Fisheries in EMS Habitats Regulations Assessment for Amber and Green risk categories

European Marine Site: Exe Estuary SPA

Fishing activities assessed: Digging with forks

D&S IFCA Interaction ID	Fishing Activity	Feature(s)	Supporting habitat
HRA_UK9010081_AR40	Bait Digging	• Non-breeding Avocet • Non-breeding Black-tailed godwit • Non-breeding Dark-bellied Brent goose • Non-breeding Dunlin • Non-breeding Grey plover • Non-breeding Oystercatcher • Non-breeding Slavonian grebe • Waterbird assemblage	Intertidal coarse sediment
HRA_UK9010081_P40			Intertidal mixed sediments
HRA_UK9010081_K40			Intertidal mud
HRA_UK9010081_L40			Intertidal sand & muddy sand

Version Control History			
Version	**Author**	**Date**	**Comment**
1	Katherine Stephenson	06/03/19	Final draft complete to be sent to NE.
1.1	Sarah Clark	02/04/2019	QA’ing before sent to NE

Contents

1. Introduction

1.1 Need for an HRA assessment

In 2012, the Department for Environment, Food and Rural Affairs (Defra) announced a revised approach to the management of commercial fisheries in European Marine Sites (EMS). The objective of this revised approach is to ensure that all existing and potential commercial fishing activities are managed in accordance with Article 6 of the Habitats Directive.

This approach is being implemented using an evidence based, risk-prioritised, and phased basis. Risk prioritisation is informed by using a matrix of the generic sensitivity of the sub-features of EMS to a suite of fishing activities as a decision making tool. These sub-feature-activity combinations have been categorised according to specific definitions, as red, amber, green or blue.

Activity/feature interactions identified within the matrix as red risk have the highest priority for implementation of management measures by the end of 2013 in order to avoid the deterioration of Annex I features in line with obligations under Article 6(2) of the Habitats Directive.

Activity/feature interactions identified within the matrix as amber risk require a site-level assessment to determine whether management of an activity is required to conserve site features. Activity/feature interactions identified within the matrix as green also require a site level assessment if there are “in combination effects” with other plans or projects.

Site level assessments are being carried out in a manner that is consistent with the provisions of Article 6(3) of the Habitats Directive. The aim of this assessment is to determine whether management measures are required in order to ensure that fishing activity or activities will have no adverse effect on the integrity of the site.

The purpose of this site specific assessment document is to assess whether or not in the view of Devon and Severn Inshore Fisheries and Conservation Authority (D&S IFCA) the fishing activity of “Bait Digging” has a likely significant effect on the intertidal sediment features of the Exe Estuary SPA, and on the basis of this assessment whether or not it can be concluded that bait digging will not have an adverse effect on the integrity of this EMS.

1.2 Documents reviewed to inform this assessment

- Natural England’s risk assessment Matrix of fishing activities and European habitat features and protected species
- Reference list (Annex 1)
- Natural England’s consultation advice (Annex 2)
- Site map(s) – sub-feature/feature location and extent (Annex 3)
- Fishing activity data (map(s), etc.) (Annex 4)

2. Information about the EMS

The Exe Estuary SPA includes both marine areas (i.e. land covered continuously or intermittently by tidal waters) and land which is not subject to tidal influence. Sub-features have been identified which describe the key habitats within the European marine site necessary to support the birds that qualify within the SPA. Bird usage of the site varies seasonally, with different areas being favoured over others at certain times of the year. The mussel beds in particular are important in supporting the wintering wader and wildfowl assemblage to enable them to acquire sufficient energy reserves to ensure population survival (English Nature, 2001 & Natural England, 2015). Figure 1 (Annex 3) shows the boundary of the Exe Estuary SPA.

2.1 Overview and qualifying features

The Exe Estuary SPA qualifies under Articles 4.1 and 4.2 of the EU Birds Directive by supporting the following interest features (Natural England, 2015):

- Non-breeding Avocet (*Recurvirostra avosetta*)
- Non-breeding Black-tailed godwit (*Limosa limosa islandica*)
- Non-breeding Dark-bellied Brent goose (*Branta bernicia bernicia*)
- Non-breeding Dunlin (*Calidris alpina alpina*)
- Non-breeding Grey plover (*Pluvialis squatarola*)
- Non-breeding Oystercatcher (*Haematopus ostralegus*)
- Non-breeding Slavonian grebe (*Podiceps auritus*)
- Waterbird assemblage

The key supporting habitats are:

- Circalittoral rock
- Freshwater and coastal grazing marsh
- Infralittoral rock
- Intertidal biogenic reef: mussel beds
- Intertidal coarse sediment
- Intertidal mixed sediments
- Intertidal mud
- Intertidal rock
- Intertidal sand & muddy sand
- Intertidal seagrass beds
- Intertidal stony reef
- Subtidal biogenic reefs: mussel beds
- Subtidal coarse sediment
- Subtidal mixed sediment
- Subtidal sand
- Subtidal seagrass beds
- Subtidal stony reef
- Water column
- Saltmarsh
    - Atlantic salt meadows (*Glauco-Puccinellietalla maritimae*)
    - Salicornia and other annuals colonising mud & sand
    - Spartina swards (*Spartinion maritimae*)

2.2 Conservation Objectives

The site's conservation objectives apply to the Special Protection Area and the individual species and/or assemblage of species for which the site has been classified.
The objectives are to ensure that, subject to natural change, the integrity of the site is maintained or restored as appropriate, and that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring:

- the extent and distribution of the habitats of the qualifying features
- the structure and function of the habitats of the qualifying features
- the supporting processes on which the habitats of the qualifying features rely
- the populations of the qualifying features
- the distribution of the qualifying features within the site

3. Interest feature(s) of the EMS categorised as 'red' risk and overview of management measure(s)

None – this site has no gear-feature interactions categorised as "red" risk.

4. Information about the fishing activities within the site

A full description of D&S IFCA's current understanding of the levels and distribution of bait digging within the Exe Estuary SPA can be found in Stephenson (2019). Bait digging occurs on the intertidal sand and mudflats, with effort being highest on the eastern shore of the estuary, in the Cockle Sands & Shelley Bank area. Bait digging occurs on the Exe all year round, peaking in the summer on the eastern shore, but in the autumn on the western shore.

During May and June 2016 D&S IFCA conducted survey visits to the estuary to identify the level of Intertidal handwork occurring (results can be found in Annex 6). The surveys looked at shellfish collection, crab tiling, and bait digging. Bait digging accounted for just over one third of the hand-gathering activity observed during the survey (35% of activity on the west shore, 38% on the east shore). Throughout the survey the estuary was visited 16 times, with bait diggers being seen on nine of these visits. Twelve bait diggers were observed on five weekday visits, and six diggers were seen over four weekend visits. This suggests this activity occurs at slightly higher levels during weekdays, which is contrary to the general pattern of total hand-gathering activity (Figure 10). However, in line with the general pattern of hand-gathering activity (Figure 9), the majority of bait digging took place on spring tides, with 15 bait diggers observed over seven visits which occurred on spring tides, whereas diggers were only seen on two visits occurring on neap tides (a total of three diggers). Therefore, it seems this activity is largely temporally limited by spring tides.

In term of backfilling holes that were dug, only 50% of bait diggers on the Exe Estuary, who were interviewed, reported that they backfilled holes, even though this is part of the Exe Estuary voluntary code of conduct. From visual surveys most of the holes seen had not been backfilled.

Other fishing activities within the EMS are described in the Fishing Activity Report (Gray, 2015).

