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Our ref: 144302
Your ref: Eastern IFCA shrimp HRA



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BY EMAIL ONLY

Dear Judith,

Habitats Regulation Assessment: Commercial beam trawling for brown shrimp (*Crangon* spp.) and pink shrimp (*Pandalus montagui*) in The Wash and North Norfolk Coast Special Area of Conservation (SAC)

Natural England (NE) is a non-departmental public body. Our statutory purpose is to ensure that the natural environment is conserved, enhanced, and managed for the benefit of present and future generations, thereby contributing to sustainable development.

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 \(EMS\)](#)¹. 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 document states that for 'amber' risk activities a site level assessment will be required to assess whether management of an activity is required to conserve site features. The Department's strong preference is that site level assessments be carried out in a manner that is consistent with the provisions of Article 6(3) of the Habitats Directive. Appropriate management measures should be put in place to ensure that the fishing activity or activities either 1) have no likely significant effect on a site in view of its conservation objectives or b) following assessment, can be concluded to have no adverse effect on the integrity of the site.

NE has considered the Habitats Regulation Assessment (HRA) documents prepared by the Eastern IFCA for the purposes of making an assessment consistent with the provisions of Article 6(3). Please accept this letter as NE's formal advice on those assessments including the conclusions reached in those assessments.

Advice overview

We would like to acknowledge the significant amount of work that Eastern IFCA have put into this version, and preceding versions of the shrimp beam trawling HRA for The Wash and North Norfolk Coast SAC. NE received the majority of sections of the HRA on 27th February 2018, principles of mitigation on 10th May 2018, responses to our clarifying questions related to the mitigation proposals on 24th May 2018, the mitigation section of the HRA on 22nd June 2018, in-combination chapter on 25th June, and the draft proposed closures on 26th June 2018.

(1) ¹ Defra revised approach:

<https://www.gov.uk/government/publications/revised-approach-to-the-management-of-commercial-fisheries-in-european-marine-sites-overarching-policy-and-delivery>

The HRA is a significant and complex document which includes an introduction, site specific information related to the SAC including Conservation Objectives, site specific shrimp fishing activity information, appropriate assessment of low, medium and high risk pressures and conclusions. The conclusion of the assessment before any mitigation is considered, is that an adverse effect on site integrity on The Wash and North Norfolk Coast SAC from the shrimp beam trawl fishery cannot be ruled out. NE agree that without mitigation, an adverse effect on site integrity cannot be ruled out.

Eastern IFCA have used all the evidence of which we are aware to inform their assessment. We would like to confirm that we do not think any further analysis is required. Feedback provided here is to highlight that NE consider that adverse effect cannot be ruled out on the basis of limitations in some of the evidence available, as well as evidence on the sensitivity of the site features to trawling pressures and likely activity levels. In some instances NE agree with Eastern IFCA's final conclusions although our rationale for reaching these conclusions may be different. Further detail on our specific comments on sections of the HRA are documented in Appendix 1.

Natural England's Advice on interactions

In addition to our advice overview, and comments on specific sections of the HRA, we have also provided our advice on the interactions with each of the subfeatures;

- **Scoped out interactions**

Table 6 in the HRA document outlines the interactions of the shrimp beam trawl with various features and subfeatures which were scoped out during the screening process and not taken to full assessment. For the features listed in Table 1 (see Appendix 2) as 'NE agree', we are content that these interactions with shrimp beam trawls can be screened out, and do not need to be considered further. For those features where NE do not agree, we have provided our rationale for disagreement.

- **Low risk pressure interactions**

Appendix 5 of the HRA considers the low risk pressure interactions of the shrimp beam trawl with various features and subfeatures. The conclusion for each of these interactions with NE's advice and rationale are included in Table 2 (Appendix 2).

- **Medium/ high risk pressures**

Appendix 6 of the HRA considers the medium/high risk pressure interactions of the shrimp beam trawl with various features and subfeatures. The conclusion for each of these interactions are included in Table 3 (Appendix 2), with NE's advice and rationale.

Mitigation principles and proposed mitigation measures

NE agree with the general mitigation principles presented within Section 6 of the HRA.

Based on the evidence available (and recognising its limitations) we agree that the proposed mitigation measures of spatial restrictions on the use of towed demersal fishing gear, technical restrictions on the type of fishing gear and overall effort limitation in the shrimp beam trawl fishery adequately reduce the risk to the site features of impacts from the shrimp trawling fishery and enable a conclusion of no adverse effect on site integrity.

