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

European Marine Site: Plymouth Sound & Estuaries SAC

Fishing activities assessed: Bait collection

Gear/feature interactions assessed:

D&S IFCA Interaction ID	Fishing Activity	Sub-feature(s)
HRA_UK0013111_K40	Digging with forks	Intertidal mud
HRA_UK0013111_L40		Intertidal sand & muddy sand
HRA_UK0013111_P40		Intertidal mixed sediment
HRA_UK0013111_AR40		Intertidal coarse sediment

Version	Date	Comment	Author
1	06/03/19	Final draft complete to be sent to NE.	Katherine Stephenson
1.1	03/04/2019	QA'ing draft to send to NE	Sarah Clark

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. If measures are required, the revised approach requires these to be implemented by 2016.

The purpose of this site specific assessment document is to assess whether or not in the view of Devon & Severn Inshore Fisheries and Conservation Authority (D&S IFCA) the fishing activities digging with forks have a likely significant effect on the 'intertidal mud', 'intertidal sand & muddy sand', 'intertidal mixed sediments' and 'intertidal coarse sediment' of the Plymouth Sound & Estuaries EMS, and on the basis of this assessment whether or not it can be concluded that digging with forks 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[1]
- Reference list[2] (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)

[1] See Fisheries in EMS matrix: http://www.marinemanagement.org.uk/protecting/conservation/documents/ems_fisheries/populated_matrix3.xls

[2] Reference list will include literature cited in the assessment (peer, grey and site specific evidence e.g. research, data on natural disturbance/energy levels etc.)

2. Information about the EMS

The Plymouth Sound & Estuaries EMS is made up of the Plymouth Sound & Estuaries SAC and the Tamar Estuaries Complex SPA (Figure 1, Annex 3). Plymouth Sound and its associated tributaries comprise a complex site of marine inlets. The ria systems entering Plymouth Sound (St John's Lake and parts of the Tavy, Tamar and Lynher), the large bay of the Sound itself, Wembury Bay, and the ria of the River Yealm are of international marine conservation importance because of their wide variety of salinity conditions and sedimentary and reef habitats. The high diversity of habitats and conditions gives rise to communities both representative of ria systems, and some very unusual features, including abundant southern Mediterranean-Atlantic species rarely found in Britain (English Nature, 2000). This site crosses the border between Devon & Severn IFCA and Cornwall IFCA.

2.1 Overview and qualifying features

Plymouth Sound and Estuaries qualifies as a SAC for the following Annex I habitats as listed in the EU Habitats Directive (Natural England, 2015a):

- Large shallow inlets and bays, the key sub-features are:
    - Intertidal rock
    - Circalittoral rock
    - Infralittoral rock
    - Subtidal mud
    - Subtidal sand
    - Subtidal seagrass beds
- Estuaries, the key sub-features are:
    - Circalittoral rock
    - Infralittoral rock
    - Intertidal mixed sediment
    - Intertidal mud
    - Intertidal rock
    - Intertidal seagrass beds
    - Lower-mid saltmarsh
    - Mid-upper saltmarsh
    - Pioneer saltmarsh
    - Subtidal mixed sediments
    - Subtidal mud
    - Subtidal sand
    - Subtidal seagrass beds
    - Transition & driftline saltmarsh
    - Upper saltmarsh
- Sandbanks which are slightly covered by seawater all the time, the key sub-features are:
    - Subtidal coarse sediment
    - Subtidal mixed sediment
    - Subtidal mud
    - Subtidal sand
    - Subtidal seagrass beds
- Atlantic salt meadows
- Mudflats & sandflats not covered by seawater at low tide, the key sub-features are:
    - Intertidal coarse sediment
    - Intertidal mixed sediments
    - Intertidal mud
    - Intertidal sand & muddy sand
    - Intertidal seagrass beds

- Reefs
    - Circalittoral rock
    - Infralittoral rock
    - Intertidal rock

Plymouth Sound and Estuaries qualifies as a SAC for the following Annex II species as listed in the EU Habitats Directive (Natural England, 2015a):