5. Test for Likely Significant Effect (LSE)
5.1 Table 1: Assessment of LSE

<table>
<tr><td>1. Is the activity/activities directly connected with or necessary to the management of the site for nature conservation?</td><td colspan="2">No</td></tr>
<tr><td>2. What pressures (such as abrasion, disturbance) are potentially exerted by the gear type(s)</td><td colspan="2">Above water noise (Bird features - Sensitive)
Visual disturbance (Bird features - Sensitive)
Abrasion & disturbance of the substrate on the surface of the seabed (Supporting habitat - Sensitive)
Penetration/disturbance of the substrate below the surface of the seabed, including abrasion (Supporting habitat – Sensitive)
Physical changes (to another seabed type) (Supporting habitat – Sensitive)
Removal of non-target species (Bird feature & supporting habitat – Sensitive)
Removal of target species (Supporting habitat – Sensitive)
See Annex 7 for Pressures Audit Trail</td></tr>
<tr><td>3. Is the feature potentially exposed to the pressure(s)?</td><td colspan="2">Yes, there are currently no management measures restricting bait digging in the Exe Estuary SPA.</td></tr>
<tr><td>4. What are the potential effects/impacts of the pressure(s) on the feature, taking into account the exposure level?</td><td colspan="2">The intertidal sediment supporting habitats have the following targets (Natural England, 2015):
Maintain the structure, function & supporting processes associated with the feature and its supporting habitat (all bird features)
Maintain the extent & distribution of suitable habitat which supports the feature for all necessary stages of the non-breeding/wintering period (all bird features)
Maintain the distribution, abundance & availability of the most important prey items (avocet, black-tailed godwit, dunlin, grey plover, Slavonian grebe)
Restore availability of key prey at preferred sizes (oystercatcher)
Maintain the structure, function & availability of the habitat, which supports the assemblage feature for all stages of the non-breeding period (waterbird assemblage)
The bird features have the following target:
The frequency, duration &/or intensity of disturbance affecting foraging &/or roosting should not reach levels that substantially affect the feature.
Given that the features/supporting habitats could be exposed to the pressures listed in Section 2 of this table, there is potential that these targets will not be met.</td></tr>
<tr><td rowspan="2">5. Is the potential scale or magnitude of any effect likely to be significant?</td><td>Alone</td><td>Yes, there is potential for likely significant effect.</td></tr>
<tr><td>In-combination</td><td>See Section 8.</td></tr>
</table>

6. Have NE been consulted on this LSE test? If yes, what was NE's advice?	NE has not been consulted at this time.

6. Appropriate Assessment

6.1 Potential risks to features

The potential pressures, impacts and exposure by gear type(s) for each feature/sub-feature are summarised in Table 2.

Table 2: Summary of Impacts

Feature/ Supporting habitat(s)	Target Attributes/Conservation Objectives	Potential pressure (such as abrasion, disturbance) exerted by gear type(s)	Potential ecological impacts of pressure exerted by the activity/activities on the feature *(reference to conservation objectives)*	Level of exposure of feature to pressure	Mitigation measures
All bird features • Intertidal coarse sediment • Intertidal mixed sediment • Intertidal mud • Intertidal sand & muddy sand	**Target Attribute:** • Maintain the structure, function & supporting processes associated with the feature and its supporting habitat • Maintain the extent & distribution of suitable habitat which supports the feature for all necessary stages of the non-breeding/wintering period **Conservation Objective:** Maintain or restore: • the extent and distribution of the habitats of the	Abrasion & disturbance of the substrate on the surface of the seabed. Penetration/disturbance of the substrate below the surface of the seabed, including abrasion. Physical changes (to another seabed type).	Bait digging usually occurs to depths of 30cm, unearthing a deeper sediment that would usually remain undisturbed (Jackson and James, 1979). Changes can therefore occur in sediment characteristics as a result of bait digging. In unexploited sediments, a 10cm layer of well-mixed sand is created by bioturbation (primarily by lugworms), overlying a layer of sands and shell (Anderson and Meyer, 1986). Undug sediment was found to have a higher organic content which is generally not site specific. The process of turning over the sediment and erosion of sediment mounds by tides and wave action leads to a loss of finer fractions and associated organic material. In contrast, the basins may collect organic matter and fine sediments (Anderson and Meyer, 1986). This could have implications for local sediment load and turbidity levels (Watson et al., 2017). Transport of fine sediment and previously buried contaminants takes place at the sediment surface.	Bait digging is commonplace on the sand and mudflats on both shores of the estuary; between Starcross and Cockwood on the west side, and just off the Imperial Recreation (Rec) Ground at Exmouth on the eastern side. Bait digging occurs at low tide (mostly spring tides), all year round. Stephenson (2019) found that the area off the Rec Ground experience higher levels of activity than Starcross-Cockwood, with activity being highest in the summer months.	The Exe Estuary Management Partnership's (2018) voluntary code of conduct requires bait diggers to backfill their holes. However, D&S IFCA's observations have found that not all bait diggers adhere to this. Through the IFCA's Byelaw Review process, D&S IFCA will be reviewing all byelaws relating to hand working (including bait digging). Options for management will include, no action, voluntary measures and the

	qualifying features • the structure and function of the habitats of the qualifying features • the supporting processes on which the habitats of the qualifying features rely		If the mounds of sediments are subsequently returned through the process of back or in-filling, then the effect of the disturbance is reduced and recovery can occur within three weeks (Fowler, 1999). Recovery rates are therefore influenced by the energy of the site, and behaviour of the bait diggers. Coarse sand beaches with considerable wave action will recover more quickly than sheltered sites. Experimentally dug plots in a very sheltered location in the Menai Strait were still visible after a year, although this is thought to be due to the presence of boulder clay (Johnson, 1984). Other, less sheltered, sites have reported a timeframe of 25 days for holes to disappear (Johnson, 1984).	Whereas at Starcross-Cockwood there was little seasonal variation in effort. The area surveyed at the Rec Ground was approximately 132.5 hectares, with the mean number of diggers seen per visit being 0.8, this equates to an average of 0.006 diggers per hectare. However, it should be noted that almost all activity occurred within the southern half of the survey area, so a more realistic average bait diggers/hectare figure is 0.12. At Starcross-Cockwood the mean number of bait diggers per visit was 0.5, over an area of approximately 57ha (0.008 diggers per hectare). Therefore, the intensity is much higher off the Rec Ground. (Figure 3, Annex 4)	potential introduction of a Hand Working Byelaw, which would allow the IFCA to monitor levels of this activity in the future and adapt to changes in effort/ environmental conditions if necessary. During 2019 D&S IFCA's Byelaw and Permitting Sub-committee will consider what management may be appropriate, which may include a requirement to backfill holes/trenches.
Waterbird assemblage • Intertidal coarse sediment • Intertidal mixed sediment • Intertidal	**Target Attribute:** • Maintain the structure, function & availability of the habitat, which supports the assemblage feature for all stages of the non-breeding period **Conservation**	Abrasion & disturbance of the substrate on the surface of the seabed. Penetration/disturbance of the substrate below the surface of	See above.	See above.	See above.

mud • Intertidal sand & muddy sand	**Objective:** Maintain or restore: • the extent and distribution of the habitats of the qualifying features • the structure and function of the habitats of the qualifying features • the supporting processes on which the habitats of the qualifying features rely	the seabed, including abrasion. Physical changes (to another seabed type).			
Avocet, Black-tailed godwit, Dark-bellied Brent goose, Dunlin, Grey plover, Oystercatcher • Intertidal coarse sediment • Intertidal mixed sediment • Intertidal mud • Intertidal sand & muddy sand	**Target Attribute:** • Maintain the area of open and unobstructed terrain around roosting and feeding sites. **Conservation Objective:** Maintain or restore: • the extent and distribution of the habitats of the qualifying features • the structure and function of the habitats of the qualifying features	Physical change to another seabed type. Visual disturbance.	Bait digging would not obstruct line of sight on the intertidal sediments.	Obstruction to the intertidal sediments caused by bait digging is not believed to be significant to prohibit bird features from feeding.	No mitigation necessary.
Grey plover, Slavonian Grebe • Intertidal	**Target Attribute:** • Maintain the distribution, abundance &	Removal of target species. Removal of non-	Both blow lugworm (*Arenicola marina*) and king ragworm (*Alitta virens*) are targeted by bait diggers on the Exe Estuary.	Blow lugworm (*Arenicola marina*) is the main target species on the eastern shore of the Exe	Through the IFCA's Byelaw Review process, D&S IFCA will be reviewing all