In particular, subtidal mixed sediments and subtidal mud are subfeatures we consider to be at most risk and spatial closures targeting the areas known to be most sensitive across the central Wash are appropriate.

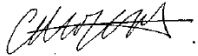
Conclusions for some of the subfeatures are drawn in part from an understanding of low levels of trawling activity in certain locations (for example intertidal sand and muddy sand and intertidal mud). It is important to ensure that effort is maintained at current low levels in these locations for confidence in the current

conclusions of the HRA to remain. It is also important to consider the potential effects of displacement as a result of the proposed spatial restrictions.

NE's final advice on each of the interactions, taking into account the proposed mitigation measures can be found in Table 4 in Appendix 2. With the proposed mitigation measures in place, we agree with the conclusion of the appropriate assessment that the beam trawling shrimp fishery would not have an adverse effect on the integrity of The Wash and North Norfolk Coast SAC alone or in combination with other plans and projects. .

Please do not hesitate to contact us if you have any questions or require further information.

Yours sincerely,



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Appendix 1. NE's key comments on specific sections of the HRA

As discussed at our meeting on 16th April 2018, we have some comments related to specific sections of the HRA. We have also provided some brief comments on one section received after this meeting. These comments are summarised below;

a) 'Penetration and/ or disturbance of the substratum below the surface of the seabed' pressure

The HRA currently only lists abrasion as a trawling pressure and does not explicitly include penetration. NE's Advice on Operations for the pressure 'Penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion' (referred to as 'penetration' hereafter) for demersal trawling notes that the pressure results where the gear makes contact with the seafloor (NE Advice on Operations 2018). The pressure benchmark for penetration for subtidal mixed sediment and subtidal mud is listed as 'Damage to surface features (e.g. species and physical structures within the habitat)'. This pressure description identifies that this pressure relates to damage of the sea bed surface layers typically up to a 50cm depth. This means any damage below the surface from 0-50cm is classified as penetration. This advice applies to all demersal trawling.

From our meeting on 16th April 2018, we understand that Eastern IFCA considered abrasion to 2-3 cm and welcome the suggestion by Eastern IFCA to update the assessment to clarify how penetration pressure has been taken into account.

The HRA references a study by Catchpole and others (2008) which looks at shrimp bycatch within The Wash, and cites that the study resulted in no infaunal species being present within any of the shrimp trawls to support the conclusion that penetration need not be considered further within this assessment. It is worth noting that this paper lists the most common species caught in tows, rather than all species caught, so we would recommend the full bycatch species list is obtained, if at all possible, to verify that no infaunal species were caught, even in lower numbers. Steenbergen and others (2015) investigated bycatch from the brown shrimp fishery in Germany and the Netherlands, and found infaunal species were present within trawls. German shrimp trawling vessels in particular are of similar size and gear configuration to The Wash vessels. As such it would be useful to review these papers to contribute to the understanding of risk to infauna through shrimp trawling activity.

b) Use of condition within the HRA

We note that the HRA uses inferred condition based on species richness, species diversity and presence of sensitive species over time to determine whether there is evidence of the shrimp trawling fishery having an impact on The Wash and North Norfolk Coast SAC. Whilst there are cases in which it may be appropriate to use condition as one aspect of an assessment (e.g. where there is a high level of certainty in the site condition and a good understanding of activity level and location over time), we feel the context in which condition is used in this assessment is not a valid approach. In addition, the assessment relies on point data with low spatial and temporal resolution.

The onus of an appropriate assessment is to demonstrate that a plan or project does not have an adverse effect on site integrity. The shrimp beam trawling appropriate assessment infers 'no evidence of an impact', rather than evidence actively supporting a determination of no impact.

