were identified of impacts to European eel from potting activities.

Evidence: Astles *et al.* 2009; Bevacqua *et al*., 2009; Ginneken & Maes 2005

Fishing gear type: Diving

Matrix risk category: GREEN

Explanation for categorisation: Chondrichthyans or elasmobranches; which include sharks, skate and rays, are less able to sustain their populations under fishing pressures that are sufficient to sustain target teleost and invertebrate species due to slow growth, long lifespans, late maturity, and low fecundity; and are therefore extremely vulnerable to over-exploitation (Baeta *et al*., 2009). Commercial diving harvests scallops within the Lyme Bay AOI; this is considered the most environmentally sustainable method of fishing, with the greatest control of the catch (Grieve *et al*., 2011). Therefore, this is considered a low risk compared to other fishing gear.

Impacts: No records were identified of commercial diving impacting on basking sharks.

Evidence: Grieve *et al*. 2011

Cod

Fishing Gear Type	Matrix Risk Categorisation	Confidence	Source
Netting		Low	Arrizabalaga *et al*. 2011; Astles *et al*. 2009
Trawling		Medium	Arrizabalaga *et al*. 2011; Astles *et al*. 2009; Piet, Hal & Greenstreet 2009
Dredging		Medium	Arrizabalaga *et al*. 2011; Astles *et al*. 2009; Craven *et al*. 2013; Gubbay & Knapman 1999
Potting		Low	Arrizabalaga *et al*. 2011; Astles *et al*. 2009
Diving		Low	Grieve *et al*. 2011

Fishing gear type: Netting

Matrix risk category: RED

Explanation for categorisation: Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling and these can be applied to other fishing gears. Cod is a high fecund, fast maturing and relatively short lived species, and although teleosts (ray-finned fishes) are considered less vulnerable to fishing than larger, less fecund and long lived species, such as elasmobranches (Arrizabalaga *et al*., 2011), cod in particular have been overexploited and many stocks worldwide have collapsed which has led to its IUCN vulnerable status. The target fisheries for this species include seine and trammel nets and are commercially exploited in demersal gillnets within the Lyme Bay AOI.

Impacts: Overexploitation from targeted fisheries and bycatch.

Evidence: Arrizabalaga *et al*. 2011; Astles *et al.* 2009

Fishing gear type: Trawling

Matrix risk category: RED

Explanation for categorisation: Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling and these can be applied to other fishing gears. Cod is a high fecund, fast maturing and relatively short lived species, and although teleosts (ray-finned fishes) are considered less vulnerable to fishing than larger, less fecund and long lived species, such as elasmobranches (Arrizabalaga *et al*., 2011), cod in particular have been overexploited and many stocks worldwide have collapsed which has led to its IUCN vulnerable status. Cod is commercially targeted in the Lyme Bay AOI and otter trawls and beam trawls are used to catch this species (Piet, Hal & Greenstreet, 2009).

Impacts: Overexploitation from targeted fisheries and bycatch.

Evidence: Arrizabalaga *et al*. 2011; Astles *et al.* 2009; Piet, Hal & Greenstreet 2009

Fishing gear type: Dredging/Scalloping

Matrix risk category: **AMBER**

Explanation for categorisation: Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling and these can be applied to other fishing gears. Cod is a high fecund, fast maturing and relatively short lived species, and although teleosts (ray-finned fishes) are considered less vulnerable to fishing than larger, less fecund and long lived species, such as elasmobranches (Arrizabalaga *et al*., 2011), cod in particular have been overexploited and many stocks worldwide have collapsed which has led to its IUCN vulnerable status. Dredging is considered the most damaging of all fishing gears to non-target benthic communities and cod has been recorded as bycatch in scallop dredges (Craven *et al.,* 2013).

Impacts: Overexploitation from bycatch.