- Allis shad (*Alosa alosa*)
- Shore dock (Rumex rupestris)

The Tamar Estuaries Complex qualifies as a SPA under the Birds Directive for (Natural England, 2015b):

- Nationally important populations of regularly occurring Annex 1 species, Avocets (*Recurvirostra avosetta*) and Little egrets (*Egretta garzetta*), the key supporting habitats are:
    - Annual vegetation of driftlines
    - Coastal reedbeds
    - Freshwater & coastal grazing marsh
    - Intertidal mixed sediments
    - Intertidal mud
    - Intertidal sand & muddy sand
    - Intertidal seagrass beds
    - Water column
    - Saltmarsh

2.2 Conservation Objectives

The site's conservation objectives which apply to the **Special Area of Conservation** and the natural habitat and/or species for which the site has been designated 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 Favourable Conservation Status of its qualifying features, by maintaining or restoring:

- the extent and distribution of qualifying natural habitats and habitats of the qualifying species
- the structure and function (including typical species) of qualifying natural habitats
- the structure and function of the habitats of qualifying species
- the supporting processes on which qualifying natural habitats and the habitats of qualifying species rely
- the populations of qualifying species
- the distribution of qualifying species within the site

The site's conservation objectives which apply to the **Special Protection Area** and the individual species and/or assemblage of species for which the site has been classified 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) (if applicable)

- Subtidal rock and reef communities were categorised as “red” risk against all demersal towed gear and towed dredges. In January 2014 D&S IFCA introduced the Mobile Fishing Permit Byelaw, which prohibits the use of towed gear within this EMS (Map Annex 5).
- Seagrass bed communities were categorised as “red” risk against towed demersal gear, dredges, intertidal handwork, crab tiling, and digging with forks. At that time, only subtidal seagrass beds were considered as a sub-feature of the site which would not be exposed to intertidal handwork, crab tiling or digging with forks. In January 2014 D&S IFCA introduced the Mobile Fishing Permit Byelaw, which prohibits the use of towed gear within this EMS (Map Annex 5).

4. Information about the fishing activities within the site

A full description of D&S IFCA’s current understanding of the levels and distribution within the Plymouth Sound & Estuaries EMS can be found in Stephenson (2019). Bait digging occurs on the intertidal sand and mudflats of the estuaries, it is not known to occur within Plymouth Sound. Within D&S IFCA’s District, Ernesettle on the Tamar is a key area for bait digging within the EMS, as well as off Embankment Road on the Plym (just outside the EMS). Bait digging occurs all year round, peaking in the spring.

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

5. Test for Likely Significant Effect (LSE)

5.1 Table 1: Assessment of LSE

1. Is the activity/activities directly connected with or necessary to the management of the site for nature conservation?	No	
2. What pressures (such as abrasion, disturbance) are potentially exerted by the gear type(s)	• Abrasion/disturbance of the substrate on the surface of the seabed • Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion • Removal of target species • Removal of non-target species See Annex 5 for pressures audit trail	
3. Is the feature potentially exposed to the pressure(s)?	**Yes,** there are currently no management measures prohibiting the use of digging with forks in Plymouth Sound and Estuaries EMS.	
4. What are the potential effects/impacts of the pressure(s) on the feature, taking into account the exposure level?	The intertidal sediment sub-features have the following targets (Natural England, 2015a): • Maintain the total extent and distribution • Maintain the total organic carbon (TOC) content in the sediment at existing levels • Maintain the presence and spatial distribution of sub-feature communities • Maintain (or restore for mixed sediments) the species composition of component communities Given that the features/sub-features could be exposed to the pressures listed in Section 2 of this table, there is potential that these targets will not be met.	
5. Is the potential scale or magnitude of any effect likely to be significant?	Alone	**Unsure,** an interaction is present between bait digging and the intertidal sub-features of Plymouth Sound and Estuaries SAC. Therefore an appropriate assessment has been carried out.
	In-combination	See section 8 for more information
6. Have NE been consulted on this LSE test? If yes, what was NE's advice?	**No,** not at this stage	