coarse sediment • Intertidal mixed sediment • Intertidal mud Intertidal sand & muddy sand	availability of the most important prey items **Conservation Objective:** Maintain or restore: • the populations of the qualifying features • the distribution of the qualifying features within the site	target species.	Contrasting evidence exists as to the *direct* environmental effects of bait digging for lugworm. Relative to other exploited intertidal invertebrates, blow lugworm are relatively resilient to exploitation and disturbance because of their relative fecundity and widespread distribution (Fowler, 1999). In addition, *A. marina* exhibit a marked annual cycle in the numbers and condition of individuals, so that any changes in population structure correlated to bait digging, would have to control for these factors (Olive, 1993). Removal rates of 50-70% of worms in the area dug have been reported in the literature (Heilgenberg 1987, Blake 1979) but D&S IFCA observations suggest this may be much lower in some areas, especially where large areas of lugworm exist, and holes are relatively well spread out. A wide range of responses by *A. marina* to exploitation or experimental simulations of exploitation have been found, relating to local environmental conditions and the intensity and distribution of bait digging activity. Olive (1993) describes the scenario which led to complete removal of all lugworms from a large area of a National Nature Reserve in Northumberland in 1984, with densities falling from >40m^{-2} to <1m^{-2}. When the site was closed to bait digging it repopulated within a matter of months, thanks to the presence of extensive non-exploited populations nearby. Similarly, lugworm populations in the Dutch Wadden Sea appear to be unaffected by large scale commercial exploitation, with an estimated 2 x 10^{7} individuals take annually. However, Cryer et al. (1987) found no recovery in worm densities after six months following experimental removal, although natural densities at the test site in	Estuary, whilst king ragworm (*Alitta virens*) is the main target on the west (Stephenson, 2019). No respondents to D&S IFCA surveys had noticed any long-term trends in bait availability, most reporting that it is fairly consistent digging on the Exe (one respondent had been digging on the Exe for 40 years) (Stephenson, 2019).	byelaws relating to hand working (including bait digging). Options for management will include, no action, voluntary measures and the potential introduction of a Hand Working Byelaw, which would allow the IFCA to monitor levels of this activity in the future and adapt to changes in effort/ environmental conditions if necessary.

			South Wales were low (9-16 m^{-2}) and the survey ran through the less productive winter months. The capacity of a population to withstand bait digging activities therefore relies on a number of factors including the size of the exploited area relative to the total lugworm bed, the presence of other lugworm beds nearby, the presence of nursery areas, the relative exploitation of adult and juvenile lugworms, and the intensity and seasonality of bait digging. However, on the whole they are thought to be resilient to bait digging. *A.virens* is a keystone intertidal species as prey for fish, birds and crustaceans, is a predator of other invertebrates and has an important role in bioturbation of the sediment (Watson et al. 2017a). King ragworm are generally found in more sheltered sediment areas but they can also be found in more mixed sediments (E West, Pers. Obs.). Differing reports exist of the life-history and population characteristics of *A.virens.* Whilst early studies of North American populations suggested a mean age at breeding of >3 years with the population dominated by 0-group individuals, a population from the Menai Straight, Wales was thought to mature later, and to have very few 0-group individual present. The latter population was therefore seen as being vulnerable to exploitation. On the North East coast of England, a study found similar densities (~15m^2 during the summer, ~3m^2 during the winter) of *A. virens* in both exploited and unexploited populations Blake (1979), suggesting that at least some populations are unaffected by bait digging. In other cases the change in macrofaunal community has been thought to benefit *A.virens*, due to its opportunistic nature (Evans et al. 2015).		

			Bait digging can have adverse effects on a wide variety of species as a result of physical damage, burial, smothering and/or exposure to desiccation or predation to non-target invertebrates. Recovery of small short-lived invertebrates will usually occur within a year, but populations of larger, long-lived invertebrates may take much longer (Fowler, 1999). In some extreme cases local diversity may be reduced, which may be especially true in physically fragile environments such as eelgrass or mussel beds (Fowler, 1999). Similarly, Beukema (1995) found that within a 1km^2 area of the Dutch Wadden Sea, local lugworm stock declined by more than double over a four year mechanical digging period. As a result of this decline, total zoobenthic biomass also declined, with short lived species showing a marked reduction during the digging period. Recovery of the benthos took several years, especially by the slower establishing species. However, if disturbance by digging is short term, benthic communities can recover within six months (Beukema, 1995). Jackson and James (1979) investigated the effects of bait digging on cockle populations. They found that increased digging in an area caused higher cockle mortality, particular on smaller individuals. The cause of mortality was due to burial/smothering as individuals that were buried at a depth of 10cm rarely survived. However, it is important to note that the effects on macrofaunal communities can differ substantially between estuaries. For example, the mud content of an estuary can impact the amount of disturbance caused by bait digging. Estuaries that have a low mud content are usually associated with a greater infaunal		

			diversity resulting in communities being able to recover within 7 days. If an estuary has a high mud content it is more likely to be dominated by key species and can therefore take longer recover (Carvalho et al., 2013).		
All bird features (in relation to the intertidal sediment supporting habitats)	**Target Attribute:** • The frequency, duration &/or intensity of disturbance affecting foraging &/or roosting should not reach levels that substantially affect the feature. **Conservation Objective:** Maintain or restore: • the populations of the qualifying features • the distribution of the qualifying features within the site	Above water noise. Visual disturbance.	Bird disturbance is also a major concern, especially where peak bait digging coincides with peak bird abundance or intertidal activity (Townshend and O'Connor, 1993). Bait collection has been found to induce a 'temporary loss of habitat' for some bird species, with bait collector numbers negatively correlating with wader and gull abundance (Watson et al., 2017). Wildfowl, such as mute swans may be the least likely group to be vulnerable to disturbance, as many of these species are fed directly by humans (Liley and Fearnley 2012, Watson et al. 2017). Lugworm is an important prey item for the Grey Plover and the Bar-Tailed Godwits in the Severn (Goss-Custard et al., 1991). There is an important link between macrofaunal biomass (energy content) and the behaviour of wading birds. Wading birds have been shown to extend their feeding period, increase their attack rate, broaden their prey or move to different areas in order to cope with reductions in infaunal biomass (Zwarts, 1993). Although the process of bait digging can directly target prey items for certain bird species, it can also indirectly impact the forging efficiency of wading birds through increased mortality of associated invertebrate fauna. For example, Shepherd and Boates (1999) found that foraging	Bait digging occurs at low tide (mostly spring tides), two hours either side of low, during the day, all year round. However, bait digging levels were generally lowest in the winter, when the over-wintering bird populations would be present. Bait diggers usually work as a hobby or as and when they need bait for recreational angling. Bait digging is usually a slow, solitary and quiet process. Disturbance would cause a temporary change in distribution and reduction in bird numbers where bait digging is occurring. The extent of disturbance from human presence would be a bait digger walking from the shore to the area of digging, the area worked, and then walking back to the shore line.	In 2018 the South East Devon Habitat Regulations Partnership established Wildlife Refuge Zones (WRZs) to mitigate for potential disturbance to the SPA birds from recreational activities (SEDHRP, 2019). Monitoring of compliance with these zones is being undertaken by the Habitat Mitigation Officers. D&S IFCA will be kept informed of the findings of this monitoring. Through the IFCA's Byelaw Review process, D&S IFCA will be reviewing all byelaws relating to hand working (including bait digging). Options for management will include, no action, voluntary measures and the potential introduction of a Hand Working

			efficiency of sandpipers was significantly lower in areas targeted for bait digging of bloodworms. Foraging efficiency decreased by 68.5%. This species of bait is not a prey item for the sandpiper but the process of bait digging resulted in a 38% decrease in density of their amphipod prey, *Corophium volutator,* after one year of baitworm harvesting in the Bay of Fundy. This decrease was as a result of direct mortality and lower juvenile recruitment. It was also observed that sandpipers on dug regions took longer to build up fat deposits needed for migration. As well as impacting habitats and prey species used by birds, the birds themselves can be impacted by bait digging activities by way of disturbance. Goss-Custard and Verboven (1993) found that the presence of people in areas used for feeding and breeding can alter the behaviour and distribution of estuarine birds. Meaning the birds may become displaced into areas with a lower prey density. A disturbance review by the Exe Estuary Management Partnership (2016) summarised that disturbance levels can be dictated by a number of factors such as noise level, amount of activity and number of people present. However, disturbance by bait collection generally occurs via visual (seeing the collector and responding as if they were a potential predator) and/or noise disturbance (causing distress via deviation from the "natural" ambient noise). Liley et al. (2011) found that whilst bait-digging and crab-tiling accounted for 7% of bird disturbance events in their study on the Exe Estuary, this was just a count of number of		Byelaw, which would allow the IFCA to monitor levels of this activity in the future and adapt to changes in effort/ environmental conditions if necessary, or if the WRZs are found to be inadequate mitigation.