Evidence: Arrizabalaga *et al*. 2011; Astles *et al.* 2009; Craven *et al.* 2013

Fishing gear type: Potting/Cuttle Potting/Whelking/Crabbing

Matrix risk category: **AMBER**

Explanation for categorisation: Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling and these can be applied to other fishing gears. Cod is a high fecund, fast maturing and relatively short lived species, and although teleosts (ray-finned fishes) are considered less vulnerable to fishing than larger, less fecund and long lived species, such as elasmobranches (Arrizabalaga *et al*., 2011), cod in particular have been overexploited and many stocks worldwide have collapsed which has led to its IUCN vulnerable status. Potting does not target cod and there is no evidence of bycatch from this fishing gear.

Impacts: No records were identified of impact to cod from potting.

Evidence: Arrizabalaga *et al*. 2011; Astles *et al.* 2009

Fishing gear type: Diving

Matrix risk category: GREEN

Explanation for categorisation: Cod is a high fecund, fast maturing and relatively short lived species, and although teleosts (ray-finned fishes) are considered less vulnerable to fishing than larger, less fecund and long lived species, such as elasmobranches (Arrizabalaga *et al.*, 2011), cod in particular have been overexploited and many stocks worldwide have collapsed which has led to its IUCN vulnerable status. Commercial diving harvests scallops within the Lyme Bay AOI; this is considered the most environmentally sustainable method of fishing, with the greatest control of the catch (Grieve *et al.*, 2011). Therefore, this is considered a low risk compared to other fishing gear.

Impacts: No records were identified of commercial diving impacting on cod.

Evidence: Grieve *et al*. 2011

Whiting

Fishing Gear Type	Matrix Risk Categorisation	Confidence	Source
Netting		Low	Arrizabalaga *et al*. 2011; Astles *et al*. 2009
Trawling		Medium	Arrizabalaga *et al*. 2011; Astles *et al*. 2009; Craven *et al*. 2013; Lengkeek *et al*. 2010; Piet, Hal & Greenstreet 2009
Dredging		Medium	Arrizabalaga *et al*. 2011; Astles *et al*. 2009; Craven *et al*. 2013
Potting		Low	Arrizabalaga *et al*. 2011; Astles *et al*. 2009
Diving		Low	Grieve et al., 2011

Fishing gear type: Netting

Matrix risk category: AMBER

Explanation for categorisation: Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling and these can be applied to other fishing gears. Whiting is a high fecund, and fast growing species and teleosts (ray-finned fishes) are considered less vulnerable to fishing than larger, less fecund and long lived species, such as elasmobranches (Arrizabalaga *et al.*, 2011). Whiting are targeted by seine and trammel nets but there are no records of discards or high rates of bycatch from non-target fisheries. Although not commercially targeted in Lyme Bay they are likely to be bycaught in gillnets and therefore can be considered as risk prone to this fishing gear.

Impacts: Overexploitation from targeted fisheries and bycatch.

Evidence: Arrizabalaga *et al*. 2011; Astles *et al.* 2009

Fishing gear type: Trawling

Matrix risk category: RED

Explanation for categorisation: Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling and these can be applied to other fishing gears. Whiting is a high fecund, and fast growing species and teleosts (ray-finned fishes) are considered less vulnerable to fishing than larger, less fecund and long lived species, such as elasmobranches (Arrizabalaga *et al*., 2011). Whiting is commercially targeted in otter trawls and beam trawls (Piet, Hal & Greenstreet, 2009). Otter trawls appear to affect a somewhat different component of the fish community, with a much higher proportion of gadoid bycatch, in particular whiting, whereas scallop dredging captures a disproportionate amount of strictly benthic species, such as monkfish (Craven *et al*., 2013). Catch efficiency for the whiting was particular high for beam trawls (Piet, Hal & Greenstreet, 2009) and a study of catch and discard data revealed that whiting was one of the most discarded species (Lengkeek *et al*., 2010). Beam trawls are operated in Lyme Bay and despite whiting not being commercially targeted here they are likely to be bycaught and therefore can be considered as risk prone to this fishing gear.

Impacts: Overexploitation from targeted fisheries and bycatch.