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/Sub feature(s)	Target Attributes/ Conservation Objectives (Natural England, 2015a)	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
Estuaries; Mudflats and sandflats not covered by seawater at low tide: • Intertidal coarse sediment • Intertidal mixed sediments • Intertidal sand and muddy sand • Intertidal mud	Target Attribute: Maintain the total extent and spatial distribution Conservation Objective: Maintain or restore the extent and distribution of qualifying natural habitats and habitats of the qualifying species.	• Abrasion/ disturbance of the substrate on the surface of the seabed • Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion	Bait digging would not have an effect on the total extent and spatial distribution of the sub-features assessed.	Bait digging occurs on the intertidal sand and mudflats of the estuaries, it is not known to occur within Plymouth Sound. Within D&S IFCA's District, Ernesettle on the Tamar is a key area for bait digging within the EMS. Bait digging occurs at low tide (mostly spring tides) all year round. Stephenson (2019) found that bait digging levels at Ernesettle are relatively consistent throughout spring to autumn but drop off in the winter. The areas surveyed at Ernesettle covered approximately 15.13ha (Figure 2, Annex 4). The mean number of bait diggers seen per visit was 0.17, which equates	No mitigation measures necessary.

				to an average of 0.01 diggers per hectare.	
Estuaries; Mudflats and sandflats not covered by seawater at low tide: • Intertidal coarse sediment • Intertidal mixed sediments • Intertidal sand and muddy sand • Intertidal mud	Target Attribute: Maintain the total organic carbon (TOC) content in the sediment at existing levels Conservation Objective: Maintain or Restore the structure and function (including typical species) of qualifying natural habitats.	• Abrasion/ disturbance of the substrate on the surface of the seabed • Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion	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. 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	See above.	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. Any management measures brought in by the IFCA may include a requirement to backfill holes/trenches**.**

			clay (Johnson, 1984). Other, less sheltered, sites have reported a timeframe of 25 days for holes to disappear (Johnson, 1984).		
Estuaries; Mudflats and sandflats not covered by seawater at low tide: • Intertidal coarse sediment • Intertidal mixed sediments • Intertidal sand and muddy sand • Intertidal mud	Target Attribute: Maintain the presence and spatial distribution of sub-feature communities Conservation Objective: Maintain or restore the extent and distribution of qualifying natural habitats and habitats of the qualifying species.	• Abrasion/ disturbance of the substrate on the surface of the seabed • Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion • Removal of target species • Removal of non-target species	See above. Both blow lugworm (*Arenicola marina*) and king ragworm (*Alitta virens*) are targeted by bait diggers throughout the D&S IFCA's District. 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's 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	See above. The low intensity of bait digging within the SAC is unlikely to be having a significant effect of the target species populations.	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.

			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 6 months following experimental removal, although natural densities at the test site in 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).		
Estuaries; Mudflats and sandflats not covered by seawater at low tide: • Intertidal coarse sediment • Intertidal mixed sediments	Target Attribute: Maintain (restore for mixed sediments) the species composition of component communities Conservation Objective: Maintain or Restore the structure and function (including typical species) of qualifying natural habitats.	• Abrasion/ disturbance of the substrate on the surface of the seabed • Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion • Removal of target species • Removal of non-target species	See above.	See above.	See above.

7. Conclusion

Bait digging occurs at a low intensity at Ernesettle, on the Tamar, within the SAC. Although bait digging can cause changes in sediment characteristics and total organic carbon, these are much reduced if the holes are backfilled.

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

8.1 Other fishing activities

The following fishing activities are either occurring or have not been able to have been ruled out as occurring in the Plymouth Sound and Estuaries EMS.

Handworking – There are no records of this activity taking place commercially but it has not been able to be ruled out. Therefore no in-combination effect thought to be possible.