The data used to infer site condition trends is of low spatial and temporal resolution. It is not possible to determine any cause/effect link between the shrimp fishery and effects on site features based on the data provided. This level of data is unlikely to be of sufficient power to determine long term trends and effects. Adverse effect should be determined by looking at the pressures from the activity; the sensitivity of the subfeatures to those pressures; the location of the activity in relation to the features; and the duration of the activity/repeated exposure.

c) Species diversity (number of taxa) and Abundance ratio (species richness)

These sections present the mean number of taxa across years and across a depth range for intertidal and subtidal sediment features. The low spatial and temporal resolution of the data alongside limited information of ongoing fishing activity levels in relation to the data collected result in significant limitations in the conclusions drawn on trends in species richness and possible long term effects of fishing activity. More specifically:

- Number of taxa is usually related to species richness- diversity is a combination of species richness and evenness.
- There are very weak trends for all subfeature and depth combinations with very large error bars. Therefore any conclusions drawn are of very low confidence.
- Samples were not collected with knowledge of level of fishing activity at each location. Therefore, it is difficult to link patterns in species richness with the ongoing fishing activity.
- The data presented do not relate to spatial distribution of communities or address the species composition of component communities as stated in the conclusions (relating to conservation objectives) as full community analysis has not been undertaken.

d) Species sensitivity

NE suggested use of sensitivity data to support mitigation rather than to inform potential effects of shrimp trawling in the appropriate assessment. We note that Eastern IFCA have agreed to revise the text within the appropriate assessment referring to NE's advice on the use of sensitive species within the assessment.

The data used is not robust enough to confidently identify trends in species abundance over time. While the appropriate assessment does note the limitations in data use, our advice is that those limitations are such that there is enough uncertainty to conclude that an adverse effect on site integrity cannot be ruled out.

The trends in species abundance are not necessarily linked to fishing activity level and distribution. Any trends identified may be related to environmental variables/anthropogenic effects and it is not possible to determine cause and effect from the data provided. In addition, many species move in space and time which will not be picked up in data collected at this resolution.

e) Natural disturbance, water depth and fishing intensity

We are in agreement that the shallower areas of the SAC are likely to be subject to appreciable wave energy, and that the communities present are tolerant to these levels of natural disturbance. Epifaunal communities are less likely to be present in highly disturbed areas. However, if epifauna is present, it is likely to be sensitive to abrasion from beam trawling regardless of natural disturbance level.

While we agree that van Denderen and others (2015) makes the conclusion that 'Given these similar impacts, there was no detectable trawling effect on communities exposed to high natural disturbance', it is also important to note the authors also recognised that 'for those areas where there were no detectable effects of trawling, we cannot be certain whether the areas had not recovered from historic trawl disturbance or whether the effects of trawl disturbance were relatively low in relation to natural disturbance.'

It is also worth considering how the trawling intensities considered as Low (≤ 0.2 per year i.e. trawled once every 5 years), Medium (> 0.2 to ≤ 0.5 per year i.e. trawled once every 2.5 years- 5 years) and High (> 0.5 per year) disturbance treatment compare to those within The Wash. The shrimp returns data shows that the majority of areas within the SAC are subjected to at least one tow per year, up to a maximum of 250 tows per year.

There are also a number of limitations within the van Denderen and others (2015) study that should be considered when determining confidence in the conclusions around the comparison of effects of fishing to natural disturbance. For example, there is a significant range in sample numbers collected at each site (minimum 14- maximum 230), and that trawl disturbance for two of the areas were estimated from aerial survey data- we are unsure how reliable this would be.

The Cooper & Barry (2017) paper compiled fifty years of grab sample data. However, it is not possible to identify the specific year each data point was collected, so each data point could have been collected at any time over the last 50 years. Therefore, there is very limited confidence in making any judgements on how the level of diversity has been driven by other factors rather than the degree of fishing pressure.

f) Use of Infaunal Quality Index (IQI)

NE maintains its advice on IQI, as presented to Eastern IFCA in July 2017, and further summarised via emails (17th January 2018, and 30th January 2018), and in person (November 2017). Our advice is based on Environment Agency guidance on use of IQI classifications for Condition Assessment (Green and Burlinson, 2016), and the results of case studies where IQI was tested against a range of fishing impacts by the Environment Agency. These case studies showed a mixed response to abrasion pressure, and IQI did not show a consistent response to fishing abrasion/ penetration across all sediment subfeatures. We therefore do not consider IQI to respond consistently to fishing pressure and so do not consider it an appropriate tool to identify benthic impacts from shrimp trawling within The Wash and North Norfolk Coast SAC.