Evidence: Arrizabalaga *et al*. 2011; Astles *et al.* 2009; Craven *et al*. 2013; Lengkeek *et al*., 2010; Piet, Hal & Greenstreet 2009

Fishing gear type: Dredging/Scalloping

Matrix risk category: AMBER

Explanation for categorisation: Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling and these can be applied to other fishing gears. Whiting is a high fecund, and fast growing species and teleosts (ray-finned fishes) are considered less vulnerable to fishing than larger, less fecund and long lived species, such as elasmobranches (Arrizabalaga *et al*., 2011). Dredging is considered the most damaging of all fishing gears to non-target benthic communities and whiting has been recorded as bycatch in scallop dredges (Craven *et al.,* 2013).

Impacts: Overexploitation from bycatch.

Evidence: Arrizabalaga *et al*. 2011; Astles *et al.* 2009; Craven *et al*. 2013

Fishing gear type: Potting/Cuttle Potting/Whelking/Crabbing

Matrix risk category: AMBER

Explanation for categorisation: Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling and these can be applied to other fishing gears. Whiting is a high fecund, and fast growing species and teleosts (ray-finned fishes) are considered less vulnerable to fishing than larger, less fecund and long lived species, such as elasmobranches (Arrizabalaga *et al*., 2011). Potting does not target whiting and there is no evidence of bycatch from this fishing gear.

Impacts: No records were identified of bycatch from potting and this fishing gear does not target whiting, intensive fishing could impact on the demersal habitat used by whiting.

Evidence: Arrizabalaga *et al*. 2011; Astles *et al.* 2009

Fishing gear type: Diving

Matrix risk category: GREEN

Explanation for categorisation: Whiting is a high fecund, and fast growing species and teleosts (ray-finned fishes) are considered less vulnerable to fishing than larger, less fecund and long lived species, such as elasmobranches (Arrizabalaga *et al*., 2011). Commercial diving harvests scallops within the Lyme Bay AOI; this is considered the most environmentally sustainable method of fishing, with the greatest control of the catch (Grieve *et al*., 2011). Therefore, this is considered a low risk compared to other fishing gear.

Impacts: No records were identified of commercial diving impacting on cod.

Evidence: Grieve *et al*. 2011

Ling

Fishing Gear Type	Matrix Risk Categorisation	Confidence	Source
Netting		Medium	Arrizabalaga *et al*. 2011; Astles *et al*. 2009; Defra 2007
Trawling		Low	Astles *et al*. 2009
Dredging		Medium	Astles *et al*. 2009; Craven *et al*. 2013
Potting		Low	Astles *et al*. 2009
Diving		Low	Grieve *et al*., 2011

Fishing gear type: Netting

Matrix risk category: AMBER

Explanation for categorisation: Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling and these can be applied to other fishing gears. Ling is a high fecund, fast growing but late maturing species, and teleosts (ray-finned fishes) are considered less vulnerable to fishing than larger, less fecund and long lived species, such as elasmobranches (Arrizabalaga *et al*., 2011). In a susceptibility analysis of bycatch species caught in Atlantic tuna gillnet fishery teleosts had high bycatch occurrences (Arrizabalaga *et al*., 2011). Ling is bycaught in gillnet fisheries and reports of the anglerfish gillnet fishery noted the poor condition of hauled ling which results in high discard rates of this species (Defra, 2007).

Impacts: Overexploitation from bycatch.

Evidence: Arrizabalaga *et al*. 2011; Astles *et al.* 2009; Defra, 2007

Fishing gear type: Trawling

Matrix risk category: RED

Explanation for categorisation: Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling and these can be applied to other fishing gears. Ling is a high fecund, fast growing but late maturing species, and teleosts (ray-finned fishes) are considered less vulnerable to fishing than larger, less fecund and long lived species, such as elasmobranches (Arrizabalaga *et al*., 2011). There are no records of ling having high rates of discards or bycatch from trawling. The late maturity of ling may make them vulnerable to overexploitation but they are not a commercially targeted species in Lyme Bay however, beam trawling is operated in Lyme Bay and so it is likely that they are bycaught.

Impacts: No records were identified of trawling having a negative impact on this species.

