Environmental analysis of fishing activity and habitat type in Lyme Bay ICES rectangles 30E6 and 30E7

In Lyme Bay, ICES areas 30E6 and 30E7 there are four main sediment types: subtidal sand, subtidal coarse sediment, subtidal mixed sediment and rocky reef. This report briefly summarises the effect that different fishing gear types can have on these sediment types and looks at fishing activity in these areas.

The effect of gear type on sediment summary is compiled from information found in scientific literature as well as reports by Natural England and the MMO. This information does not specifically relate to the effect of these gear types in Lyme Bay but is based on a wide range of studies looking at the effects of different fishing gears on sediment types across a range of locations.

The fishing activity data is currently provided for vessels under 10m and over 12m. Data for vessels under 10m is determined from information entered by fishers into the Catch App during 2022. Data for over-12m vessels has been taken from VMS (Vessel Monitoring System) data.

Habitat mapping and gear effects

Data for the sediment analysis was taken from a dataset produced by the British Geological Survey in 2013. The groupings for sediment type are based on British Geological Survey (BGS) data. Listed below are the habitat types relevant to Lyme Bay.

Table 1. Habitat categories in Lyme Bay and the individual sediment types they are composed of.

Categories	**Sediment type breakdown**
Rocky reef	
Subtidal coarse sediment	Gravel, Sandy Gravel, Gravelly Sand, Diamicton, Rock or Diamicton, Rock and Sediment
Subtidal sand	Sand, Muddy Sand, Slightly Gravelly Sand
Subtidal mud	Mud, Sandy Mud, Slightly Gravelly Mud
Subtidal mixed sediment	Clay And Sand, Gravel, Sand and Silt, Gravelly Mud, Muddy Sandy Gravel, Muddy Gravel, Slightly Gravelly Muddy Sand, Slightly Gravelly Sandy Mud, Gravelly Muddy Sand

Coarse sediment is mostly contained within 30E7 2, 3 and 6, mixed sediment is mostly in 30E6 8,9 (with a small amount in 6) and 30E7 2,3, and sandy sediment is contained in 30E6 6 and 9 and 30E7 3,6 (Figure 1).