In addition to our advice that IQI is not an appropriate tool to use in this context, there are also a number of limitations in the data used in this section of the HRA. The number of samples collected each year were hugely variable (minimum 5- maximum 60), and so changes in IQI between years may be a result of number of samples collected rather than accurately reflecting the representative IQI values. Error bars, confidence score, average mean, number of samples and geographic spread would all generally need to be considered together in reaching conclusions on IQI variation within a site.

g) Appendix 12: Consideration of sensitivities of biotopes within features to the abrasion pressures and removal of non-target species pressure

This Appendix outlines the component communities and biotopes you would expect to find within the SAC, and their sensitivity to the abrasion and removal of non-target species pressures. We found this to be a particularly useful section in determining the likely impact of shrimp beam trawl pressure on the subfeatures of the SAC. With limited direct evidence on the impact of this fishery on this specific site, this assessment of sensitivity of biotopes to the pressure exerted (considering magnitude, duration and reversibility of impact) is the most appropriate way to assess the impact of an activity.

h) Chapter 6- mitigation

The mitigation chapter was particularly useful in demonstrating how the outcomes of previous sections relate to the mitigation measures proposed. The mitigation scoring system and mitigation action related to the mitigation score is a very useful way in making the link between shrimp fishery impact and the proposed mitigation measures.

Appendix 1 References

Catchpole, T. L. and others. 2008. Evaluating the efficacy of technical measures: a case study of selection device legislation in the UK *Crangon crangon* (brown shrimp) fishery. *ICES Journal of Marine Science*, 65: 267–275.

Cooper, K.M., and Barry, J. 2017. A big data approach to macrofaunal baseline assessment, monitoring and sustainable exploitation of the seabed. *Scientific Reports* 7 (1), 12431. URL: <http://rdcu.be/AjfQ> [Accessed 10 July 2018].

Green, B., and Burlinson, F. 2016. WFD Infaunal Quality Index Classifications for Condition Assessment. Environment Agency.

NE Advice on Operations 2018. The Wash and North Norfolk Coast SAC Advice on Operations. Last updated 16th March 2018. URL: <https://designatedsites.naturalengland.org.uk/Marine/FAPMatrix.aspx?SiteCode=UK0017075&SiteName=wash+and+north+norfolk+coast&SiteNameDisplay=The+Wash+and+North+Norfolk+Coast+SAC&countyCode=&responsiblePerson=&SeaArea=&IFCAArea> [Accessed 10 April 2018].

Steenbergen, J. and others. 2015. Discards Sampling of the Dutch and German Brown Shrimp Fisheries in 2009 – 2012. Stichting DLO Centre for Fisheries Research (CVO). *Cvo REPORT* 15.003- 40

Van Denderen and others. 2015. Similar effects of bottom trawling and natural disturbance on composition and function of benthic communities across habitats. *Marine Ecology Progress Series*. Vol. 541: 31–43, 2015

Appendix 2. NE's Advice on interactions

Table 1: Features and subfeatures scoped out and NE's advice

Features/ subfeatures	Justification	NE's advice
Coastal lagoons	Blue (Non-Occurring interactions- EMS matrix)	NE agree
Intertidal seagrass beds	Red (High-risk interactions- EMS matrix)- Appropriate management already in place	NE note the monitoring undertaken by the Environment Agency, highlighting damage to the seagrass bed at Wells. The cause of the damage is currently undetermined and as such a review of the risk to the seagrass beds on the North Norfolk coast should be undertaken. We suggest working across the relevant organisations through The Wash and North Norfolk Marine Partnership to determine an appropriate route to remove the risk to the seagrass beds.
Circalittoral rock		NE recommend that circalittoral rock in The Wash and North Norfolk Coast SAC is considered for management.
Subtidal stony reef		NE agree
Intertidal biogenic reef: <i>Sabellaria</i> spp.		NE recommend that intertidal <i>Sabellaria spinulosa</i> reef in The Wash and North Norfolk Coast SAC is considered for management.
Subtidal biogenic reef: <i>Sabellaria</i> spp.		We understand that a review of management is required for subtidal <i>Sabellaria spinulosa</i> reef closures for the interaction with bottom towed gear
Atlantic salt meadows (<i>Glauco-Puccinellietalia maritimae</i>)	NOIR (Non-Occurring Interactions Report); Natural England correspondence	NE agree
Mediterranean and thermo-Atlantic halophilous scrubs (<i>Sarcocornetea fruticosi</i>)		
<i>Salicornia</i> and other annuals colonising mud and sand		We note that sections of this feature is being protected through the proposed spatial closures
Otter (<i>Lutra lutra</i>)	Advice on operations- interaction not relevant	NE agree
Intertidal rock	Shrimp beam trawling activity highly unlikely	NE agree
Intertidal mixed sediment	Feature misclassified- should be subtidal mixed sediments	Intertidal mixed sediment is a subfeature of the 'Mudflats and Sandflats not covered by seawater at high tide' feature. It has been identified at Scolt Head (APEM, 2013) and Blakeney Point (MNCR) on the North Norfolk coast and may be found as a component of the