			events, and bait-digging actually accounted for 16% of all major flight events. Liley et al. (2012) carried out observational surveys in Poole Harbour, recording activities which resulted in bird disturbance. For 93% of observations there was no response from birds, only 1% resulted in major flights. 1558 potential disturbance events were recorded over 63 hours of survey. During the 63 hours of surveillance there were just five individual disturbance events involving bait collection, none resulted in the birds being flushed. Townshend and O'Connor (1993) found that disturbance caused by bait digging activity greatly reduced the extent of use of the Lindisfarne National Nature Reserve (NNR) by wigeon, bar-tailed godwit and redshank. However, significant increases in the populations of wildfowl were recorded in the year following a ban on bait digging. Urfi et al. (1996) looked at how oystercatchers compensate for lost feeding time following disturbance. They expected to find that feeding rates would increase, however, instead they found that feeding time was extended. They also found that birds are able to habituate to the frequent presence of people within feeding areas, reducing the distance at which they take flight, therefore reducing the amount of feeding time lost. Goss-Custard and Verboven (1993) also found that oystercatchers subjected to minimal disturbance conditions have been known to habituate to the presence of people, depending on the movement of the individuals.		

			However, De Boer and Langamane (1996) found that larger birds have longer Minimal Approach Distances (MADs) when influenced by human presence and their foraging activity decreases earlier when approached. Hockin et al. (1992), shows disturbance can have an effect on breeding success through several factors e.g. nest abandonment, increased mortality of eggs due to predation & increased mortality of young through reduced feeding. Disturbance can reduce use of sites by birds, and can affect nest site choice, having a negative effect on population density. It can also have a negative effect on energy budgets – time spent flying, reduces time spent feeding. Over the last five years the only feature bird species to show a decline on the Exe Estuary are the Avocet (-23%), Dunlin (-4%) and Grey plover (-37%), all others have increasing population numbers. Both Dunlin and Grey plover are declining nationally; therefore Avocet is the only species not following the national trend (Frost et al., 2017).		

7. Conclusion

Bait digging occurs at a relatively low intensity on the western shore of the Exe Estuary SPA, and in a localised area on the eastern shore. Although bait digging can cause changes in sediment characteristics, these are much reduced if the holes are backfilled.

Bait diggers are usually solitary, working only at low tide (usually on spring tides) for a couple of hours around the time of low water. Disturbance is only from the presence of bait diggers during this time. This disturbance may result in a temporary change in distribution and abundance of birds in vicinity of the bait digging activity. It is hoped that the newly introduced Wildlife Refuge Zones on the Exe Estuary will mitigate against disturbance caused by recreational activities, including bait digging. The effectiveness of these zones will require ongoing monitoring by the Habitat Mitigation Officers.

Through the IFCA’s Byelaw Review process, D&S IFCA will be reviewing all byelaws relating to hand working (including bait digging). Options for management will include, no action, voluntary measures and the potential introduction of a Hand Working Byelaw, which would allow the IFCA to monitor levels of this activity in the future and adapt to changes in effort/ environmental conditions if necessary. If D&S IFCA decides that regulation, other than voluntary measures that are already in place, should be introduced by way of a Hand working Byelaw, it might consider including the requirement for bait diggers to backfill holes/trenches.

8. In-combination assessment

Bait digging occurs alongside other fishing activities within the Exe Estuary SPA (Gray, 2015). Other fishing activities, occurring on this site, which may interact with the intertidal sediments are the elevator harvester, intertidal handwork and crab tiling. The elevator harvester fishery has already undergone an HRA, which concluded it was not likely to have a significant effect in combination with other plans or projects. The low levels of intertidal handwork mean that there is no likelihood of significant adverse effect to the features considered in this assessment in-combination with bait digging.

Crab tiling has already undergone an HRA and was found to not be having a significant effect on its own. However, there is potential that crab tiling and bait digging may be having a significant effect when considered in combination. There is no physical overlap between the two activities, although they do occur in close proximity to each other. Therefore, it is unlikely that they will be having a combined effect on the sediment characteristics or infaunal communities. Bird disturbance is a major concern, however it is hoped the Wildlife Refuge Zones will mitigate against this. This will require long-term monitoring.

The impact of future plans or projects will require assessment in their own right, including accounting for any in-combination effects, alongside existing activities.

9. Summary of consultation with Natural England

N/A Natural England have not been consulted at this stage.

10. Integrity test

It can be concluded that bait digging, alone or in-combination, within the Exe Estuary SPA has the potential to effect bird features and their supporting habitats assessed and that the conservation objects may not be met. Management measures are not currently in place, however, Devon and Severn IFCA is reviewing management measures that cover hand working activities (including bait digging). This may provide the opportunity to introduce a requirement to backfill holes/trenches to reduce the impact on the intertidal sediment. D&S IFCA should stay informed of the results of the monitoring of the Wildlife Refuge Zones going forward.

Annex 1: Reference list

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Annex 2: Natural England’s consultation advice

N/A Natural England have not been consulted at this stage.

Annex 3: Site Maps

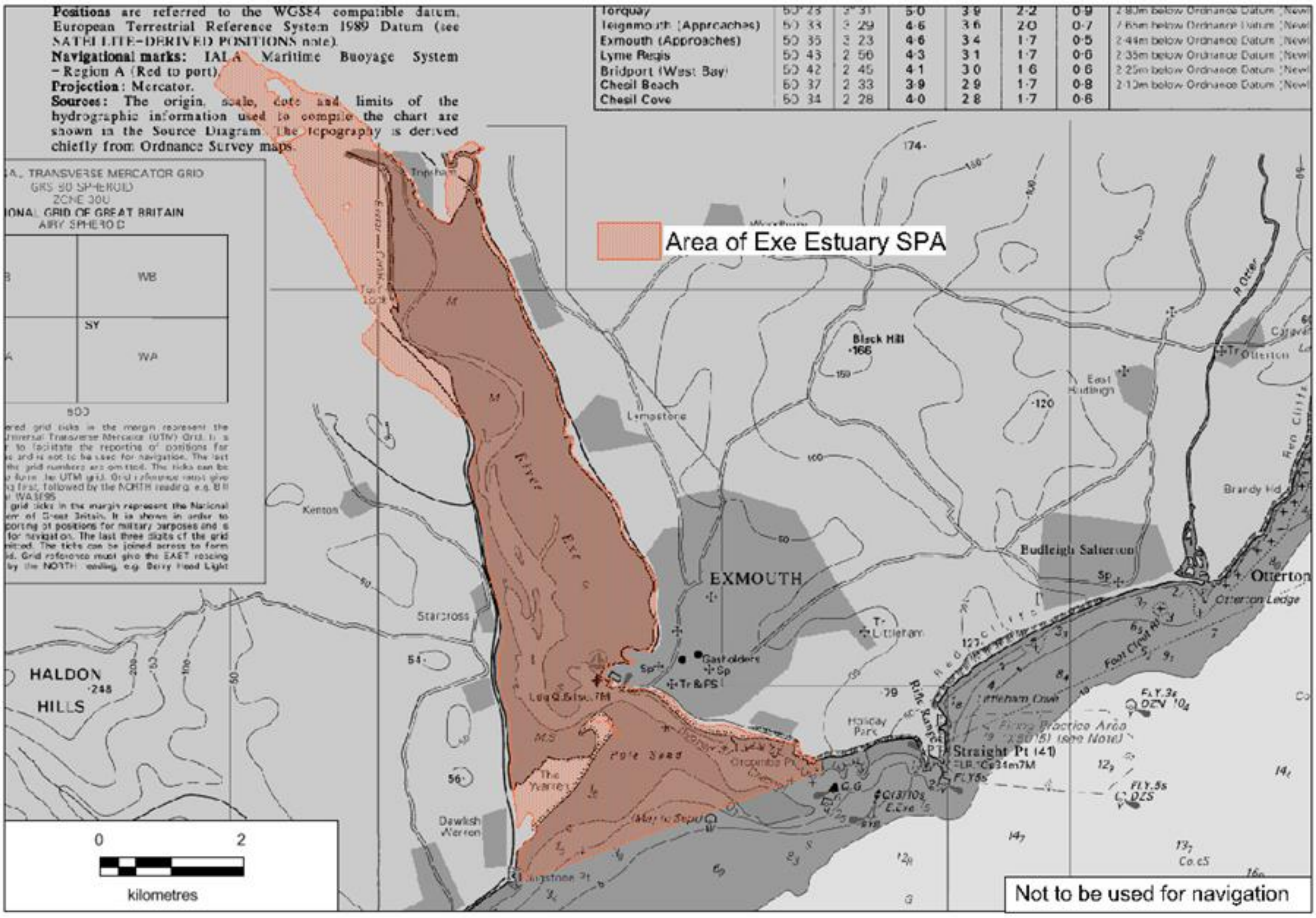


Figure 1 Exe Estuary SPA boundary (shown in red)