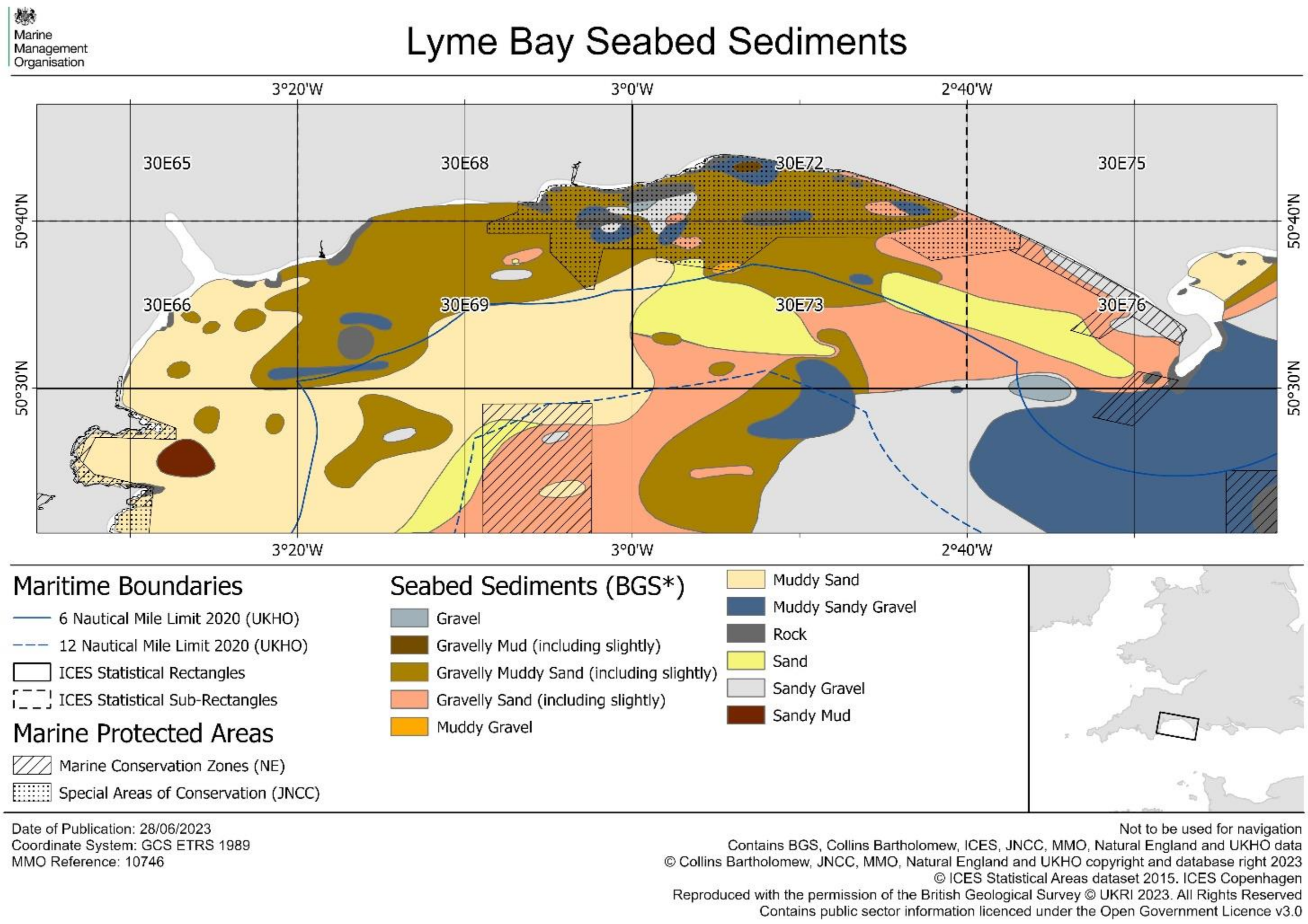

Figure 1. Map showing the distribution of seabed sediment types in Lyme Bay. Based on British Geological Survey data. ICES sub-rectangles are shown as well as marine protected areas (see key).

Sediment and gear type risk analysis

Information was taken from a paper published by Natural England, the MMO draft MPA risk assessments and scientific literature. A review of these sources conducted to inform development of a risk matrix for the different major sediment types and gears found in Lyme Bay. The information does not relate directly to Lyme Bay; however, it does relate to the specific habitat and gear types. The actual impact of a gear type on a habitat can be influenced by several factors including the exposure of the habitat, the specific gear type (single rig, double rig trawl etc.), the specific infauna or epifauna found associated with the habitat, etc. This risk matrix does not include a breakdown of all these factors and is designed to give an overview of some of the risks in relative terms (Figure 2).

A summary of the key points per major sediment type is given under the risk matrix based on the sources covered in Annex 1. The scores in the risk matrix are based on the combination of two factors: the level of impact a gear type can have on the habitat and its associated communities and the rate of recovery of that habitat/community scores. It was deemed that the recovery rate can vary within a habitat between gears; this is because the gears might impact different types of animals that live within different parts of the habitat found in those environments. For example, gears that penetrate the surface of a habitat would reach animals living within the sediment (infauna) whilst those only touching the surface would impact only the animals living on the surface.

Recovery rates vary for benthic animals, and this can relate to both the habitat type they are in as well as where in the habitat they are found.

Figure 2: Risk matrix for the major habitat types and fishing gear types found in Lyme Bay.

Gear type matrix	Nets and lines	Traps	Otter trawl	Beam trawl	Dredging
Subtidal sand	1	1	4	5	6
Subtidal coarse sediment	2	3	6	7	9
Subtidal mixed	2	3	9	9	9
Rocky reef	4	6	9	9	9

Key

Low risk	1-3	1
Medium risk	4-6	6
High risk	7-9	9

As highlighted in the risk matrix, the evidence from the literature review shows that subtidal sand is the least sensitive habitat, mainly being found in high energy environments where the fauna are used to high levels of natural disturbance and are thus are more resilient to the effects of human disturbance. In other environments such as rocky reefs and mixed sediment, the species found are less resistant to damage and recovery times are higher than for sand, resulting in higher risk ratings overall. Whilst we have shown risk ratings for all gear types and all habitat types within Lyme Bay, most of the rocky reef habitat is found in protected areas in Lyme Bay where bottom towed gears are prohibited.

Below some key summary points on the sensitivity of the major sediment types found in Lyme Bay are listed based on information compiled from the sources that are covered in Annex 1 and helping to explain the risk scores given above in Figure 2.