Evidence: Astles *et al.* 2009

Fishing gear type: Dredging/Scalloping

Matrix risk category: **AMBER**

Explanation for categorisation: Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling and these can be applied to other fishing gears. Ling is a high fecund, fast growing but late maturing species, and teleosts (ray-finned fishes) are considered less vulnerable to fishing than larger, less fecund and long lived species, such as elasmobranches (Arrizabalaga *et al*., 2011). Dredging is considered the most damaging of all fishing gears to non-target benthic communities and ling has been recorded as bycatch in scallop dredges (Craven *et al.,* 2013).

Impacts: Overexploitation from bycatch.

Evidence: Astles *et al.* 2009; Craven *et al*. 2013

Fishing gear type: Potting/Cuttle Potting/Whelking/Crabbing

Matrix risk category: **AMBER**

Explanation for categorisation: Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling and these can be applied to other fishing gears. Ling is a high fecund, fast growing but late maturing species, and teleosts (ray-finned fishes) are considered less vulnerable to fishing than larger, less fecund and long lived species, such as elasmobranches (Arrizabalaga *et al*., 2011). Potting does not target ling and there are no records of significant bycatch from this fishing gear.

Impacts: No records were identified of bycatch from potting and this fishing gear does not target ling, intensive fishing could impact on the demersal habitat used by ling.

Evidence: Astles *et al.* 2009

Fishing gear type: Diving

Matrix risk category: **GREEN**

Explanation for categorisation: Ling is a high fecund, fast growing but late maturing species, and teleosts (ray-finned fishes) are considered less vulnerable to fishing than larger, less fecund and long lived species, such as elasmobranches (Arrizabalaga *et al*., 2011). Commercial diving harvests scallops within the Lyme Bay AOI; this is considered the most environmentally sustainable method of fishing, with the greatest control of the catch (Grieve *et al*., 2011). Therefore, this is considered a low risk compared to other fishing gear.

Impacts: No records were identified of commercial diving impacting on cod.

Evidence: Grieve *et al*. 2011

Anglerfish

Fishing Gear Type	Matrix Risk Categorisation	Confidence	Source
Netting		Medium	Arrizabalaga *et al*. 2011; Astles *et al*. 2009; Craven *et al*. 2013; Defra 2007
Trawling		Medium	Astles *et al*. 2009; Craven *et al*. 2013; Piet, Hal & Greenstreet 2009
Dredging		Medium	Astles *et al*. 2009; Craven *et al*. 2013
Potting		Low	Astles *et al*. 2009; Craven *et al*. 2013
Diving		Low	Grieve *et al*. 2011

Fishing gear type: Netting

Matrix risk category: AMBER

Explanation for categorisation: Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling and these can be applied to other fishing gears. Teleost (ray-finned fishes) are considered less vulnerable to fishing than larger, less fecund and long lived species, such as elasmobranches (Arrizabalaga *et al*., 2011); however anglerfish grow and reproduce slowly and so are vulnerable to overexploitation (Craven *et al*., 2013). Teleosts had high bycatch occurrences in gillnets (Arrizabalaga *et al*., 2011). Anglerfish are targeted in gillnet fisheries (Defra, 2007), and gillnets are deployed in the Lyme Bay AOI therefore they are considered risk prone to this fishing gear.

Impacts: Overexploitation from target fisheries and bycatch.

Evidence: Arrizabalaga *et al*. 2011; Astles *et al.* 2009; Defra, 2007

Fishing gear type: Trawling

Matrix risk category: **RED**

Explanation for categorisation: Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling; anglerfish are commercially valuable and are targeted by trawlers. Teleosts (ray-finned fishes) are considered less vulnerable to fishing than larger, less fecund and long lived species, such as elasmobranches (Arrizabalaga *et al*., 2011); however anglerfish grow and reproduce slowly and so are vulnerable to overexploitation (Craven *et al*., 2013). Anglerfish bycatch has been recorded in otter and beam trawls, with high mortality rates in otter trawls (Piet, Hal & Greenstreet, 2009).

