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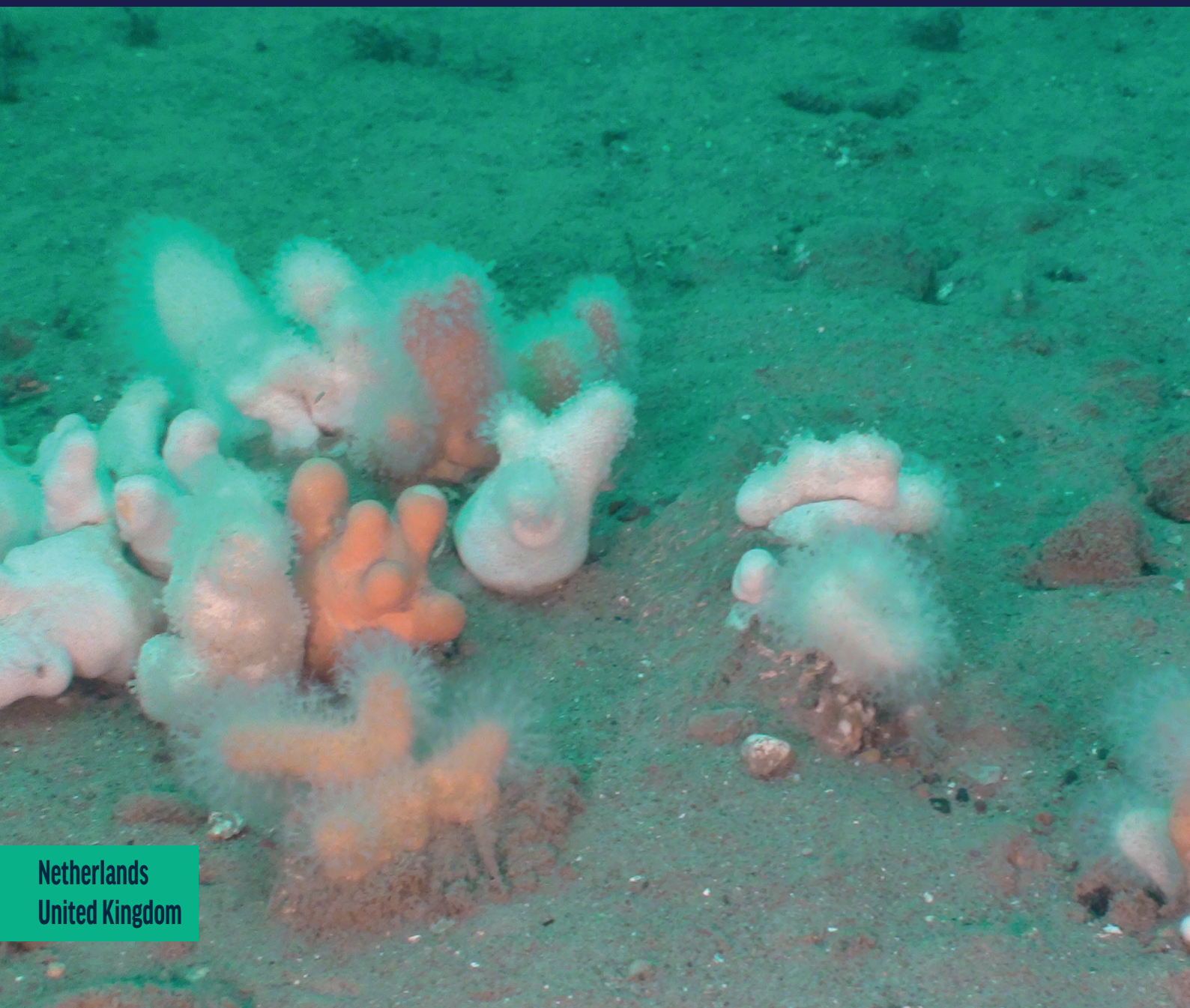
# PROTECTING THE NORTH SEA: CLEAVER BANK



Netherlands
United Kingdom

# PROTECTING THE NORTH SEA: CLEAVER BANK

## Credits

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**Cover:** Garden of dead man's fingers (*Alcyonium digitatum*).



