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

European Marine Site: Plymouth Sound & Estuaries

Fishing activities assessed: Miscellaneous

Gear/feature interactions assessed:

D&S IFCA Interaction ID	Fishing Activity	Sub-feature(s)
HRA_UK0013111_K39	Crab tiling	Intertidal mud
HRA_UK0013111_L39		Intertidal sand & muddy sand
HRA_UK0013111_P39		Intertidal mixed sediment
HRA_UK0013111_AR39		Intertidal coarse sediment

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 crab tiling 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 crab tiling 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 (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. 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

Devon and Severn IFCA undertakes crab tile surveys every four years to determine the current number of crab tiles and to see if there have been any changes. A baseline survey of crab tiles in the EMS was undertaken in 2000/2001 and then further surveys were carried out in 2003/2004, 2012 and 2016. These surveys have identified the activity is occurring at a high level within certain areas of the EMS. The overall number of crab tiles increased by 86% in 2012 but has since decreased by 28% in 2016, see Table 1 for more information. Annex 4, Figures 2, 3 and 4 show the location of crab tiles which are namely in the Tamar and the mouth of the Tavy. The material used for the majority of crab tiles consisted of plastic piping, corrugated iron and roof tiles and most had seaweed and barnacle coverage on the tiles. Most of the crab tiles were deemed to be within recent use, with the exception of some (approximately 170) that were almost buried.

Table 1 - Crab tile distribution, counts and comparison in D&S IFCA District only; from Noble (2013) and Black (2004)

Location	Estuary Area	2016 Tiles	2012 Tiles	2003/04 Tiles	2000/01 Tiles	Difference (2003/04 to 2012)	Difference (2012 to 2016)
Tavy	TAM07	0	0	0	20	0	0
Tavy	TAM08	184	181	360	284	-179	+3
Tavy	TAM09	726	816	980	442	-164	-90
Tamerton Lake	TAM10	1,129	938	470	490	+468	+191
Tamerton Lake	TAM11	0	0	0	112	0	0
Tamar	TAM12	701	1,581	344	1,068	+1,237	-880
Tamar	TAM13	425	810	281	475	+529	-385
Tamar	TAM14	78	191	211	227	-20	-113
Tamar	TAM15	327	412	0	294	+412	-85
	TOTALS:	**3,570**	**4,929**	**2,646**	**3,412**	**+2,283**	**-1,359**
					Percentage change:	**86%↑**	**28%↓**

Through the IFCA's Byelaw Review process, D&S IFCA will be reviewing all byelaws relating to hand-gathering. There is the intention to create a permitting byelaw that covers hand-gathering (including crab tiling activity), which would allow the IFCA to monitor levels of this activity in the future, and adapt permit conditions to changes in effort/ environmental conditions if necessary.

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 2: 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 • Physical change (to another seabed type) • 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**, currently there are no management measures controlling crab tiling in the 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?	There are 3,570 crab tiles within the EMS, namely on the Tamar, Tamerton Lake and Tavy. Crab tiling has the potential to impact the intertidal features assessed.	
5. Is the potential scale or magnitude of any effect likely to be significant?	**Alone**	**Unsure,** an interaction is present between crab tiling 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

Table 3: 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 • Physical change (to another seabed type)	Crab tiling would not have an effect on the extent and distribution of the sub-features assessed.	No exposure	No mitigation measures necessary
Estuaries; Mudflats and sandflats not covered by seawater at low tide: • Intertidal coarse	**Target Attribute:** Maintain the total organic carbon (TOC) content in the sediment at existing levels	• Abrasion/ disturbance of the substrate on the surface of the seabed • Penetration and/or disturbance of the	Sheehan et al. (2010b) looked at the effects of crab tiling on three estuaries (Yealm, Erme and Avon) which had previously been unexposed to crab tiles. The study manipulated sites for a month with controls, tiled only, trampled only, crab tiled to determine the impact. Trampling and crab tiling was conducted three times a week. They found the organic content of the	There are 3,570 crab tiles in the EMS however TOC is not thought to be affected by crab tiling.	No mitigation measures necessary