		Mudflats and sandflats feature across the site. Therefore, consideration should be given to the interaction between fishing activities and intertidal mixed sediments.
Intertidal biogenic reef: mussel beds	Shrimp beam trawling activity does not occur on this feature.	We understand that spatial closures are being implemented to protect intertidal mussel beds on a precautionary basis.

Table 2: Low risk pressure interactions and NE's advice

Pressure	HRA conclusion	NE advice and rationale
Above water noise	No adverse effect on site integrity from this pressure	NE agree with rationale that routine operation of the shrimping vessels is not considered to generate sufficiently loud noise to be of significant risk. Deployment and recovery of beams will generate more noise, but these are relatively low level and of limited duration. NE agree with conclusion.
Collision BELOW water with static or moving objects not naturally found in the marine environment		Collision of vessels with Harbour seals is more likely for larger and faster travelling vessels. NE agree risk of collision is low due to relatively small size of shrimp trawl vessels and low speed of travel. NE agree with conclusion.
Deoxygenation		NE agree with conclusion that there is no pathway identified by which shrimp trawling could produce significant changes in oxygen levels. NE agree with conclusion.
Hydrocarbon & polycyclic aromatic hydrocarbons (PAH) contamination		Increases in levels of hydrocarbon and PAH contamination can result from discharges of fuel and oil from vessels. Sediment disturbance by fishing activities can result in remobilisation of contaminants/substances. However, the amount of sediment suspended by the gear is relatively low. As such there is likely limited effect from this pressure. NE agree with conclusion.
Introduction of light		NE agree that low levels of light sometimes used for navigation and deck work, and fact that light is moving is not likely to impact on designated features. NE agree with conclusion.

Introduction or spread of invasive non-indigenous species (INIS)		<p>Shrimp fishing vessels do not use ballast water, and extent travelled outside the SAC is limited. When vessels do participate in the Thames estuary cockle fishery, different fishing gear is used. Limited pathway for spread of INIS.</p> <p>NE agree with conclusion.</p>
Litter		<p>Gear is always attended, and accidental loss is limited by environmental conditions.</p> <p>NE agree with conclusion.</p>
Nutrient enrichment		<p>Possible pathway for pressure is disturbance and resuspension of sediment from the towed gear. However, the amount of sediment suspended by the gear is relatively low. As such there is likely limited effect from this pressure.</p> <p>NE agree with conclusion.</p>
Organic enrichment		<p>Possible pathway from pressure is from disturbance and resuspension of organic matter, as well as disposal of discarded bycatch. The amount of sediment suspended by the gear is relatively low and tends to come from the topmost layers of the seabed.</p> <p>It is anticipated 92% of undersized shrimps riddled out from mandatory riddling requirement. Eastern IFCA assume that for each kg of landed shrimp, 0.365kg bycatch is discarded dead as worst case scenario (finfish 0.28kg, undersize shrimp-0.085kg). Eastern IFCA assume organic matter potentially introduced evenly over 10% of the SAC. NE agree that level of organic enrichment is unlikely to be significant.</p> <p>NE agree with conclusion.</p>
Physical change (to another seabed type)		<p>Shrimp beam trawling may degrade the seabed habitat and associated habitat, but at current activity level is unlikely to result in permanent change from one seabed type to another.</p> <p>NE agree with conclusion.</p>
Physical change (to another sediment type)		<p>Shrimp beam trawling may degrade the seabed habitat and associated habitat, but at current activity level is unlikely to result in permanent change from marine habitat type to another through the change in substratum.</p> <p>NE agree with conclusion.</p>
Synthetic compound contamination (incl. pesticides, antifoulants, pharmaceuticals)		<p>Management of these compounds is subject to strict international regulations. Sediment disturbance by fishing activities could result in the remobilisation of contaminants/ substances. In many cases, natural disturbance may contribute the majority of contaminated sediment resuspension. At current fishing level, NE do not consider possible impacts to be significant.</p>