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# INTRODUCTION and FINDINGS

# Introduction

Cleaver Bank (*Klaverbank* in Dutch) extends over 1235 km$^2$ in a transboundary area shared between the UK and the Netherlands (Fig. 1). In comparison with surrounding areas, it is home to a diverse benthic community and a wide variety of substrates, specifically gravel and dispersed rocks that originated in the last Ice Age (15 000 years ago).[1] The relatively greater depth of Cleaver Bank in comparison with the surrounding area prevents the bottom from being disturbed by wave action; as a result, it is the only area in the Dutch North Sea where such an accumulation of hard substrate occurs, with around 30% of non-sedimented gravel.[2] Over large areas, silt and sand have accumulated, forming ripples that follow the main water current direction and that can extend over kilometres.[3]

This atypical substrate and clear waters – which enable light penetration down to 30-50 m – support a high level of benthic diversity in Cleaver Bank: the highest in the Dutch continental shelf.[4] The ecological value of the UK side of the area is likely to be even higher, as gravel and rocky areas also occur there.[5] There is a large proliferation of crustose red algae (i.e., *Lithothamnion sonderi* and *Phymatolithon* sp.),[1] as well as fauna such as crabs, worms and molluscs. Moreover, Cleaver Bank is divided in two sectors by the Botney Cut, a 60 m deep channel running from northwest to southeast that hosts harbour porpoises, minke whales, and seals, as well as white-beaked dolphins during the summer.[6] Razorbills and guillemots are also found in the area, mostly during the months of April and May.[7]

The area qualifies as a stony reef under the EU Habitats Directive,[8] as it meets the criterion of containing a considerable number of cobbles and boulders (i.e., rocks generally larger than 6 cm). As a result, the Dutch side has partially been designated as a Natura 2000 Special Area of Conservation (SAC), named *Klaverbank*. An OSPAR marine protected area (MPA) has also been designated, the boundaries of which almost coincide with the SAC.

In the case of the UK side, previous studies have focused mainly on the part of the area known as *Markham's Triangle*, which in May 2019 was designated as a Marine Conservation Zone (MCZ).[9] The area was designated for the protection of four sediment types, which in turn support an array of invertebrate species within and on the sediment, and a range of fish species. The southwestern corner of the area overlaps with the *Southern North Sea* SAC, which is intended to protect just a single species, harbour porpoise (*Phocoena phocoena*). Other species in Cleaver Bank that are listed under the Habitats Directive are grey seal (*Halichoerus grypus*) and harbour seal (*Phoca vitulina*).