sediment • Intertidal mixed sediments • Intertidal sand and muddy sand • Intertidal mud	**Conservation Objective:** Maintain or Restore the structure and function (including typical species) of qualifying natural habitats.	substrate below the surface of the seabed, including abrasion	sediment was unaffected by crab tiling. Johnson et al. (2007) examined the effects of trampling from crab tiling activity on nematodes in mudflats in the Yealm Estuary. Plots were trampled six times over a two week period and no significant difference was seen in TOC.		
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 • Physical change (to another seabed type) • Removal of target species • Removal of non-target species	Sheehan et al. (2010b) looked at the effects of crab tiling on three estuaries (Yealm, Erme and Avon) which had previously been unexposed to crab tiles. The study manipulated sites for a month with controls, tiled only, trampled only and crab tiled to determine the impact on macro-infaunal diversity. Trampling and crab tiling was conducted three times a week. Samples were taken after the final day of disturbance. They found the organic content of the sediment and sediment particle size was unaffected by crab tiling. Crab tiling made sediments more penetrable and infaunal assemblages differed most in the muddiest estuaries (Yealm and Erme). Non-trampled sites (controlled and tiled only) had similar measure of sediment stability and similar abundance to each other, whereas, the sediments in trampling only were least stable and had the lowest infaunal abundance. Crab tiled and trampled sites which were more stable than trampling only sites also had a greater abundance. Sheehan et al. (2010b) suggested that trampling was the mechanism that contributed most to the decrease in infaunal abundance rather than the presence of the tiles. In the Yealm, non-trampled plots	Crab tile surveys undertaken in 2016 identified 3,570 crab tiles within the EMS. The overall number of crab tiles from 2003/04 increased by 86% in 2012 but has since decreased by 28% in 2016, see Table 1 for more information. Annex 4, Figures 2, 3 and 4 show the location of crab tiles which are namely in the Tamar and the mouth of the Tavy. Crab tiles are worked at low tide (mostly spring tides) during the day, all year round. Usually a patch of tiles is solely worked by one individual who owns those tiles. Crab tile owners usually work their tiles part time, as a hobby or as and when they need bait for	Devon and Severn IFCA monitor the number of crab tiles every four years. The next survey is due in 2020. Through the IFCA's Byelaw Review process, D&S IFCA will be reviewing all byelaws relating to hand-gathering. There is the intention to create a permitting byelaw that covers hand-gathering (including crab tiling activity), which would allow the IFCA to monitor levels of this activity in the future, and adapt permit conditions to changes in effort/ environmental

			had greater abundances of oligochaetes, polychaetes and species of sabellid worm, gastropod, bivalve and shrimp (Sheehan et al. 2010b). Johnson et al. (2007) examined the effects of trampling from crab tiling activity on nematodes in mudflats in the Yealm Estuary. Plots were trampled six times over a two week period which significantly reduced nematode abundance. This might have been caused by meiofauna burrowing deeper into the sediment. However, 12-36 hours after activity ceased, species numbers had returned to control levels. Johnson et al. (2007) attributed the fast recovery to the dynamic nature of intertidal mudflats, which frequently experience natural disturbance. Additionally, abiotic factors (grain size, total organic content and penetrability) indicated that crab tiling made no significant changes to habitat structure. Crab tiles can be mistaken for rocks as they provide a structural habitat and allow organisms such as seaweeds and barnacles to attach in a typically homogenous environment. Additionally, at low tide, pools of water are often retained around the crab tiles. Sheehan et al. (2010a) used fixed underwater video cameras in tiled and non-tiled sites on Yealm estuary to determine crab distribution during high tide. They found crabs were significantly more abundant in tiled sites. Sheehan et al. (2008) assessed the effects of crab tiling on the population of the green crab *Carcinus maenas* in tiled (Plym, Teign and Exe) and non-tiled (Yealm, Fowey and Salcombe) estuaries. Crabs were caught by	recreational angling. Crab tilers only collect crabs which are over 40mm carapace width, not berried females and in the stage of pre-ecdysis (moulting stage) (Sheehan et al. 2008). Moulting crabs represent 10% of the crabs found under crab tiles (Sheehan et al. 2008). Trampling extent would be from the shore to the area of tiles, from tile to tile and then back to the shore line. These footprints are visible in the sediment until the tide homogenises the sediment again. Tiles are spread approximately 1m apart (Sheehan et al. 2010b). The potential area of sediment impacted from crab tiling within the EMS is approximately 2.5 hectares. An area worked is only impacted by trampling for a small time frame and recovery can be within 36 hours (Johnson et al. 2007). Intertidal mudflat communities are exposed naturally to repeat disturbances from tidal forces and currents (Johnson et al. 2007).	conditions if necessary.