Impacts: Overexploitation from targeted fisheries and bycatch. Bottom trawling methods are destructive to demersal habitats.

Evidence: Astles *et al.* 2009; Craven *et al*. 2013; Piet, Hal & Greenstreet 2009

Fishing gear type: Dredging/Scalloping

Matrix risk category: **RED**

Explanation for categorisation: Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling and these can be applied to other fishing gears. Teleosts (ray-finned fishes) are considered less vulnerable to fishing than larger, less fecund and long lived species, such as elasmobranches (Arrizabalaga *et al*., 2011); however anglerfish grow and reproduce slowly and so are vulnerable to overexploitation (Craven *et al*., 2013). Anglerfish dominated the bycatch of a scallop dredge fishery in the north Irish Sea and appear disproportionately susceptible to capture in dredges; the study suggests the dredging had a negative effect on this species (Craven *et al*., 2013).

Impacts: Overexploitation from bycatch.

Evidence: Astles *et al.* 2009; Craven *et al*. 2013

Fishing gear type: Potting/Cuttle Potting/Whelking/Crabbing

Matrix risk category: **AMBER**

Explanation for categorisation: Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling and these can be applied to other fishing gears. Teleosts (ray-finned fishes) are considered less vulnerable to fishing than larger, less fecund and long lived species, such as elasmobranches (Arrizabalaga *et al*., 2011); however anglerfish grow and reproduce slowly and so are vulnerable to overexploitation (Craven *et al*., 2013). Potting does not target anglerfish and there is no evidence of significant bycatch from this fishing gear.

Impacts: No records were identified of bycatch from potting and this fishing gear does not target anglerfish.

Evidence: Astles *et al.* 2009; Craven *et al*. 2013

Fishing gear type: Diving

Matrix risk category: GREEN

Explanation for categorisation: Teleosts (ray-finned fishes) are considered less vulnerable to fishing than larger, less fecund and long lived species, such as elasmobranches (Arrizabalaga *et al*., 2011); however anglerfish grow and reproduce slowly and so are vulnerable to overexploitation (Craven *et al*., 2013). Commercial diving harvests scallops within the Lyme Bay AOI; this is considered the most environmentally sustainable method of fishing, with the greatest control of the catch (Grieve *et al*., 2011). Therefore, this is considered a low risk compared to other fishing gear.

Impacts: No records were identified of commercial diving impacting on cod.

Evidence: Grieve *et al*. 2011

Sand goby

Fishing Gear Type	Matrix Risk Categorisation	Confidence	Source
Netting		Low	Astles *et al*. 2009
Trawling		Low	Astles *et al*. 2009
Dredging		Medium	Astles *et al*. 2009; Craven *et al*. 2013
Potting		Low	Astles *et al*. 2009; Jennings & Kaiser, 1998
Diving		Low	Grieve *et al*. 2011

Fishing gear type: Netting

Matrix risk category: AMBER

Explanation for categorisation: Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling and these can be applied to other fishing gears. Sand goby are a benthic, high fecund, short lived and early maturing species. They are not a commercially targeted fish; however they have a high conservation status and are important prey for many large fish. There is no evidence of bycatch within nets but sand gobies are a demersal species and gillnets are deployed in Lyme Bay so there may be incidences of bycatch.

Impacts: No records were identified of impact to sand goby from netting activities.

Evidence: Astles *et al.* 2009

Fishing gear type: Trawling

Matrix risk category: AMBER

Explanation for categorisation: Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling and these can be applied to other fishing gears. Sand goby are a benthic, high fecund, short lived and early maturing species. They are not a commercially targeted fish; however they have a high conservation status and are important prey for many large fish. Bottom towed gear are damaging to benthic habitats and there may be interactions with this type of fishing gear with sand gobies and their habitat. There is no evidence of bycatch from trawling.

Impacts: No records were identified of impacts to sand goby from trawling, however bottom towed gear are damaging to benthic habitats.