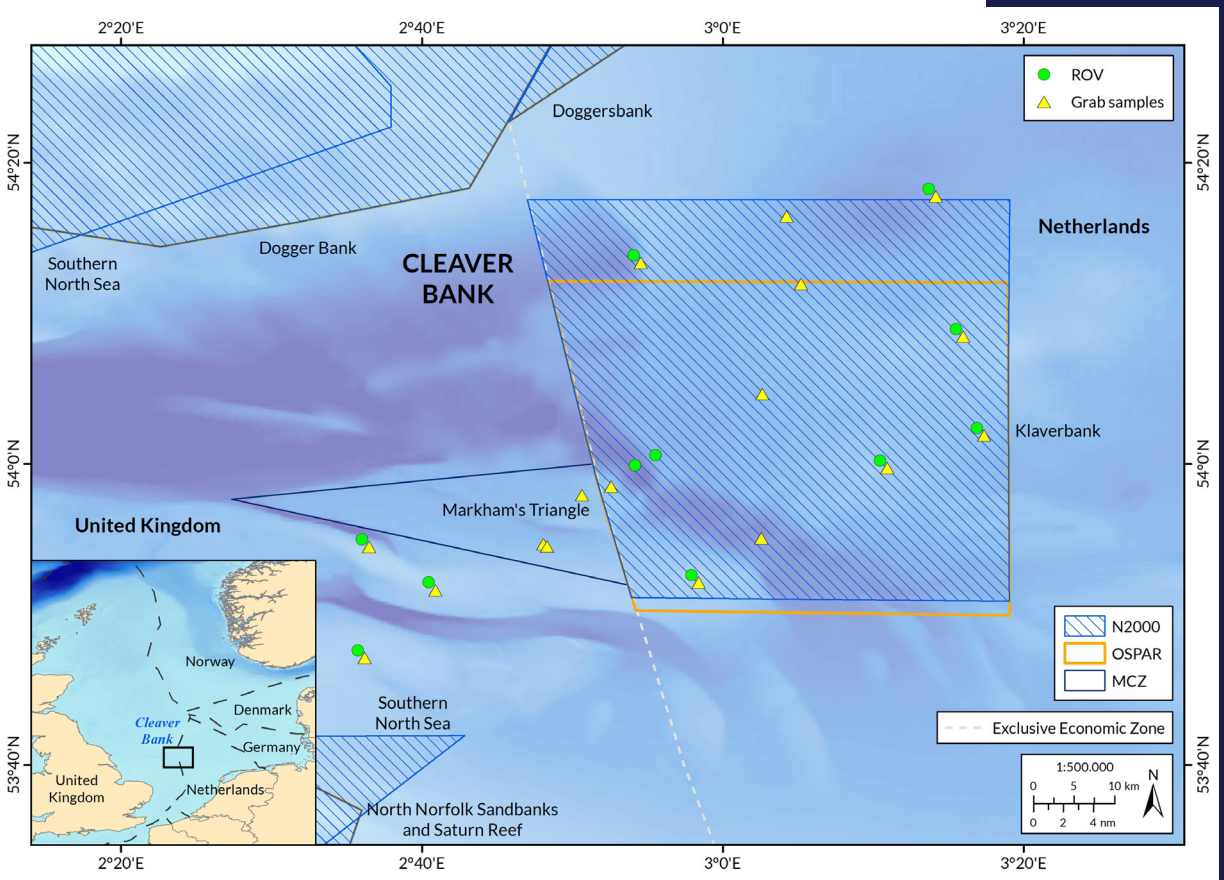


Figure 1. Oceana sampling locations in Cleaver Bank, according to survey methodology (ROV, grab). Marine protected areas are shown by type. (N2000: Natura 2000 MPA designated under the Habitats Directive;[10] MCZ: Marine Conservation Zone). Sources: EMODnet [11] EEA,[12] Natural England,[13] and OSPAR.[14]

### *Box 1. The importance of reefs*

Reefs are among the most biodiversity-rich ecosystems in the world.[15] In temperate waters such as the North Sea, reef habitats may host twice as many benthic species as the surrounding sandy areas, with biomass levels on reefs over one thousand times greater.[16] Reefs increase habitat complexity, providing surfaces for benthic species to colonise, giving shelter to animals such as fishes and crustaceans, and serving as nursery areas for a variety of species, including commercial ones such as cod.[17] Within the European Union, reefs of natural origin are considered key habitats for biodiversity conservation and thus are a priority for protection under the Habitats Directive.[10]

Reefs can be of a biogenic or geogenic nature. Biogenic reefs are created by bioengineer species that generate calcareous structures.[19] In the North Sea, such organisms include calcareous algae (*Lithothamnion* spp.), sand mason worms (*Lanice conchilega*), and blue mussels (*Mytilus edulis*). Geogenic reefs are formed by compact, hard substrata of varying geological origins and sizes, such as rocky outcrops, boulders, pebbles, and gravel beds,[19] the latter of which occur in Cleaver Bank. The presence of geogenic reefs in the North Sea is quite scarce, since only 20% of its seabed is formed by this habitat (coarse sands, gravels and rocks), while mobile sediments such as sand or mud are the most common.[20 21]

In the past, a considerable area of the North Sea was covered with hard substrata. This is the case of the flat oyster (*Ostrea edulis*), which forms reefs that once extended over large areas but in the last century have almost disappeared in the southern North Sea, partially due to overfishing.[5] Similarly, a number of naturally rocky areas (e.g., Cleaver Bank, parts of Dogger Bank, and Borkum Reef Ground)[22] have been stripped of rocks by trawl nets. As a result, the Dutch North Sea is virtually devoid of rocks or biogenic reefs.[23]

***Box 2. Methodology***

**Oceana North Sea Expeditions 2016 & 2017:**

Oceana carried out two eight-week research expeditions, in 2016 and 2017, to document the richness of marine life in the North Sea. The main objective was to collect data about seafloor habitats and species in areas of potential ecological importance, in the interest of strengthening the network of marine protected areas (MPAs) in the North Sea.

Cleaver Bank was surveyed as part of the 2016 expedition, which encompassed a total of 13 areas across the waters of Denmark, the Netherlands, Norway, and the United Kingdom. Surveys were carried out through filming with a remotely operated vehicle (ROV) and by SCUBA divers, and infaunal sampling using a Van Veen grab.