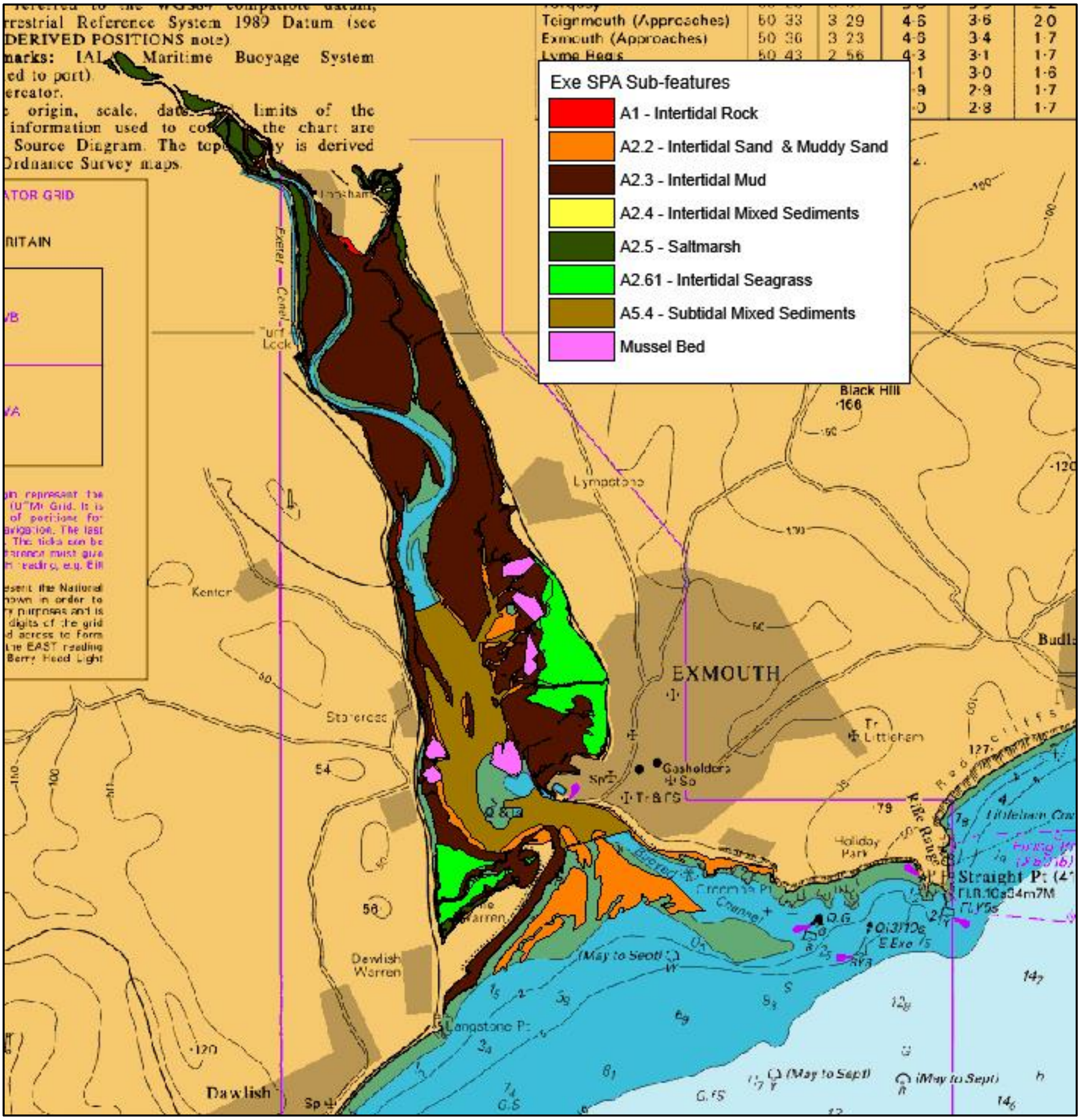


Figure 2 Exe Estuary SPA sub-features (Natural England, 2015)

Annex 4: Fishing activity maps

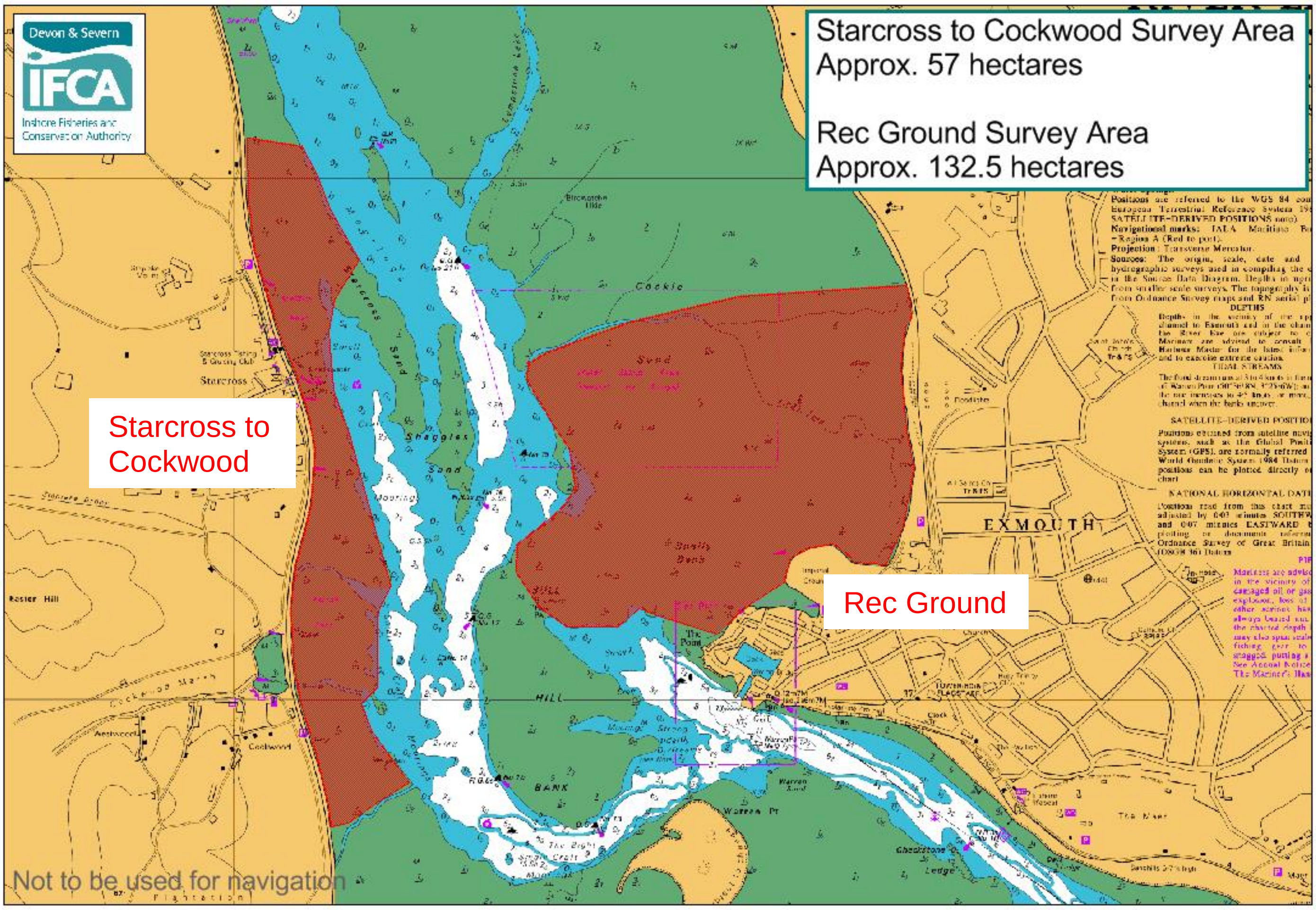


Figure 3 Areas covered by D&S IFCA bait digging surveys, where bait digging effort was observed (Stephenson, 2019)