			baited drop nets, sexed and measured. Tiled estuaries had significantly 63% more crabs than non-tiled estuaries. Crab populations were found to have different size structure such that tiled estuaries had a smaller proportion of large crabs and a smaller modal size call of 20-29mm compared to 30-39mm in non-tiled estuaries. The greater abundance of crabs in tiled estuaries could have adverse effects for associated estuarine fauna. Sheehan et al. (2010a) noted that oysters *Ostrea edulis* and mussels *Mytilus edulis* are an important part of adult *C. maenus* diet and therefore changes in crab population could potentially have an effect on the abundance of their prey species.		
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 • Physical change (to another seabed type) • Removal of target species • Removal of non-target species	See above	See above	See above

7. Conclusion[2]

Crab tiling occurs at a high level on the mudflats within the EMS, with 3,570 crab tiles on the Tamar, Tamerton Lake and the mouth of the Tavy. The literature cited in the appropriate assessment has indicated that crab tiles do not change the habitat structure of mudflats, with there being no change in total organic carbon and sediment grain size. Trampling causing penetrability of the sediment varied with Johnson et al. (2007) finding no difference and Sheehan et al. (2010b) found trampled plots where less stable and more penetrable. However, crab tiles do increase habitat complexity by allowing species such as seaweeds and barnacles to colonise a previously homogenous environment.

Trampling from crab tiling was found to lower infaunal abundance of nematodes, oligochaetes, polychaetes and species of sabellid worm, gastropod, bivalve and shrimp (Sheehan et al. 2010b; Johnson et al. 2007). Johnson et al. (2007) found that up to 36 hours after the activity ceased, species abundance returned to control levels. Recovery of intertidal mudflat communities is thought to be rapid as they are naturally exposed to repeat disturbances from tidal forces and currents (Johnson et al. 2007).

Areas of crab tiles are worked part time by their owners at spring low tides. Crab tile numbers are monitored every four years with the next survey due in 2020. Through the IFCA's Byelaw Review process, D&S IFCA will be reviewing all byelaws relating to hand-working. The IFCA will consider whether to create a permitting byelaw that covers hand-working (including crab tiling activity), which would allow the IFCA to monitor levels of this activity in the future,and adapt permit conditions to changes in effort/ environmental conditions if necessary. At the current number of crab tiles, the effect of removal of crabs and trampling to the sediment is not thought to significantly affect the presence, distribution and communities of Plymouth Sound and Estuaries EMS.

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. However, no in-combination effect thought to be possible.

Digging with forks - Activity is occurring within Plymouth Sound and Estuaries EMS. Digging with forks has not yet been assessed by D&S IFCA, therefore the in-combination assessments will be carried out at a later date.

Shrimp push nets - There are no records of this activity taking place but it has not been able to be ruled out. However, 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. However, 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.

[2] If conclusion of adverse effect alone an in-combination assessment is not required.

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. However, 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. However, 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. However, 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. However,e no in-combination effect thought to be possible.

D&S IFCA concludes 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 concludes 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 crab tiling, alone or in-combination, within Plymouth Sound and Estuaries EMS does not adversely affect intertidal sediments assessed and that the conservation objects can be met. Management measures are not currently in place, however, Devon and Severn IFCA aim to implement a permitting byelaw that will cover hand-gathering (including crab tiling activity).

Annex 1: Reference list

Black, G (2004) Report on surveys in 2003/04 of crab tiling activities on Devon's estuaries, and comparison with 2000/01 crab tile survey data. Devon Biodiversity Records Centre, Shirehampton House, 35-37 St David's Hill, Exeter, EX4 4DA

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

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

Johnson, G.E.L., Attrill, M.J., Sheehan, E.V. and Somerfield, P.J., (2007) Recovery of meiofauna communities following mudflat disturbance by trampling associated with crab-tiling. Marine Environmental Research, 64: 409-416.