**Study area: Cleaver Bank**

Dates: 9-11 July 2016

Research vessel: *MV Neptune*, a fully-equipped vessel of 49.85 m overall length and 10 m extreme breadth.

Surveys: 26 stations

- ROV Surveys: A total of 5 transects, with a Saab Seaeye Falcon DR ROV, equipped with a high-definition camera (1920 x 1080 resolution), used to document species and habitats.
- Infaunal Surveys: A total of 21 grab samples, with a 12L Van Veen grab, to identify fauna living on and within the sediment.
- Biological samples: 67, comprising mainly bivalves and worms.
- Depth range: 26.7-66.1 m.

During the 2016 at-sea expedition in the North Sea (see Box 2), Oceana documented a total of 268 taxa in Cleaver Bank, of which 161 were identified to the species level (see Annex). Below, the key findings are presented according to the primary habitat types documented, and the main species that were associated with them, including an artificial reef created by a pipeline (see Box 3).

## HABITATS AND COMMUNITIES

### Muddy bottom with burrows

The two deepest transects (maximum 49-66 m) were carried out over mainly muddy sediments, where species were present that also occurred in sandy-muddy bottoms, such as *Asterias rubens*, *Limanda limanda*, *Merlangius merlangus* and *Pagurus bernhardus*. One of the areas surveyed had more fine mud and burrows of a smaller diameter, possibly belonging to common dragonet (*Callionymus lyra*) recorded in the area. The other area hosted Norway lobster (*Nephrops norvegicus*), with individuals occasionally found sheltering in their burrows (of a larger diameter than the others) (Fig. 2). Whiting (*Merlangius merlangus*) was also observed in the area.

Figure 2. Norway lobster (*Nephrops norvegicus*) in its burrow.

**Muddy sand with ripples, bryozoans and soft corals**

The seabed in this habitat type comprised sandy bottom in which the sand was mixed with mud and shell remains. Several molluscs were identified, such as basket shell (*Corbula gibba*) and grey top shell (*Steromphala cineraria*), together with various annelids, arthropods and echinoderms.

One ROV transect that was carried out in an area at 45 m depth was characterised by low biodiversity, but a relatively high abundance of two sea star species: common sea star (*Asterias rubens*) and sand star (*Astropecten irregularis*). One noteworthy finding in this area was the presence of habitat-forming invertebrates such as the soft coral dead man's fingers (*Alcyonium digitatum*) and the bryozoan rose-coral (*Pentapora foliacea*) (Fig. 3). These species can provide essential habitat for other fauna, such as crustaceans, molluscs and fishes.

It should also be noted that a grab sample collected in this area comprised 18 species of molluscs, crustaceans, echinoderms, and other invertebrates; this level of species richness was higher than that of grab samples collected from other types of soft sediments in the surrounding area.

Figure 3. Rose-coral (*Pentapora foliacea*) in muddy sand.

### Sandy bottom with ripples

This habitat was found at 29 m depth, and the benthos was neither diverse nor abundant. Sea stars such as *Asterias rubens* and *Astropecten irregularis* were relatively common (Fig. 4), and razor shells (*Ensis* sp.) were commonly found semi-buried in the sand. Lesser sandeel (*Ammodytes tobianus*) and shiny nutclam (*Nucula nitidosa*) were also found in this substrate.

Figure 4. Common sea star (*Asterias rubens*) in sand with ripples.

### Sandy-muddy bottom with shell remains, sparse rocks and burrows

Sandy-muddy bottoms characterised most of the surveyed areas in Cleaver Bank. Fauna found on these bottoms were typical of soft bottoms, such as echinoderms (e.g., *Asterias rubens* and *Astropecten irregularis*) and crustaceans (e.g., *Pagurus bernhardus* and *Liocarcinus holsatus*). Dab (*Limanda limanda*) was also abundant in these areas.