Evidence: Astles *et al.* 2009

Fishing gear type: Dredging/Scalloping

Matrix risk category: AMBER

Explanation for categorisation: Teleosts (ray-finned fishes), such as the sand goby are considered less vulnerable to fishing than larger, less fecund and long lived species, such as sharks and rays (Arrizabalaga *et al*., 2011). Sand goby are a benthic, high fecund, short lived and early maturing species. They are not a commercially targeted fish; however they have a high conservation status and are important prey for many large fish. Dredging is considered the most damaging of all fishing gears to non-target benthic communities and other species of goby, particularly the common goby were bycaught in the scallop dredge fishery in the north Irish Sea although not in high abundance (Craven *et al*., 2013). In addition scallop dredging is operated within Lyme Bay and therefore there is a high risk of interaction with this type of fishing gear with sand gobies.

Impacts: No records were identified of impacts to sand gobies from dredging but this type of fishing gear cause damage to the benthic habitat and communities.

Evidence: Astles *et al.* 2009; Craven *et al*. 2013

Fishing gear type: Potting/Cuttle Potting/Whelking/Crabbing

Matrix risk category: AMBER

Explanation for categorisation: Teleosts (ray-finned fishes), such as the sand goby are considered less vulnerable to fishing than larger, less fecund and long lived species, such as sharks and rays (Arrizabalaga *et al*., 2011). Sand goby are a benthic, high fecund, short lived and early maturing species. They are not a commercially targeted fish; however they have a high conservation status and are important prey for many large fish. There is no evidence of bycatch from potting activities.

Impacts: No records were identified of impacts to sand goby from potting activities. The impact of static fishing gears, such as pots are likely to be insignificant compared to mobile fishing gears, however if a high density of pots are utilised in a small area with long lived fauna the impacts on the habitat may be significant (Jennings & Kaiser, 1998).

Evidence: Astles *et al.* 2009; Jennings & Kaiser 1998

Fishing gear type: Diving

Matrix risk category: GREEN

Explanation for categorisation: Sand goby are a benthic, high fecund, short lived and early maturing species. They are not a commercially targeted fish; however they have a high conservation status and are important prey for many large fish. Commercial diving harvests scallops within the Lyme Bay AOI; this is considered the most environmentally sustainable method of fishing, with the greatest control of the catch (Grieve *et al*., 2011). Therefore, this is considered a low risk compared to other fishing gear.

Impacts: No records were identified of commercial diving impacting on cod.

Evidence: Grieve *et al*. 2011

Plaice

Fishing Gear Type	Matrix Risk Categorisation	Confidence	Source
Netting		Low	Arrizabalaga *et al*. 2011; Astles *et al*. 2009
Trawling		Medium	Astles *et al*. 2009; Lengkeek *et al.* 2010; Piet, Hal & Greenstreet 2009
Dredging		Medium	Astles *et al*. 2009; Craven *et al*. 2013; Gubbay & Knapman 1999
Potting		Low	Astles *et al*. 2009
Diving		Low	Grieve *et al*. 2011

Fishing gear type: Netting

Matrix risk category: RED

Explanation for categorisation: Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling and these can be applied to other fishing gears. Plaice is a long lived and early maturing species, and teleosts (ray-finned fishes) are considered less vulnerable to fishing than larger, less fecund and long lived species, such as elasmobranches (Arrizabalaga *et al*., 2011). In a susceptibility analysis of bycatch species caught in Atlantic tuna gillnet fishery teleosts had high bycatch occurrences (Arrizabalaga *et al*., 2011). Plaice is commercially targeted in the Lyme Bay AOI and the target fisheries for this species include seine and trammel nets.

Impacts: Overexploitation from targeted fisheries and bycatch.

Evidence: Astles *et al.* 2009

Fishing gear type: Trawling

Matrix risk category: RED

Explanation for categorisation: Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling. Plaice is a long lived and early maturing species, and teleosts (ray-finned fishes) are considered less vulnerable to fishing than larger, less fecund and long lived species, such as elasmobranches (Arrizabalaga *et al*., 2011). Plaice is commercially targeted in the Lyme Bay AOI and have been recorded in both beam and otter trawl fisheries of the

North Sea with the mortality rate considerably higher for beam trawls (Piet, Hal & Greenstreet, 2009). Catch and discard data analysis of trawling in the English channel, Celtic and Irish sea concluded that plaice was one of the most discarded species from both otter and beam trawls (Lengkeek *et al*., 2010).