Crab tiling - Activity is occurring within Plymouth Sound and Estuaries EMS. Crab tiling has already undergone a 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.

Shrimp push nets - There are no records of this activity taking place but it has not been able to be ruled out. Therefore no in-combination effect thought to be possible.

Pots/ creels – Activity thought to only occur in the subtidal and not believed to interact with features assessed. Therefore no in-combination effect thought to be possible.

Cuttlepots & fishtraps - There are no records of these activities taking place but they have not been able to be ruled out. Therefore no in-combination effect thought to be possible.

Commercial diving - Activity not believed to be occurring/ occurring at a very low level. Therefore no in-combination effect thought to be possible.

Purse seine - Activity occurs in the subtidal and not believed to interact with features assessed. There are no records of this activity taking place but it has not been able to be ruled out. Therefore no in-combination effect thought to be possible.

Beach seine/ ring nets - There are no records of beach seine nets but it has not been able to be ruled out. Ringnets occur in the subtidal and not believed to interact with features assessed. Therefore no in-combination effect thought to be possible.

Drift, gill, trammel & entangling nets - Activity thought to only occur in the subtidal and not believed to interact with features assessed. Therefore no in-combination effect thought to be possible.

Fyke and stakenets - There are no records of these activities taking place but they have not been able to be ruled out. Therefore no in-combination effect thought to be possible.

Longlines - There are no records of these activities taking place in the intertidal but they have not been able to be ruled out. Therefore no in-combination effect thought to be possible.

Handlines, Jigging and trolling - There are no records of these activities taking place in the intertidal but they have not been able to be ruled out. Therefore no in-combination effect thought to be possible.

D&S IFCA conclude there is no likelihood of significant adverse effect on the interest features from in-combination effects with other fishing activities addressed within section 8.1.

8.2 Other activities

Plymouth Sound and Estuaries EMS is a busy site, with other commercial ongoing plans/projects from different sectors where impacts could combine. However, currently there are no known proposed plans or projects in Plymouth Sound and Estuaries EMS which could theoretically interact with the intertidal sub-features addressed.

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

D&S IFCA conclude there is no likelihood of significant adverse effect on the interest features from in-combination effects with other plans or projects addressed within section 8.2.

9. Summary of consultation with Natural England

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

10. Integrity test

It can be concluded that bait digging, alone or in-combination, within the Plymouth Sound & Estuaries SAC has the potential to effect sub-features 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.

Annex 1: Reference list

Anderson, F.E. and Meyer, L.M. (1986) The interaction of tidal currents on a disturbed intertidal bottom with a resulting change in particulate matter quantity, texture and food quality. Estuarine, Coastal and Shelf Science 22: 19-29.

Beukema J.J. (1995). Long-term effects of mechanical harvesting of lugworms *Arenicola marina* on the zoobenthic community of a tidal flat in the Wadden Sea. Netherlands Journal of Sea Research. 33: 2019-227

Blake R.W. (1979) Exploitation of a natural population of *Arenicola marina* (L.) from the north east coast of England. Journal of Applied Ecology 16: 663-670.

Carvalho, S., Constantino, R., Cerqueria, M., Pereira, F., Subida, M., Drake, P. and Gaspar, M (2013). Short term impact of bait digging on intertidal microbenthic assemblages of two south Iberian Atlantic systems. Estuarine, Coastal and Shelf Science. 132 pp65-75.

Cryer, M., Whittle, G.N. & Williams, R. (1987) The impact of bait collection by anglers on marine intertidal invertebrates. Biological Conservation. 42: 83-93.

English Nature (2000) PLYMOUTH SOUND AND ESTUARIES: European Marine Site. English Nature's advice given under Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994

Evans, S., Moon, J., Bunker, A.R. and Green. M. 2015. Impacts of Bait Digging on the Gann: An Evidence Review. NRW Evidence Report No: 81 34pp, NRW, Bangor.