Subtidal coarse sediment

- Of the subtidal coarse sediments, communities in gravel habitats are generally considered to be particularly sensitive to bottom towed gear activity. There is evidence to suggest the recovery of subtidal coarse sediments to disturbance may be longer than for softer sediments.
- Subtidal coarse sediments are generally not considered to be sensitive to static demersal gears such as nets, except where contact is made on retrieval or setting of gear and emergent epifauna are present.

Subtidal mixed sediment

- Mixed sediments are more susceptible to surface and subsurface penetration from bottom towed gear than subtidal sand and subtidal coarse sediments. Recovery may also be slow.
- A study concerning the effects of potting on sandbanks suggested there is no detectable effect. As per the other habitats covered, static gears are not likely to have a significant impact.

Subtidal sand

- Clean sand and ‘well sorted’ sediments generally appear to have greater resilience to bottom-towed gear disturbance. As the mud fraction of sand increases (for example muddy sand vs coarse sand) recovery times increase and more vulnerable fauna are found.

- Recovery rates are related to the system's energy which itself determines the sediment type e.g. In a highly exposed area it is likely the habitats will be dominated by clean sand or well sorted sediments (subtidal sands) and the effects of disturbance from fishing gears will likely be reduced as compared to a lower energy area.
- The impact of traps is of limited concern due to the generally high energy environments where subtidal sand occurs and the likely greater impact of natural disturbance.
- Set nets are likely to be of limited concern to subtidal sand habitats.

Subtidal mud

- Subtidal muds tend to be found in the lower energy environments and benthic animal communities associated with those habitats are much more sensitive to bottom towed gears, with longer recovery times and more fragile associated species, including epifauna.
- Traps and pots can impact muddy habitats where contact is made and gear is dragged on setting or retrieving.
- Set nets are of more concern for these more sensitive habitats where they make contact with the seafloor (e.g. anchor points and lines on the seafloor).

Rocky reefs

- The physical structure of rocky reefs is more resistant to impact than the other habitat types. However, some parts of the reef such as soft rock can be broken up easily, creating a less diverse habitat.
- The ability of a rocky reef to recover from damage is highly variable and dependant on the species present. Rocky reefs are host to a large variety of species, which have different life cycles, some of these species such as sea fans and ross corals can take a long time to recover and are very fragile to physical disturbance.
- In high energy areas static gears such as pots and traps can cause significant damage due to abrasion impacts from pots which may occur during deployment, positioning (via dragging), soak time, movement and hauling. While the pressure is unlikely to impact the rock substrate itself, it may impact taxa associated with the rock habitat.
- Sensitivity assessments suggest there is the potential for static gear such as anchored nets and lines to cause damage to rocky reefs and sensitive epifauna.

Analysis of fishing activity in Lyme Bay

To consider likely exposure of different sediment types in Lyme Bay to different fishing gears, fishing activity data was extracted for each ICES sub rectangle and then the predominant sediment type allocated for each sub-rectangle using the mapped information on sediment types. In Table 3, fishing activity data (in days at sea) is shown per ICES sub-rectangle, per gear type, for the under-10m fishing vessels taken from the Catch App using data for 2022 only. In Table 4, fishing activity data (in days at sea) is shown per ICES sub-rectangle, per gear type, for the over-12m fishing vessels taken from VMS data using data for 2022 only. In each table, sub-rectangles were colour coded based on the most common sediment types in the sub-rectangle: this includes any sediment types contributing to over 25% of the sub rectangle. Where more than one sediment type is common (over 25%) in an area, they have been shaded with both colours to reflect this. The area 30E7 3 is made up of three different sediment types (mixed sediment, sand sediment and coarse sediment) and therefore is shaded a separate colour to reflect this.

Highest activity levels for under 10m vessels in 2022 in Lyme Bay were recorded from Catch App data for Traps, then Gill Nets and Entangling Nets (Table 3). These gears are associated with the lowest levels of risk to benthic habitats (Figure 2) and distribution of activity for Traps was highest in rectangles dominated by subtidal sands and subtidal mixed sediments, where risk levels are relatively low. For the set nets, highest levels of activity were distributed across sub-rectangles that include habitats predominated by subtidal sands, subtidal coarse sediment and subtidal mixed sediment. In all cases, low levels of risk are associated in these habitats for these gears.