		NE agree with conclusion.
Transition elements & organo-metal (e.g. TBT) contamination		Management of these compounds is subject to strict international regulations. Sediment disturbance by fishing activities could result in the remobilisation of contaminants/ substances. In many cases, natural disturbance may contribute the majority of contaminated sediment resuspension. At current fishing level, NE do not consider possible impacts to be significant.
Underwater noise changes		NE agree with conclusion. Vessel movement is an important source of underwater noise. High amplitude low and mid-frequency impulse sounds and low frequency continuous sound are of greatest concern for effects on marine organisms. Larger vessels generally generate lower frequency sound. Beam shrimp trawl vessels are relatively small and so likely of a relatively high frequency. Shrimp trawl vessels tend to emit continuous, relatively high frequency sound, so NE consider a significant effect to be unlikely.
Visual disturbance		NE agree with conclusion. Magnitude of pressure will depend on nature, scale, intensity and duration of activity, and other factors such as species present and age, weather conditions and degree of habituation to disturbance source. Vessels are likely to be within the visual range of harbour seals at some times. From the fishing intensity data, there are some areas where relatively high areas of fishing intensity overlaps with seal haulouts. However, given the haulouts are intertidal, and the majority of shrimp fishing is subtidal, there is limited direct overlap. Seals at haulouts are most sensitive to disturbance in June to September, which is generally when shrimp fishing is around its lowest intensity, since many shrimp fishers tend to exploit the cockle fishery instead at this time.
		NE agree with conclusion.

Table 3: Medium and high risk pressure interactions and NE's advice

Pressure	HRA conclusion	NE advice
Changes in suspended solids	No adverse effect on site integrity	Physical disturbance of the sediment and hydrodynamic action caused by passage of towed gear may result in changes in suspended solids (water clarity). Quantity of suspended material and spatial and temporal persistence will depend on factors related to gear, sediment, intensity of activity and background hydrographic conditions.

		<p>Pressure benchmark for this pressure on subtidal mud is a change in one Water Framework Directive (WFD) ecological status class for one year within a site. WFD ecological status for Wash Outer has been moderate for every year from 2009 to 2016. WFD ecological status for Wash Inner was moderate for the years 2009, and 2012- 2016, and bad in 2010 and 2011.</p> <p>There is potentially an issue for changes in suspended solids for subtidal mud in The Wash, but the cause of that is not understood.</p> <p>NE agree with conclusion.</p>
Penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion	No adverse effect on site integrity (surface penetration considered within assessment of abrasion)	See main advice letter. Pressure was screened out too early, and needs to be assessed.
Removal of target species	No adverse effect on site integrity	<p>The physical effects of fishing gear on the seabed communities are addressed by the 'abrasion' pressure. 'Removal of target species' pressure relates to the direct removal of the target species, and the ecological consequences. <i>Crangon crangon</i> has rapid growth, early maturity, high fecundity and a prolonged reproductive season, allowing populations to recover quickly. Annual fishing mortality of brown shrimp have been estimated to be well below natural mortality.</p> <p>NE agree with conclusion</p>
Smothering and siltation rate changes (Light)	No adverse effect on site integrity	<p>This pressure may result from physical disturbance of the sediment, along with hydrodynamic action caused by the passage of towed gear. The Wash is a highly dynamic environment, with significant suspended sediment movement, settlement and movement. Benthic species are well adapted to this natural pressure. Deposition of sediment from beam trawl gear is limited in comparison to natural disturbance.</p> <p>NE agree with conclusion</p>
Abrasion/disturbance of the substrate on the surface of the seabed	Adverse effect on site integrity cannot be ruled out	<p>Physical disturbance or abrasion at surface of substratum may impact epiflora and fauna living on the surface of the sediment.</p> <p>Bottom trawls causing surface abrasion can cover large spatial areas. The area affected is determined by the footprint of the gear and the amount of movement across the seabed. The different gear components</p>