Fowler, S.L. (1999). Guidelines for managing the collection of bait and other shoreline animals within UK European marine sites. UK Marine SAC project.

Gray, K. (2015) Fishing Activities Currently Occurring in the Plymouth Sound and Estuaries European Marine Site (SAC and SPA), Devon and Severn IFCA Report

Heiligenberg, T. van den. (1987). Effects of mechanical and manual harvesting of lugworms Arenicola marina L. on the benthic fauna of tidal flats in the Dutch Wadden Sea. Biological Conservation. 39: 165-177.

Jackson, J. and James, R. (1979). The influence of bait digging on cockle, *Cerastoderma edule,* populations in North Norfolk. Journal of Applied Ecology. 16: 671-679.

Johnson, G. (1984) Bait collection in a proposed marine nature reserve, MSc Report, Ecology and Conservation Unit, University College London in http://www.ukmarinesac.org.uk/activities/bait-collection/, accessed February 2019.

MAGIC (2015) Multi-Agency Geographic Information for the Countryside interactive map http://magic.defra.gov.uk/magicmap.aspx?startTopic=magicall&chosenLayers=sacIndex&sggridref=SX472506&startscale=500000

Natural England (2015a) Marine conservation advice for Special Area of Conservation: Plymouth Sound and Estuaries (UK0013111)

Natural England (2015b) Marine conservation advice for Special Protection Area: Tamar Estuaries Complex (UK9010141)

Olive P.J.W. (1993) Management of the exploitation of the lugworm Arenicola marina and the ragworm Nereis virens (Polychaeta) in conservation areas. Aquatic Conservation: Marine and Freshwater Ecosystems 3: 1-24

Stephenson, K. (2019) Devon & Severn IFCA Report: Bait Digging in the Plymouth Sound & Estuaries European Marine Site and Tamar Estuary Sites Marine Conservation Zone. Data Analysis Report.

Watson G.J., Murray J.M., Schaefer M., Bonner A. and M. Gillingham (2017) Assessing the impacts of bait collection on inter-tidal sediment and the associated macrofaunal and bird communities: The importance of spatial scales, Marine Environmental Research 130: 122-133