Table 3. Under 10m vessel fishing activity in Lyme Bay by gear type and ICES sub-rectangle

	30E6			30E7		
ICES sub rectangle	6	8	9	2	3	6
Dredges	24					
Gill nets and entangling nets	63	4	363	84	325	352
Hooks and lines	59	47	127	8	137	322
Miscellaneous gear			55	53	91	48
Seine nets	2					
Traps	446	55	553	147	151	289
Bottom trawls	59		42	4	155	115
Total	659	114	1149	298	862	1132

Subtidal sand	
Subtidal mixed sediment	
Subtidal coarse sediment	
Subtidal sand and subtidal mixed sediment	
Subtidal sand and subtidal coarse sediment	
Mix: Subtidal sand, subtidal coarse and subtidal mixed sediment	

Hook and line gear were next most common in terms of activity levels, followed by bottom trawls. Hook and line gears are low risk in all type of habitat they are found in (see nets and lines in Figure 2). Trawling mostly took place in areas made up of sands and subtidal coarse sediments and some mixed sediments. Communities found in mixed sediments can be at high levels of risk from bottom gears, and coarse sediments at moderate levels of risk. Sands, which make up around a third of the areas in these two sub-rectangles are at lower levels of risk to bottom trawls. Catch App data shows that dredging only takes place in 30E6 6 and at lower levels of activity overall compared to other gears (Table 3). This sub-rectangle is mostly made up of subtidal sands, which are at moderate levels of risk due to this gear type (Figure 2).

The most sensitive habitat type represented in the predominant habitats was mixed sediments (in 30E6 8 and 30E7 2). These two sub-rectangles had comparatively low levels of fishing activity overall and most was associated with Traps, which were recorded to have relatively low levels of risk overall for this habitat type.

VMS data for larger vessels (Table 4) shows highest levels of activity to be associated with bottom trawls overall, followed by Traps then Dredges. Dredging is the most damaging gear type of these and was mostly taking place in areas 30E6 6 and 30E6 9. Bottom trawling was also mostly taking place in these same areas, as well as in 30E7 3. These three areas are mostly made up of sandy sediment, with some mixed sediment in 30E6 9 and some coarse sediment also in 30E7 3. As shown in the risk matrix (Figure 2) subtidal sands are the least sensitive sediments to dredging and trawling, when compared to other sediment types, but there is a high risk associated for mixed sediment habitats for these gears and for coarse sediments for dredging and beam trawling. Otter trawls are associated with moderate risk in coarse sediments. In general, Traps are associated with lower levels of risk and in terms of the distribution of activity of this gear, highest levels were found in 30E7 6 followed by 30E6 6. These are dominated by sands, and some coarse sediment in 30E7 6. Both of these habitat types have relatively low levels of risk for this gear type.

Table 4. Over 12m vessel fishing activity in Lyme Bay by gear type and ICES sub-rectangle

	30E6			30E7		
ICES sub rectangle	**6**	**8**	**9**	**2**	**3**	**6**
Dredges	151	0	142	0	47	62
Gill nets and entangling nets						
Hooks and lines						
Miscellaneous gear	1	0	1	1	54	6
Traps	162	0	7	0	0	274
Bottom trawls	103	1	381	0	214	0
Total	417	1	531	1	315	342

Subtidal sand	
Subtidal mixed sediment	
Subtidal coarse sediment	
Subtidal sand and subtidal mixed sediment	
Subtidal sand and subtidal coarse sediment	
Mix: Subtidal sand, subtidal coarse and subtidal mixed sediment	

Conclusion

There are some limitations to the information available for this report. These include the reliability of Catch App data, as this has not been quality checked or verified against other landings data. Additionally, there is no data in this report for fishing activity of vessels between 10 and 12m in length. This is due to vessels of this size not falling in either the size range for Catch App data or VMS data. Furthermore, fishing activity data is only available at sub-rectangle level, this means where there are multiple sediment types within one sub rectangle it is not possible to tell what the distribution of fishing activity is like amongst the sediment types.

In general, risks from fishing gears to habitats and their associated biodiversity are highest for rocky reefs, followed by mixed and coarse sediments. In Lyme Bay, rocky reef habitats are protected in an MPA and bottom gears are prohibited in this area. However, there are still moderate levels of risk associated with trap fishing and other set gears including nets on rocky reef habitats, due to the sensitivity of associated epifauna and the potential to degrade the reef structure over time. The specific distribution of fishing activity from these gear types in the MPAs is unknown and so actual risk cannot be presented at this time.