Annex 5: Bird usage of the Exe Estuary

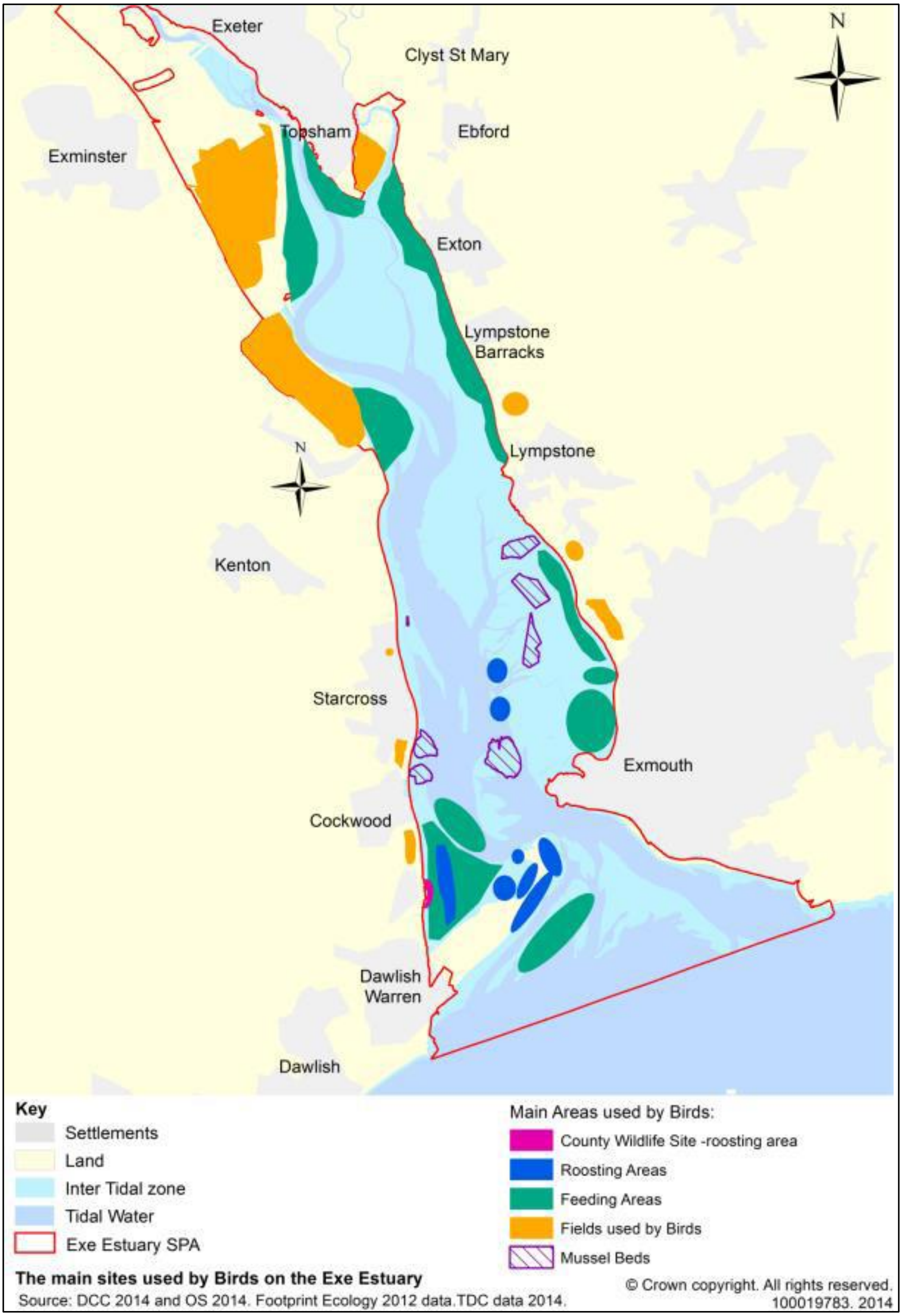


Figure 4 Main sites used by birds on the Exe Estuary (EEMP, 2014)

Annex 6: Summary of Results of the D&S IFCA Intertidal Handwork Survey

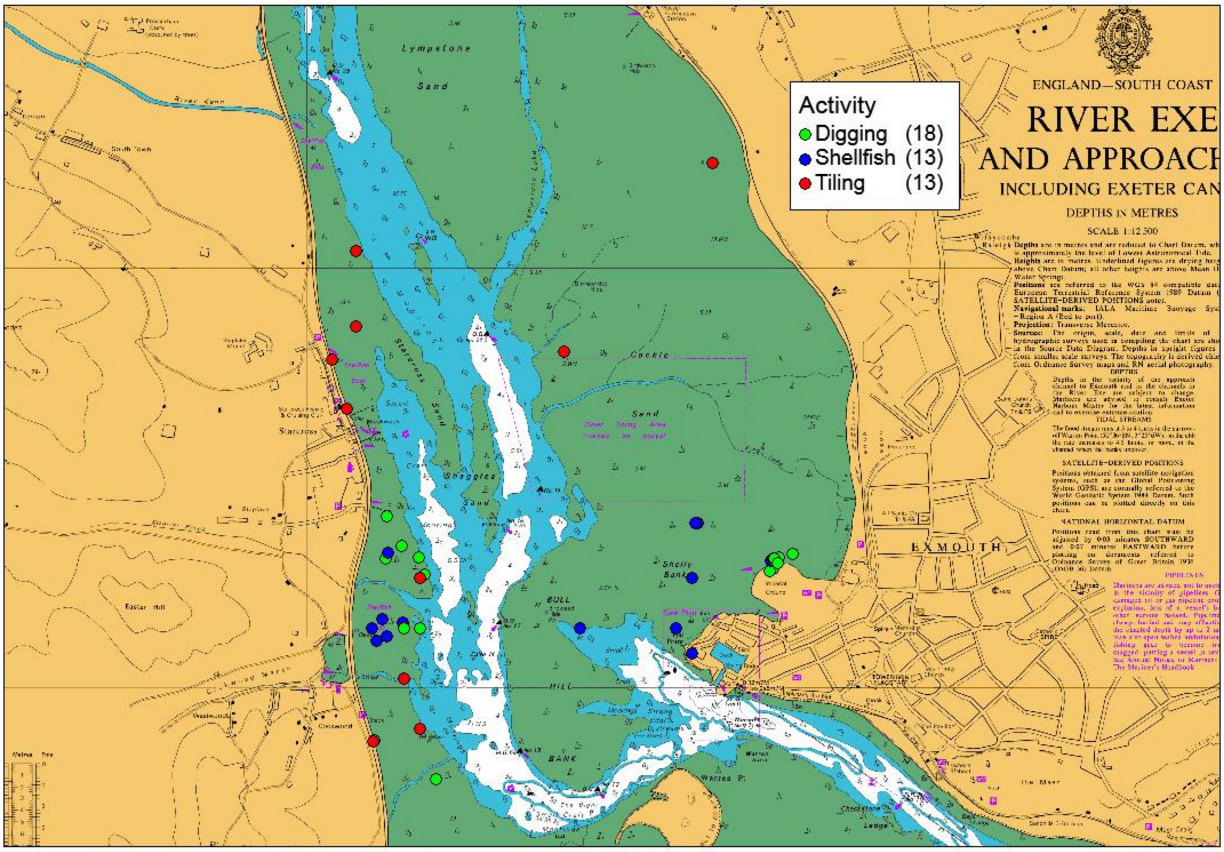


Figure 5 Total people observed (recreational & commercial) working in the intertidal area, shown by activity; bait digging, shellfish collection, and crab tiling.