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)

Noble (2013) Devon & Severn IFCA report: Tamar Estuaries Complex Crab Tile Survey 2012

Sheehan, E.V., Thompson, R.C., Coleman, R.A., and Attrill, M.J. (2008) Positive feedback fishery: Population consequences of 'crab-tiling' on the green crab *Carcinus maenas*. Journal of Sea Research, 60: 303-309

Sheehan, E.V., Coleman, R.A., Attrill, M.J., and Thompson, R.C. (2010a) A quantitative assessment of the response of mobile estuarine fauna to crab-tiles during tidal immersion using remote underwater video cameras. Journal of Experimental Marine Biology and Ecology, 387: 68-74

Sheehan, E.V., Coleman, R.A., Thompson, R.C., and Attrill, M.J. (2010b) Crab tiling reduces the diversity of estuarine infauna. Marine Ecology Progress Series, 411: 137 -148

Annex 2: Natural England’s consultation advice

N/A

Annex 3: Site Map

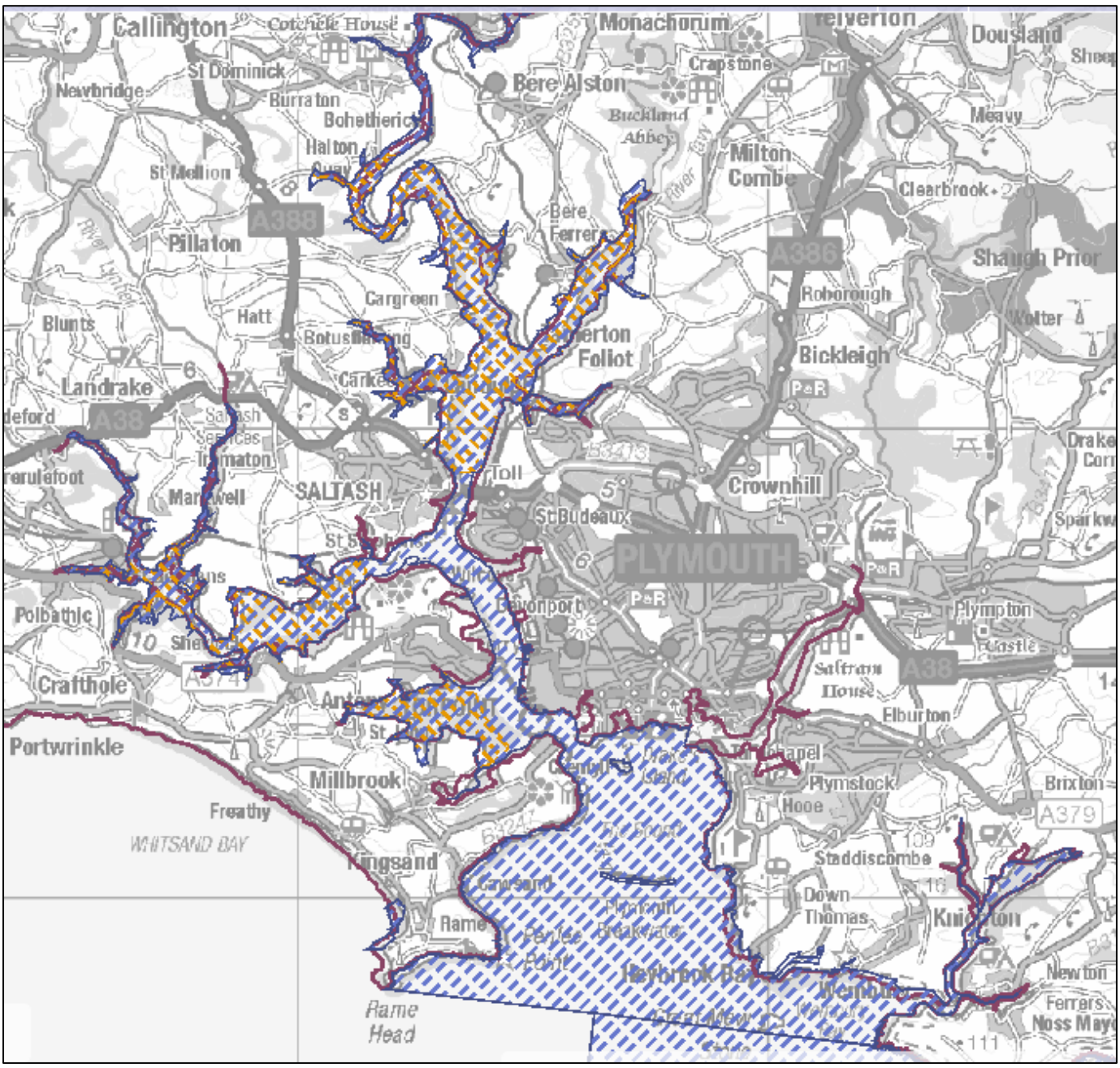

Figure 1 - Area of SAC (blue hatched) and SPA (Orange hatched) (MAGIC, 2015)

Annex 4: Fishing activity maps

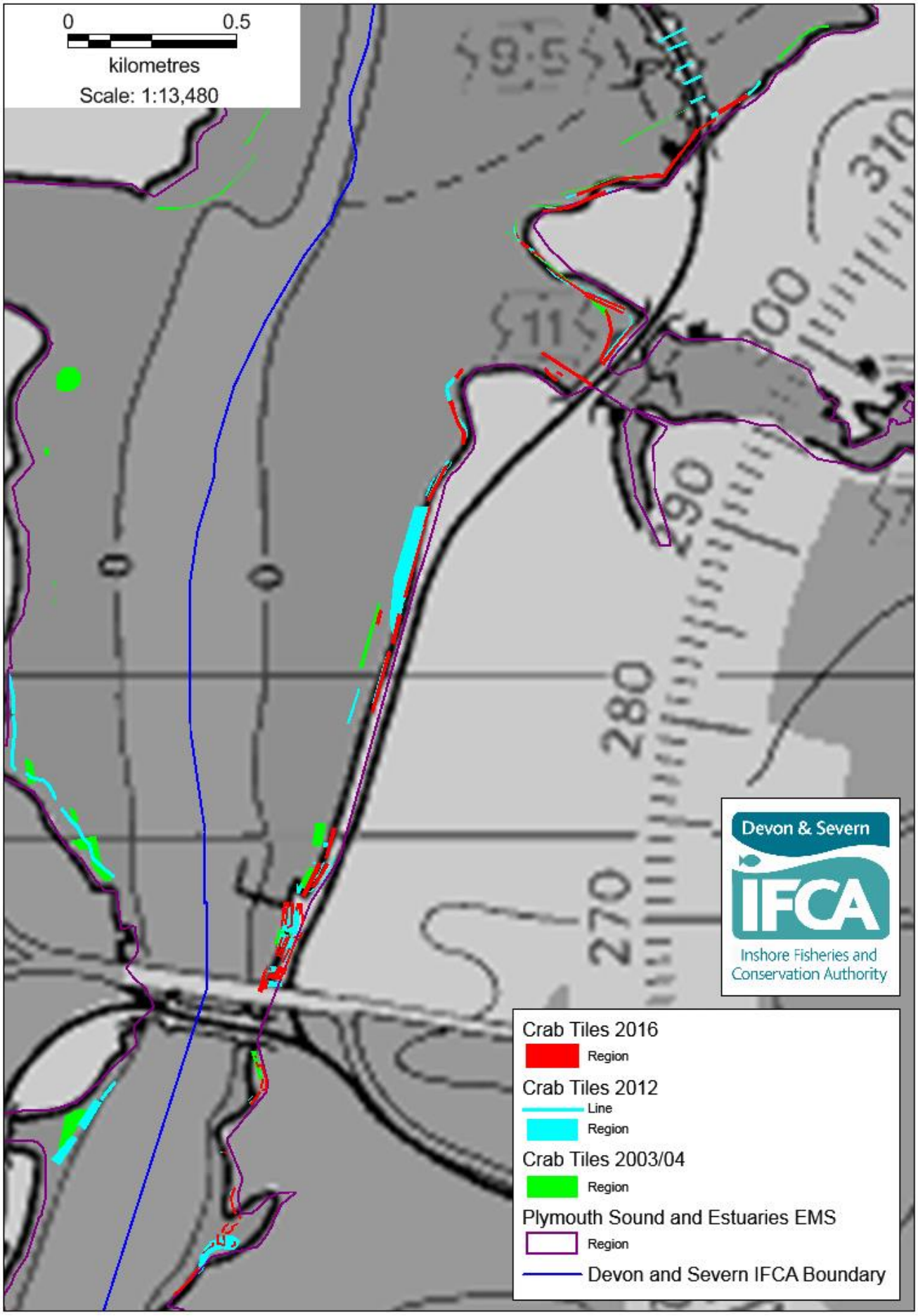

Figure 2 - Crab tile locations on the Tamar (data from Noble (2013) and Black (2004)).