Annex 2: Natural England’s consultation advice

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

Annex 3: Site Map

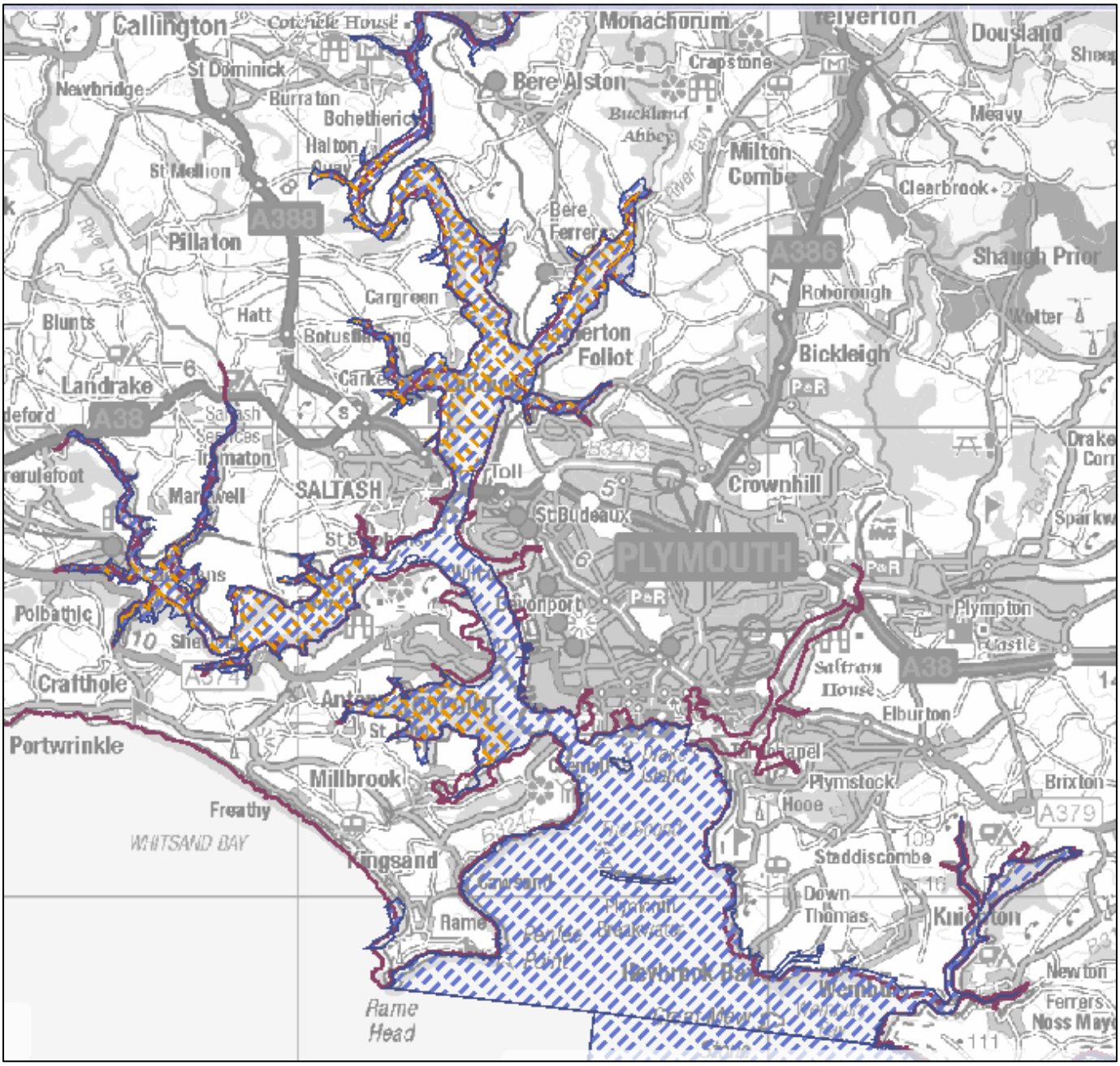

Figure 1 Area of SAC (blue hatched) and SPA (Orange hatched) (MAGIC, 2015)