Impacts: Overexploitation from targeted fisheries and bycatch.

Evidence: Astles *et al.* 2009; Lengkeek *et al*., 2010; Piet, Hal & Greenstreet 2009

Fishing gear type: Dredging/Scalloping

Matrix risk category: RED

Explanation for categorisation: Teleosts (ray-finned fishes), such as plaice are considered less vulnerable to fishing than larger, less fecund and long lived species, such as sharks and rays (Arrizabalaga *et al*., 2011). Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling and these can be applied to other fishing gears. Plaice is a long lived and early maturing species, is commercially targeted within the Lyme Bay AOI, and although dredging does not target this species, plaice is still bycaught and therefore is risk prone to this type of fishing activity. Dredging is considered the most damaging of all fishing gears to non-target benthic communities and plaice were amongst the most abundant species in the bycatch of scallop dredges within the north Irish Sea (Craven *et al*., 2013; Gubbay & Knapman, 1999).

Impacts: Overexploitation from bycatch and damage to habitat.

Evidence: Arrizabalaga *et al*. 2011; Astles *et al.* 2009; Craven *et al*., 2013; Gubbay & Knapman, 1999

Fishing gear type: Potting/Cuttle Potting/Whelking/Crabbing

Matrix risk category: AMBER

Explanation for categorisation: Biological characteristics and fishery factors such as how species are fished have been used by Astles *et al.* (2009) to determine the risk for harvested species from trawling and these can be applied to other fishing gears. Plaice is a long lived and early maturing species, and teleosts (ray-finned fishes) are considered less vulnerable to fishing than larger, less fecund and long lived species, such as elasmobranches (Arrizabalaga *et al*., 2011). Potting does not target plaice and there is no evidence of bycatch from this fishing gear.

Impacts: No records were identified of bycatch from potting and this fishing gear does not target plaice, intensive fishing could impact on the benthic habitat.

Evidence: Arrizabalaga *et al*. 2011; Astles *et al.* 2009

Fishing gear type: Diving

Matrix risk category: GREEN

Explanation for categorisation: Plaice is a long lived and early maturing species, and teleosts (ray-finned fishes) are considered less vulnerable to fishing than larger, less fecund and long lived species, such as elasmobranches (Arrizabalaga *et al*., 2011). Commercial diving harvests scallops within the Lyme Bay AOI; this is considered the most environmentally sustainable method of fishing, with the greatest control of the catch (Grieve *et al*., 2011). Therefore, this is considered a low risk compared to other fishing gear.

Impacts: No records were identified of impacts to cod from commercial diving.

Evidence: Grieve *et al*. 2011

Confidence protocol for risk categories

Confidence of individual sources

Confidence in the data gathered to inform the risk categories is a key consideration in the project. Confidence has been assessed in a number of ways. The confidence matrix utilised for individual evidence sources is shown in **Tables G1-3**. This utilises parameters such as source quality (peer-reviewed/non peer-reviewed) as shown in **Table G1**, and applicability of the study (whether the source is based on data from the UK and relates to specific conservation features selected or not) as shown in **Table G2**. The confidence assessment also has provisions for assigning confidence to 'expert opinion' judgements. Overall confidence is based on the lowest common denominator in confidence from the two source tables, as shown in **Table G3** (i.e. a source with a high quality score and a medium applicability score would have an overall confidence of medium etc.). Note that this confidence approach was developed by the project team to provide structure to the process but does conform to the more general description provided in the EMS Fisheries approach, as provided below.