Mixed sediment habitats are the next most vulnerable habitat type found in Lyme Bay, but these are less frequently fished by bottom towed gears in the under 10m category and the risks from other gears are relatively low for this habitat type. However, there was a significant amount of activity in sub rectangle 30E6 9, in the over 12m group. This area (30E6 9) is made up of a combination of sand and mixed sediment. At present the specific extent of the interaction of bottom towed gears and mixed sediment in this sub rectangle is unknown. However, levels of risk to benthic communities are higher in mixed sediments and this should be considered in terms of the benefits of exploring more spatially defined distributions of fishing effort data and working with industry to understand actual levels of vulnerability and how any associated impacts can be reduced.

Coarse sediment habitats are mostly found in two sub-rectangles (30E7 3 and 6) in Lyme Bay. These areas have the highest levels of activity for bottom trawls in the under 10m vessel category, as well as being popular for a range of other gears. These areas also have some activity in the over 12m category for dredging and for bottom trawling in 30E7 3. Bottom trawling and dredging on coarse sediments are associated with a high level of environmental risk.

Annex 1

Below a short summary is given of some of the literature that was reviewed to provide both the environmental sensitivity information and the risk matrix.

MMO MPA draft stage 3 summary

- Clean sand and 'well sorted' sediments generally appear to have greater resilience to and recovery from, fishing disturbance
- There is evidence to suggest the recovery of subtidal coarse sediments to disturbance may be longer than softer sediments
- As the mud fraction of sand increases (for example muddy sand vs coarse sand) recovery times also increase
- Mixed sediments are more susceptible to surface and subsurface penetration than subtidal sand and subtidal coarse sediments

  MMO MPA Stage 2 Summary
- Bottom towed gears can also modify and homogenise the substrate, as soft rocks are broken up Although harder substrate is relatively resistant to physical damage, bottom towed fishing gears can still damage the substrate and its associated communities (Roberts *et al.,* 2010).
- long-lived species such as pink sea fans (*Eunicella verrucosa*) and Ross corals (*Pentapora foliacea*), potentially taking 17 to 20 years to recover, whereas shorter-lived species (such as scallops and dead man's fingers, (*Alcyonium digitatum*) taking 2.5 to 6 years to recover.

Cantrell R, Covey R, Relf C, Irving R, and Nicholson J. 2023. Fisheries Impacts on Marine Protected Habitats – A Review of the Evidence. Natural England Evidence Review, Number NEER023

In the long-term, communities in areas of high natural disturbance are typically more resilient to the increased mortality rates generated by bottom trawling

- More mobile sediments, such as sand, mud and to a lesser extent gravel, are more resilient than others. Subtidal sand habitats, subject to natural periodic wave or current disturbance, have often been found to be recover quickly from dredging.
- Stable mixed sediments are usually dominated by faunal turfs which are particularly vulnerable to scallop dredging.
- Scallop dredgers can penetrate 3-10cm into the seabed therefore they have a strong potential to disrupt benthic infauna.

Ole R. Eigaard and others, The footprint of bottom trawling in European waters: distribution, intensity, and seabed integrity, *ICES Journal of Marine Science*, Volume 74, Issue 3, March-April 2017, Pages 847–865, https://doi.org/10.1093/icesjms/fsw194

- Otter trawls and seines mainly sweep the surface of the seabed, whereas shellfish or flatfish dredges and tickler chain beam trawls will penetrate deeper into the sediment
- The most severe impact occurred in response to scallop dredging in biogenic habitats, followed by beam trawls in sandy habitats and otter trawls in muddy habitats.

Kaiser, M.J., Clarke, K.R., Hinz, H., Austen, M.C.V., Somerfield, P.J. and Karakassis, I. (2006). Global analysis of response and recovery of benthic biota to fishing. Marine Ecology Progress Series, 311, 1-14

- In sand habitats, the initial response was most severe with the application of intertidal dredging
- Beam Trawling and Scallop Dredging had significant negative short-term impacts in sand and muddy-sand habitats
- Otter Trawling had a significant initial effect on muddy-sand and mud habitats
- Gravel habitats, which are relatively stable and tend to support communities with high levels of diversity and biomass, were negatively affected by Scallop Dredging both in the short and long-term