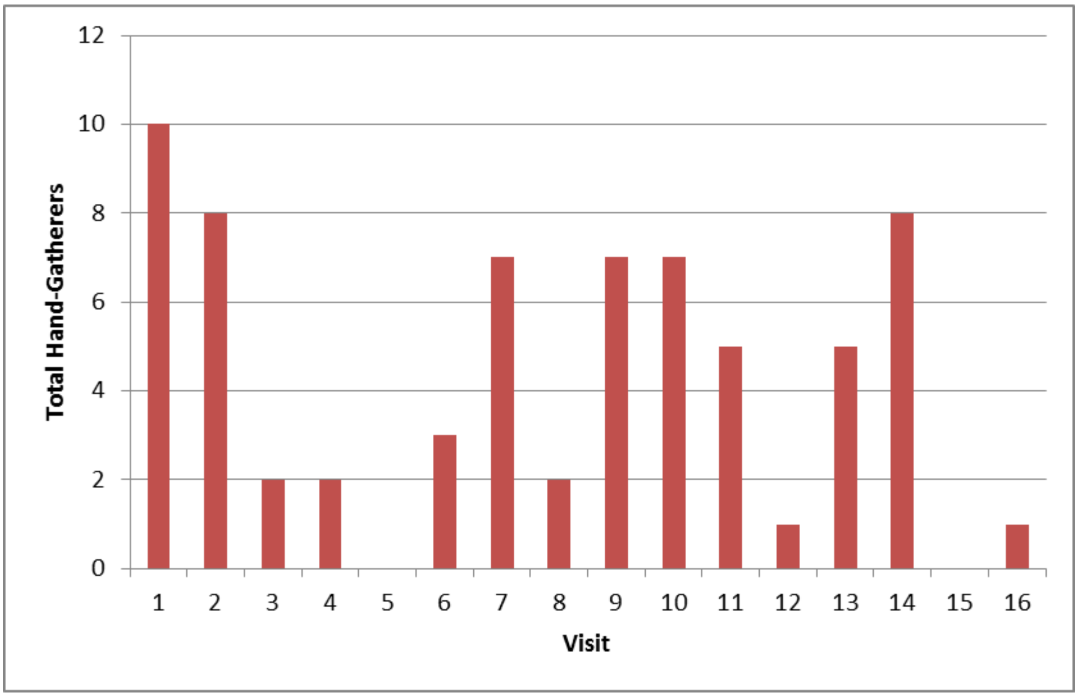
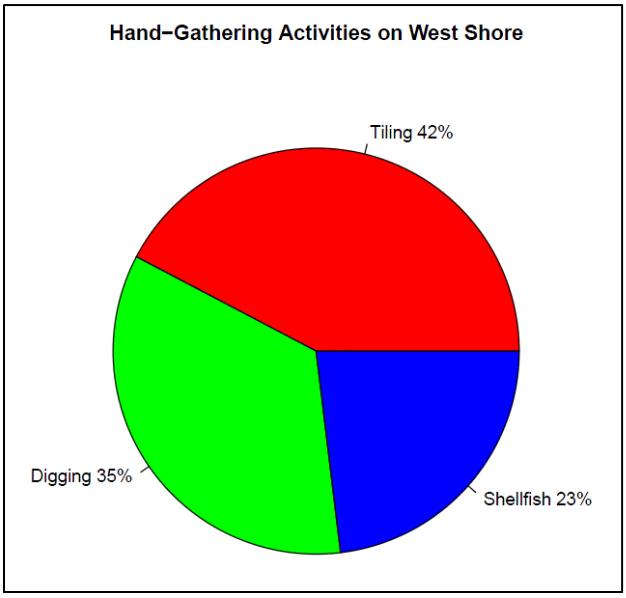
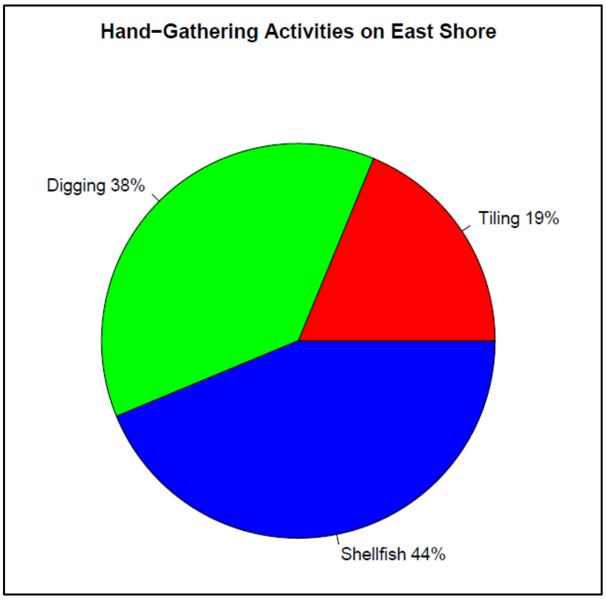


Figure 6 Total people observed (recreational & commercial) during each visit.



a)



b)

Figure 7 Proportions of each activity on the West Shore (a) and East Shore (b)