Table G1. Confidence assessment of quality for individual evidence sources

Individual Source Confidence	Quality Requirement
High	Peer reviewed Or grey literature reports by established agencies
Medium	Does not fulfil 'high' confidence requirement but methods used to ascertain the influence of a gear type on the species are fully described in the literature to a suitable level of detail, and are considered fit for purpose Or expert opinion where impact described is well-known/obvious
Low	Does not fulfil 'medium' requirement but methods used to ascertain the influence of a gear type on the species are described Or no methods adopted and informed through expert judgement

Table G2. Confidence assessment of applicability for individual evidence sources

Individual Source Confidence	Applicability Requirement
High	Study based on exact feature/species and exact fishing gear
Medium	Study used as proxy for feature/species or fishing gear
Low	Study used as proxy for both feature/species and fishing gear

Table G3. Overall confidence of individual evidence sources based on combining both quality and applicability, as outlined separately above.

Overall Source Confidence		Applicability Score		
		Low	Medium	High
Quality Score	Low	Low	Low	Low
	Medium	Low	Medium	Medium
	High	Low	Medium	High

Confidence of final risk score

The final confidence for the level of risk assigned to each conservation feature / fishing gear interaction was scored in accordance with the protocol presented in **Table G4**.

Table G4. Combined confidence assessment of all evidence sources for a single gear-feature interaction.

Combined relationship confidence	Requirement if one literature source only	Requirement if more than one literature source	Requirement if expert judgement applied
Low	Single source is low confidence	Strong disagreement between sources AND low-medium confidence scores for individual sources	Relationship is considered to exist based on experience of project team
Medium	Single source is medium confidence	Majority agreement between sources AND low-medium confidence scores for individual sources OR minority agreement between sources AND high confidence	Relationship is strongly thought to exist based on the experience of the project team and is well established and accepted by the scientific community
High	Single source is high confidence	Agreement between sources AND majority individual sources are medium to high confidence	N/A

The above approach was used to provide firm guidelines to the confidence methodology. However this also conforms to the EMS matrix guidelines as detailed below.

Confidence approach in EMS Fisheries Approach

The following text is sourced from the EMS risk matrix[2] and is provided as reference.

"(i) The degree and type of uncertainty in each of the RAGB categorisations will be stipulated with base on the sources of evidence used. These are classified as high, medium and low uncertainty, with appropriate sub-divisions. This is necessary to make clear to the end-user the strength of evidence used but also that expert judgment can still be used to make an assessment. The categories are described below

Low certainty

(ii) There is no available direct evidence (peer-reviewed scientific, grey literature or non-scientific). It has been necessary to rely on analogy with other habitats in a similar environment for which evidence does exist. Evidence may be limited (specifically, the relative sensitivity of the habitats is not clear).

(ii) There is no available direct evidence (peer-reviewed scientific, grey literature or non-scientific). It has been necessary to rely on analogy with other habitats in a similar environment for which evidence does exist. Evidence may be limited (specifically, the relative sensitivity of the habitats is not clear).

(iv) Conclusions have been based on sensitivity assessments which may rely on significant assumptions or generalisations. It has not been possible to validate these assumptions but they will be listed.

(v) The evidence base is conflicting, as a result it is not possible to reach accurate conclusions on the effect of activities on features and consequently provide direct and clear advice. This will be indicated.

Medium certainty

(vi) There is no direct available evidence. It has been necessary to make an analogy with other similar habitats in a similar environment for which evidence exists. There is good reason to believe that the analogy is justified (such as occurrence of species with similar characteristics and inhabiting a similar environment).

(vii) The feature may encompass a number of sub-types which vary in their sensitivity to fishing pressure. The available evidence does not cover the full range of the variation so some cases may not be well supported by evidence.

(viii) There is directly relevant scientific information to support the conclusion but it comes from grey literature sources.

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[2] http://www.marinemanagement.org.uk/protecting/conservation/documents/ems_fisheries/matrixprotocol.pdf

(ix) There is relevant non-scientific information that directly supports the conclusion on impacts and advice on management options.

High certainty

(x) There is peer reviewed, highly relevant scientific information to directly support the conclusion.

(xi) There is good quality, highly relevant non-scientific information that directly supports the conclusion.

(xii) There may not be direct evidence to support the conclusions, but they are logical conclusions which will be documented and available for review."

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