		<p>will make variable contributions to the total physical disturbance of the seabed and its associated biota. The interaction with the seabed can lead to disturbance of the upper layers of the seabed.</p> <p>The magnitude of the immediate response to fishing disturbance, cumulative effects and recovery times varies significantly according to factors such as the type of fishing gear and fishing intensity, the habitat and sediment type, levels of natural disturbance and among different taxa. There is limited primary evidence on the impact of shrimp beam trawling on habitat features and their communities in The Wash and North Norfolk Coast SAC. Activity data show 66% of the site's grid of rectangles is trawled at least once a year, with some activity location squares trawled up to 250 times in one year.</p> <p>Biotopes present include those where there is an estimated significant mortality of key and characterising species, with a loss of 25-75% of the extent, density or abundance of the species or habitat component. Full recovery is expected within 2- 10 years, assuming this is a one off impact. Where impact occurs before full recovery, biotopes may not fully recover.</p> <p>Activity data shows with some activity location squares with these biotopes present are trawled up to 250 times in one year. Low number of records of presence of characterising species e.g. <i>Flustra foliacea</i> may indicate this species and biotope are being impacted by the activity. Exact location of trawling compared to subtidal sediments is unknown and likely to change from year to year. Anecdotal evidence suggests that shrimp trawlers often follow the path of another beam trawl. The limited detailed data on overlap of beam trawl activity with subfeature spatially and temporally means that adverse effect cannot be ruled out.</p> <p>NE agree adverse effect on site integrity cannot be ruled out.</p>
Removal of non-target species	Adverse effect on site integrity cannot be ruled out	All of the features/ subfeatures of the site are classified as sensitive to this pressure. Bycatch is associated with almost all fishing gear, including shrimp beam trawls.

		<p>Bycatch studies for the fishery in The Wash (Catchpole and others 2008) found that the species other than shrimp most commonly caught were surface dwelling animals. Comparable bycatch studies from the brown shrimp fishery in Germany and the Netherlands (Steenburgen and others 2015) resulted in some infaunal bycatch.</p> <p>NE agree adverse effect on site integrity cannot be ruled out.</p>
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Table 4: Summary of NE’s advice on Eastern IFCA’s proposed mitigation

Sub-feature	Mitigation	NE advice
Harbour seal	Gear restriction; effort limitation	<p>The pressure of removal of non-target species and Harbour seal is categorised as low resistance, low resilience and high sensitivity, with high levels of confidence. Level of direct capture of Harbour Seals within the shrimp fishing gear is assessed by Eastern IFCA to be negligible for the following reasons:</p> <ul style="list-style-type: none"> • Shrimp beam trawl gear is relatively narrow across the mouth • Height of top of the net when fishing is less than 1m • Trawling speed is low • There is no incentive for seals to enter the net <p>Limited available evidence to support these assumptions</p> <p>Vessels in The Wash are required to use a screening system such as a veil net which reduce bycatch of larger fish, including whiting and sole, which are dominant food species for the Harbour Seal.</p> <p>NE agree with the mitigation measures being proposed.</p>
A2.1 Intertidal coarse sediment	Gear restriction; effort limitation	<p>Interaction scoped out as does not occur where the fishery is present.</p> <p>NE agree with the mitigation measures being proposed.</p>
A2.2 Intertidal sand	Gear restriction; effort limitation	<p>NE agree with the biotopes that have been scoped out</p> <p>Intertidal sand and muddy sand biotopes range from low to medium resistance, medium to high resilience, and not sensitive to medium sensitivity. Bottom-towed gear may damage surface of seabed, and some characteristic species. With repeated exposure to activity, it is likely many of these biotopes will be unable to fully recover. Appendix 12</p>