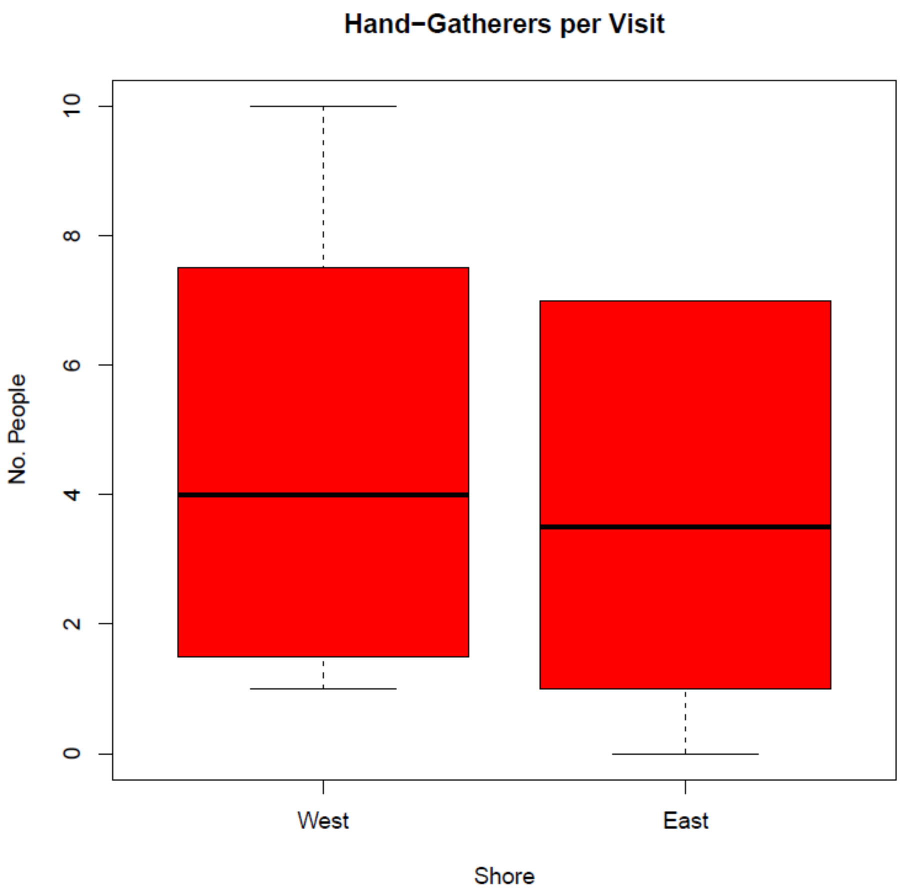


Figure 8 Numbers of people working on each shore per visit

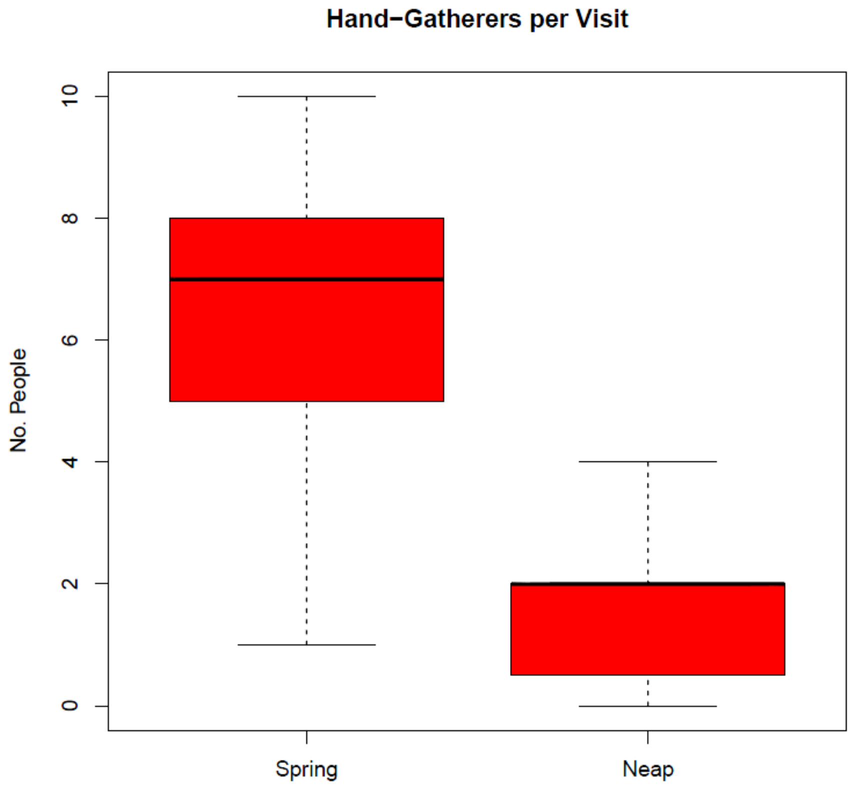


Figure 9 Numbers of people working during spring and neap tide visits

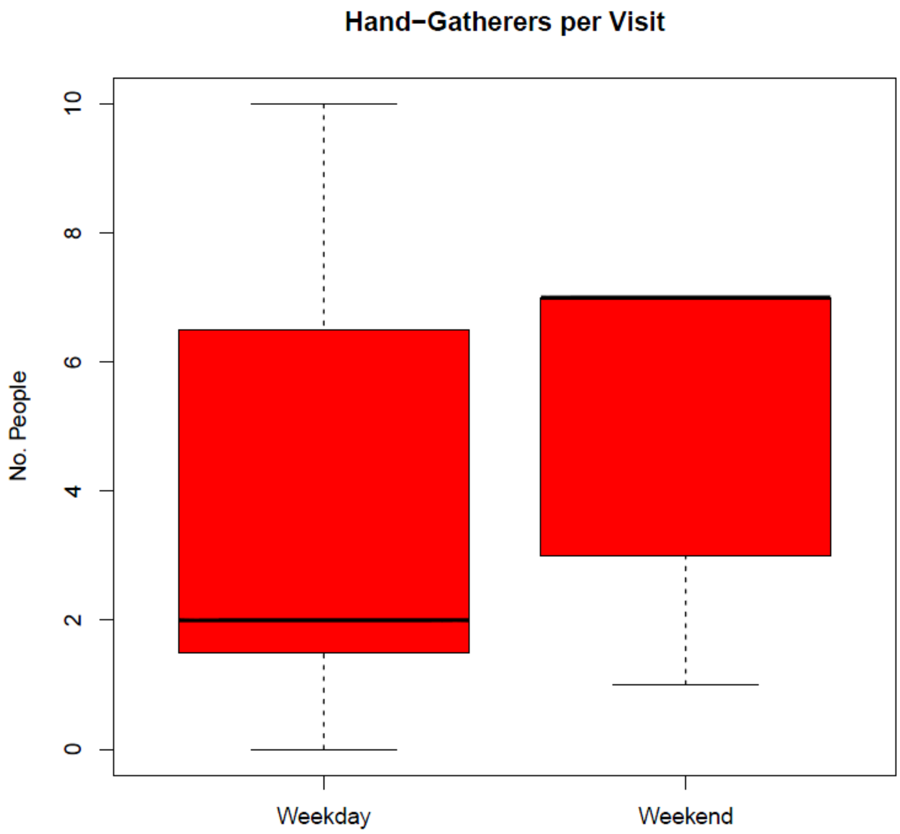


Figure 10 Numbers of people working during weekday and weekend visits

Annex 7: Pressures Audit Trail

Sensitivities based on Conservation Advice (Natural England, 2015)

Shore-based activities	Feature/Sub-feature & Screen Justification				
	Bird Feature	Intertidal Coarse Sediment	Intertidal Mixed Sediments	Intertidal Mud	Intertidal Sand & Muddy Sand
Above water noise	**Sensitivity: S** **IN** - Need to consider spatial scale/intensity of activity to determine likely magnitude of pressure				
Abrasion/disturbance of the substrate on the surface of the seabed		**Sensitivity: NS**	**Sensitivity: S** **IN** - Need to consider spatial scale/intensity of activity to determine likely magnitude of pressure.	**Sensitivity: S** **IN** - Need to consider spatial scale/intensity of activity to determine likely magnitude of pressure.	**Sensitivity: S** **IN** - Need to consider spatial scale/intensity of activity to determine likely magnitude of pressure.
Collision BELOW water with static or moving objects not naturally found in the marine environment	**Sensitivity: S** **OUT** - This interaction was only sensitive for Slavonian grebe with shore-based activities, so is considered extremely low risk.				
Deoxygenation		**Sensitivity: NS**	**Sensitivity: NS**	**Sensitivity: NS**	**Sensitivity: NS**
Genetic modification & translocation of indigenous species					**Sensitivity: IE** **OUT** - Insufficient activity levels within proximity to this habitat to pose risk.

Hydrocarbon & PAH contamination. Includes those priority substances listed in Annex II of Directive 2008/105/EC.	**Sensitivity: IE** **OUT** - Insufficient activity levels to pose risk of large scale pollution event	**Sensitivity: NS**	**Sensitivity: NS**	**Sensitivity: NS**	**Sensitivity: NS**
Introduction of light	**Sensitivity: S** **OUT** - Insufficient activity levels within proximity to this habitat to pose risk.				
Litter	**Sensitivity: IE (S for Slavonian grebe)** **OUT** – Low risk of litter from bait digging activities.	**Sensitivity: IE** **OUT** – Low risk of litter from bait digging activities.	**Sensitivity: IE** **OUT** – Low risk of litter from bait digging activities.	**Sensitivity: IE** **OUT** – Low risk of litter from bait digging activities.	**Sensitivity: IE** **OUT** – Low risk of litter from bait digging activities.
Penetration/disturbance of the substrate below the surface of the seabed, including abrasion		**Sensitivity: NS**	**Sensitivity: S** **IN** - Need to consider spatial scale/intensity of activity to determine likely magnitude of pressure.	**Sensitivity: S** **IN** - Need to consider spatial scale/intensity of activity to determine likely magnitude of pressure.	**Sensitivity: S** **IN** - Need to consider spatial scale/intensity of activity to determine likely magnitude of pressure.
Physical changes (to another seabed type)		**Sensitivity: S** **IN** - Need to consider spatial scale/intensity of activity to determine likely magnitude of pressure.	**Sensitivity: S** **IN** - Need to consider spatial scale/intensity of activity to determine likely magnitude of pressure.	**Sensitivity: S** **IN** - Need to consider spatial scale/intensity of activity to determine likely magnitude of pressure.	**Sensitivity: S** **IN** - Need to consider spatial scale/intensity of activity to determine likely magnitude of pressure.
Removal of non-target species	**Sensitivity: S** **IN** – Mortality of prey from trampling.				**Sensitivity: S** **IN** – Mortality of prey from trampling.
Removal of target species			**Sensitivity: S** **IN** - Removal of target species associated with fishing activity.	**Sensitivity: S** **IN** - Removal of target species associated with fishing activity.	**Sensitivity: S** **IN** - Removal of target species associated with fishing activity.
Visual disturbance	**Sensitivity: S** **IN** - Need to consider spatial scale/intensity of				

	activity to determine likely magnitude of pressure				