Annex 4: Fishing activity maps

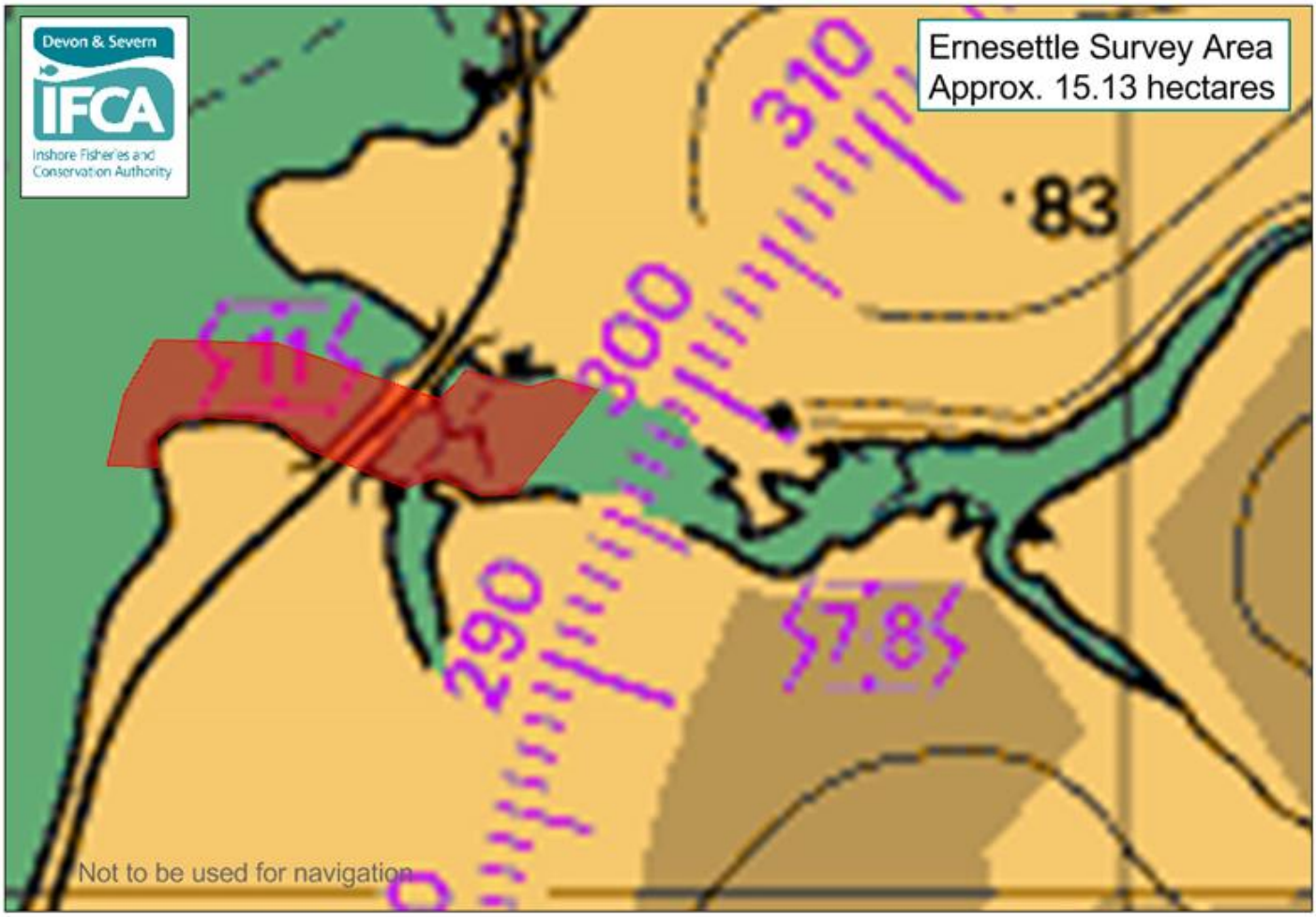

Figure 2 Area where bait digging is known to occur (Stephenson, 2019)

Annex 5: Pressure Audit Trail

Fishing Activity Pressures: Shore-based activities	Intertidal coarse sediment	Intertidal mixed sediments	Intertidal mud	Intertidal sand and muddy sand	Screening Justification
Abrasion/disturbance of the substrate on the surface of the seabed	NS	S	S	S	**IN** – Need to consider spatial scale/intensity of activity to determine likely magnitude of pressure
Deoxygenation	NS	NS	NS	NS	**OUT** – Insufficient activity levels to pose risk at level of concern
Genetic modification & translocation of indigenous species				IE	**OUT** - the fleet operates in local area only so risk considered extremely low
Hydrocarbon & PAH contamination. Includes those priority substances listed in Annex II of Directive 2008/105/EC.	NS	NS	NS	NS	**OUT** - Insufficient activity levels to pose risk of large scale pollution event
Introduction or spread of non-indigenous species	IE	S	IE	S	**OUT** - the fleet operates in local area only so risk considered extremely low
Litter	IE	IE	IE	IE	**OUT** – Insufficient activity levels to pose risk at level of concern
Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion	NS	S	S	S	**IN** – Need to consider spatial scale/intensity of activity to determine likely magnitude of pressure
Physical change (to another seabed type)	S	S	S	S	**OUT** – Bait digging not thought to change habitat type. No extraction of sediment carried out.
Removal of non-target species				S	**IN** – Need to consider spatial scale/intensity of activity to determine likely magnitude of pressure
Removal of target species		S	S	S	**IN** – Need to consider spatial

					scale/intensity of activity to determine likely magnitude of pressure