In some locations, rocks of varying sizes were present, which were colonised by species that differed from those present in the surrounding soft bottoms. Cnidarians such as dead man's fingers (*Alcyonium digitatum*), bryozoans such as feather bryozoan (*Crisularia plumosa*), and hydrozoans such as *Leptothecata* sp. and tall tubularian (*Tubularia indivisa*) were abundant, together with a multitude of hydrozoans and annelids. In both Dutch and UK waters of Cleaver Bank, edible crab (*Cancer pagurus*) was found only on this coarser type of substrate, with the exception of some individuals that were recorded close to a pipeline. Also present was whiting (*Merlangius merlangus*), a commercially fished species that was recently assessed as being overfished and outside safe biological limits in the North Sea. Cleaver Bank represents a spawning and nursery area for whiting.[25]

Some burrows were also present in these areas, (Fig. 5), which were likely associated with the occurrence of common dragonet (*Callionymus lyra*), a known burrowing species.

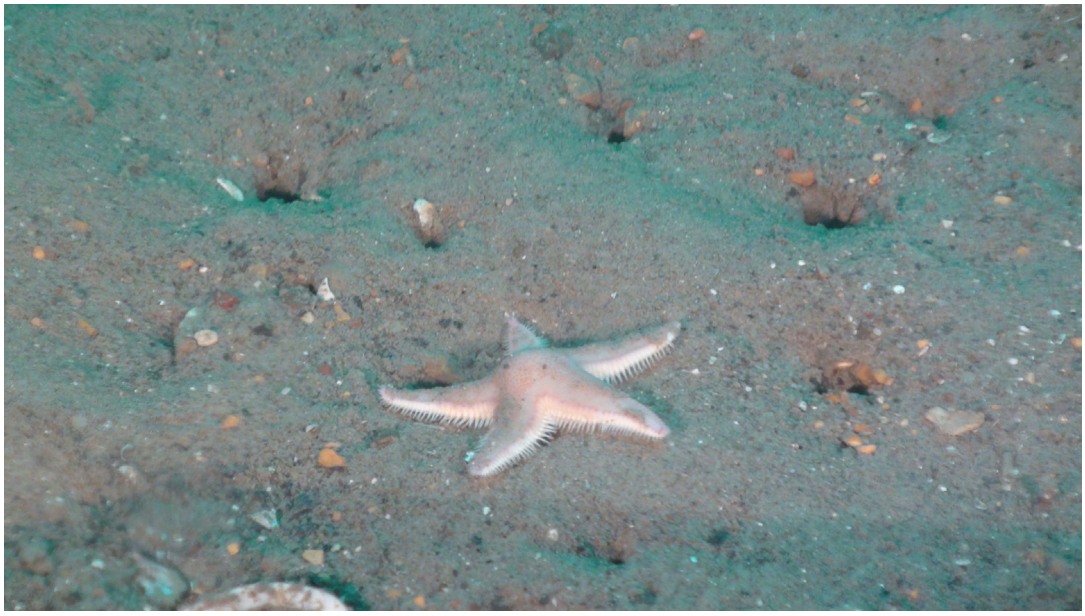

Figure 5. Sand star (*Astropecten irregularis*) on a sandy-muddy bottom, surrounded by burrows.

### Shell gravel and coarse sand with ripples and spread rocks

At 32 m depth, the sea bottom in Cleaver Bank was composed of mixed sand and shell gravel, pebbles, and some rocks (Fig. 6). In this habitat, common mobile fauna included schools of flounder (*Platichthys flesus*), common sea star (*Asterias rubens*), crustaceans, and molluscs. In contrast with sandy bottom sites without rocks, this habitat harboured various cnidarian species, especially hydrozoans, which were attached to the stones.