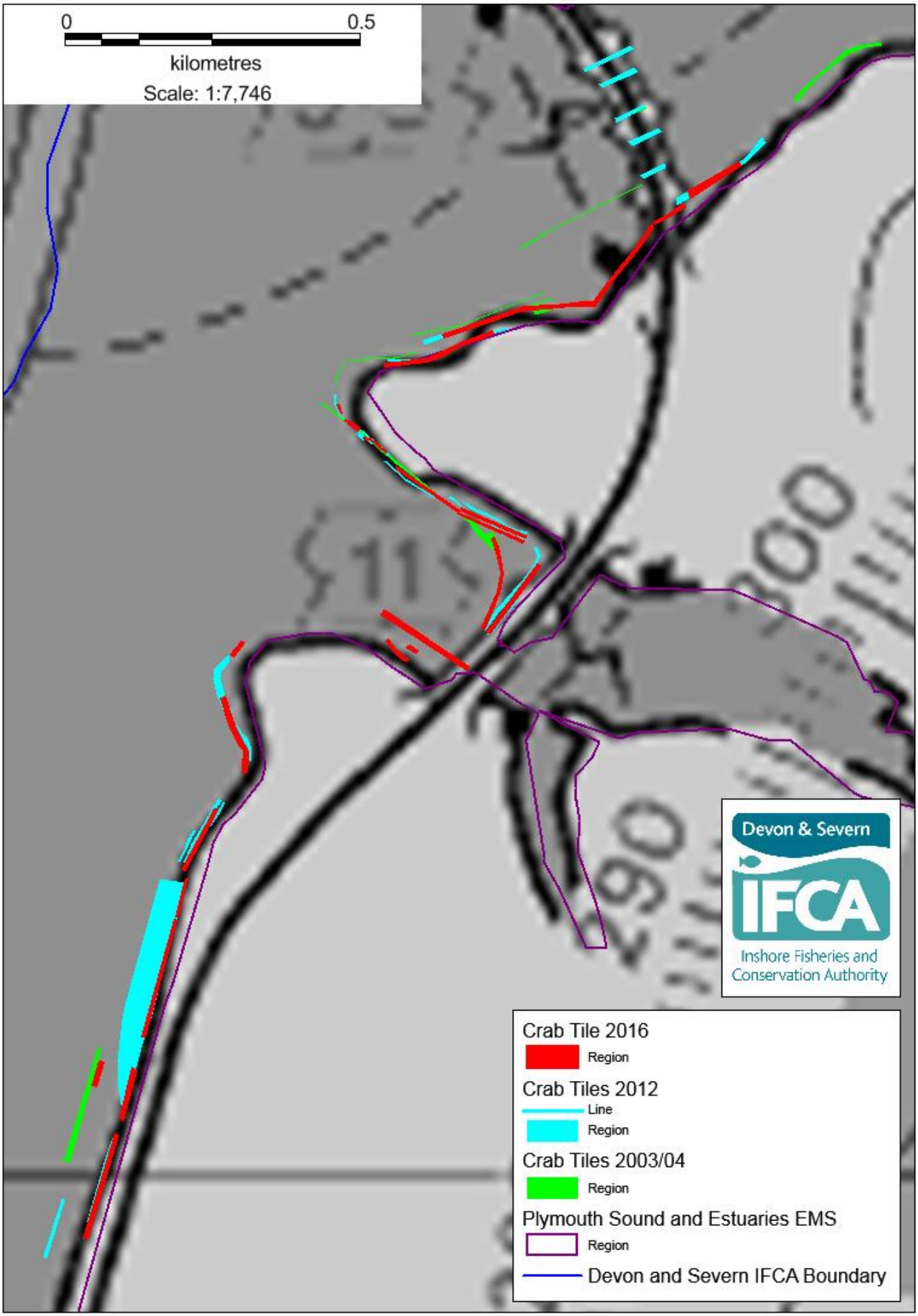

Figure 3 - Crab tile locations on the Tamar

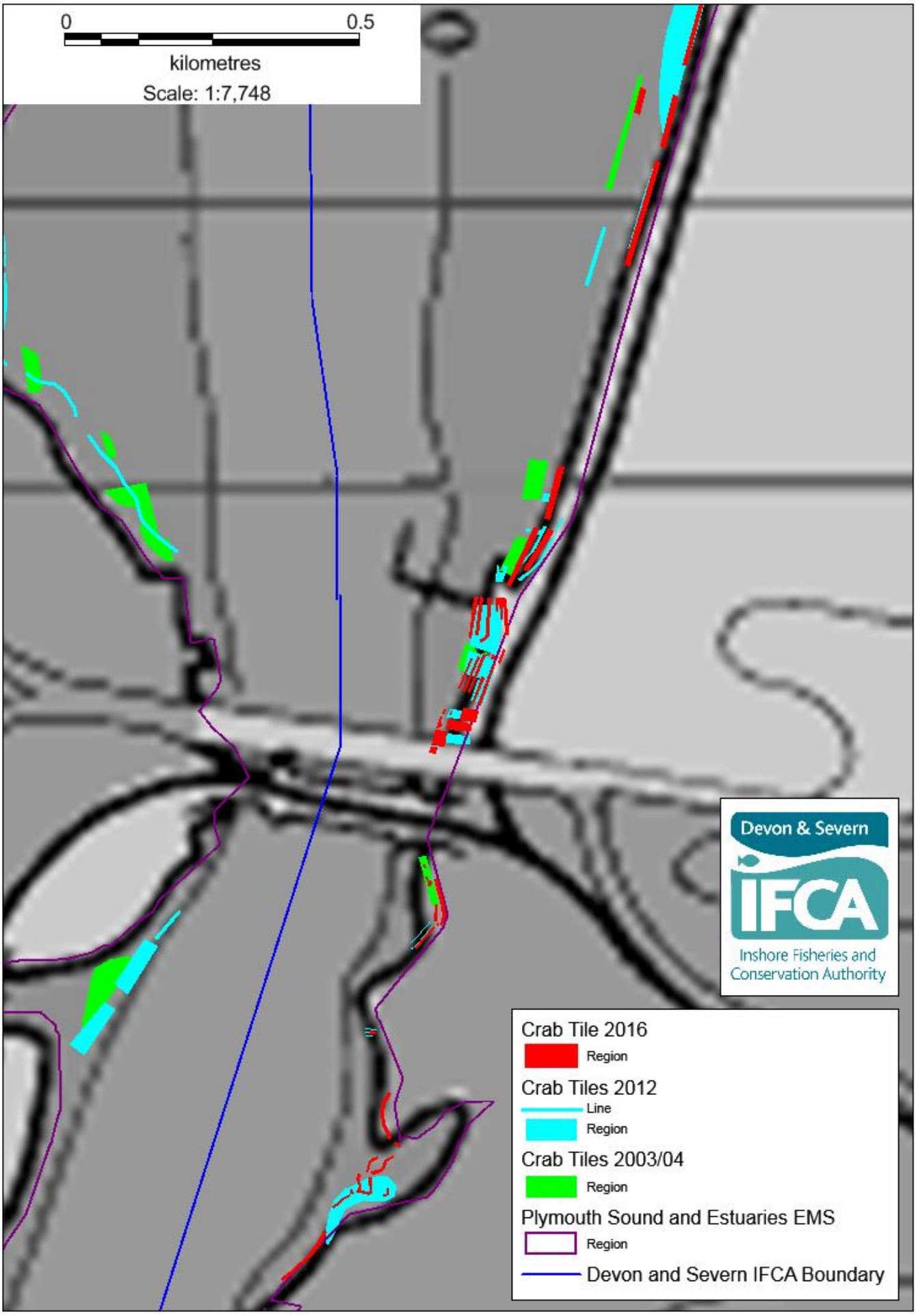

Figure 4 - Crab tile locations on the Tamar

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**	**IN** – Need to consider spatial scale/intensity of activity to determine likely magnitude of pressure
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