Sub-feature	Mitigation	NE advice
		<p>notes that “the biotope sensitivity information presented above shows it is likely that repeated trawling activity, even at low levels occurring in intertidal sand areas, could reduce abundance and inhibit recovery of species with low resistance to abrasion”.</p> <p>Eastern IFCA note that there is generally a low level of trawling activity on the intertidal sand and muddy sand subfeature as most activity is directed towards the subtidal areas of the site and channels. Therefore risk from repeated shrimp trawling pressure is low.</p> <p>Eastern IFCA propose gear restrictions and effort limitations as mitigation. The fishing effort considered in the HRA is based on ‘levels of fishing as it has occurred in recent years’. As noted in the HRA, there is significant variation in effort between months and years, and so the cap on activity level must be at the level that will avoid adverse effect on site integrity, which may or may not be equivalent to highest levels of activity in recent years</p> <p>NE agree with the conclusion presented with the caveat that effort levels remain low on this subfeature.</p>
A2.3 Intertidal mud	Gear restriction; effort limitation	<p>Mud biotopes range from low to medium resistance, all are classified as high resilience, and all are classified as low sensitivity. Relatively little shrimp fishing activity occurs in these areas.</p> <p>NE agree that there is likely limited impact on intertidal mud due to lower activity levels, but that consideration of management could be given to some areas of intertidal mud to provide an area of zero fishing activity for comparison.</p> <p>Eastern IFCA are proposing management of the shrimp fishery in some areas of intertidal mud flat habitat (“Upper Estuary mud”). NE welcome this proposal.</p> <p>NE agree with the mitigation measures being proposed.</p>
A5.1 Subtidal coarse sediment	Gear restriction; effort limitation	<p>Biotopes show medium resistance, high resilience and low sensitivity. Two biotopes are considered not sensitive to abrasion pressure. Very limited shrimp fishing activity takes place in areas where this subfeature is found.</p> <p>NE have limited concern about potential impact to these biotopes, but agree with Eastern IFCA’s proposal to protect deep sheltered, low energy areas which may be associated with rich fauna.</p> <p>NE agree with the mitigation measures being proposed.</p>

Sub-feature	Mitigation	NE advice
A5.2 Subtidal sand	Gear restriction; effort limitation	<p>Biotopes range from low to high resistance, medium to high resilience, and low to medium sensitivity, although the subfeature is generally dominated by areas of extremely sparse fauna (APEM 2013). Fishery likely to result in repeated exposure to pressure.</p> <p>Given the generally sparse fauna and extensive nature of this subfeature, NE agree that impacts from shrimp trawling are likely minimal at current activity levels and that mitigation through gear restriction and effort limitation is appropriate.</p> <p>NE agree with the mitigation measures being proposed.</p>
A5.3 Subtidal mud	Spatial closures (part) Gear restriction; effort limitation	<p>Biotopes have low to medium resistance, medium to high resilience and low to medium sensitivity.</p> <p>Mud sediments within the SAC usually occur at shallow (intertidal) depths and deep water. Given that constituent communities may include species with long recovery times and there is potential for repeated exposure over short timescales, inclusion of subtidal mud as part of the spatial closure is important.</p> <p>NE agree with the mitigation measures being proposed.</p>
A5.4 Subtidal mixed sediment	Spatial closures (part) Gear restriction; effort limitation	<p>Biotopes have low resistance, medium resilience and medium sensitivity, which suggests that the activity is likely to have a significant effect on key and characterising species of this subfeature. Reasonably large coverage of this subfeature indicated in the Shrimp fishery returns grid cells. Activity data shows approximately 66% of this subfeature is trawled at least once a year, and as such recovery of the subfeature is unlikely.</p> <p>Low number of records of the presence of species such as <i>F. foliacea</i> and <i>H. falcata</i> likely indicate that these species and biotope are being impacted by the activity.</p> <p>NE agree with Eastern IFCA's proposal for closures in the areas that are likely to harbour some of the most sensitive communities of subtidal mixed sediment.</p> <p>NE agree with the mitigation measures being proposed</p>
A5.6 Subtidal biogenic reef	Spatial closures (update of 2014 closures)	<p>Biotopes resistance are classified as low, resilience is low to medium, sensitivity ranges from medium to high. Subtidal <i>Mytilus</i> beds are ephemeral, and there are no known permanent subtidal mussel beds in the SAC. Eastern IFCA note that although unlikely, the shrimp fishery could potentially constrain the formation of subtidal mussels beds, but then rule this out due to the infrequent occurrence of sublittoral mussels, the absence of mussels as bycatch and their ephemeral nature.</p>

Sub-feature	Mitigation	NE advice
		<p>NE notes that the ephemeral nature of the subtidal mussel beds mean that established beds made up of a range of sizes and age classes are unlikely to be present. We therefore agree with Eastern IFCA's conclusion that the shrimp beam trawl fishery is unlikely to be constraining the formation of subtidal mussel beds.</p> <p>NE agree with the mitigation measures being proposed</p>

Appendix 2 References

APEM. 2013. The Wash and North Norfolk Coast SAC: Intertidal mud and sand flats assessment. *APEM Scientific Report 412317*.

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