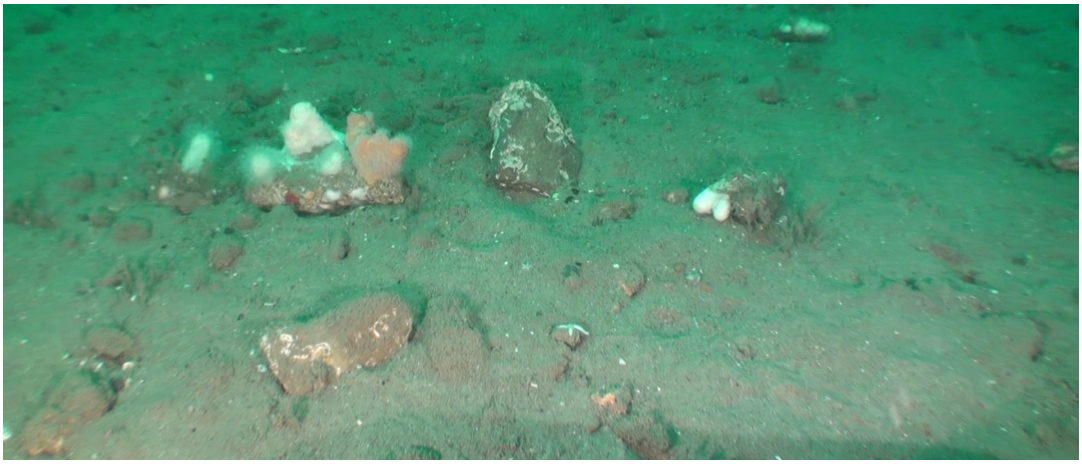

Figure 6. Benthic fauna on scattered rocks.


Specimens collected in a grab sample in Dutch waters of Cleaver Bank, including ocean quahog (*Arctica islandica*), pelican's foot (*Aporrhais pespelecani*), and common saddle oyster (*Anomia ephippium*).


Specimens of sea potato (*Echinocardium cordatum*) collected in a grab sample in UK waters of Cleaver Bank.



***Box 3. Muddy bottom with a pipeline***

A pipeline was found at 48.7 m depth, situated in the northeasternmost corner of the survey area. This feature served as a sort of artificial reef; its surface permitted sessile species to attach and grow and provided mobile species with a three-dimensional structure that served as refuge. Some parts of the pipeline were completely covered with brittle stars (*Ophiothrix fragilis*) (Figure 7), while other parts were covered by annelids (Serpulidae). Common sea star (*Asterias rubens*) and dead man's fingers (*Alcyonium digitatum*) were common in this area. Also encountered were aggregations of European sea squirt (*Ascidiella aspersa*) together with dahlia anemone (*Urticina felina*). Species of commercial interest recorded included edible crab (*Cancer pagurus*), common lobster (*Homarus gammarus*), juvenile cod (*Gadus morhua*), and some flatfishes.

Figure 7. Common brittlestar (*Ophiothrix fragilis*) covering a pipeline.

## Features of conservation interest

Oceana's surveys in Cleaver Bank documented the occurrence of one habitat type and six species that are recognised as threatened and/or are protected under Dutch, UK, and international conservation frameworks (Table 1 and Fig. 8).

Cleaver Bank stands out as the only area in the Dutch North Sea with an accumulation of hard substrate (non-sedimented gravel). This type of habitat falls under the Habitats Directive definition of *Reefs*, and so is subject to protection. Two habitats that are considered priorities in the UK (i.e., *Subtidal coarse sediments* and *Subtidal sand*) are also present in the area.

Among the priority species for conservation, three are included on the OSPAR List of Threatened and/or Declining Species and Habitats. North-East Atlantic countries are required to take action to conserve and recover these species:

- Ocean quahog (*Arctica islandica*) is large, slow-growing, and extremely long-lived bivalve; some individuals have been known to live more than 500 years.[26] It usually lives in sandy bottoms, which are affected by a variety of anthropogenic impacts. In particular, ocean quahog is very sensitive to mechanical damage and incidental catches by bottom-contact fishing gears such as beam trawls.[27] This species has suffered a significant decline in population levels and has disappeared from some areas, especially in shallow locations (30-50 m) where fishing activity is high.

- Atlantic cod (*Gadus morhua*): the most recent assessment of the cod stock in the North Sea, eastern English Channel, and the Skagerrak indicates that despite a period of apparent increase, cod in these areas has once again been declining. It is currently below safe biological limits and remains subject to ongoing overfishing.[28]

- European flat oyster (*Ostrea edulis*) is considered a keystone species, and once formed large offshore reefs in the southern North Sea and the English Channel.[29] Its population is currently at critical levels, due in large part to overexploitation (see Box 1).[32]

Two additional species are listed as threatened in Dutch waters: transparent goby (cf. *Aphia minuta*) and rock gunnel (*Pholis gunnellus*), the former of which is Critically Endangered. Under UK legislation, plaice (*Pleuronectes platessa*) is considered a species of principal importance for conserving biodiversity.[30] However, it should be noted that according to the most recent stock assessment of plaice for the North Sea and the Skagerrak, the stock is considered to be sustainably fished.[31]

| | FEATURES | INTERNATIONAL FRAMEWORKS | | | NATIONAL FRAMEWORKS | | |
|---|---|---|---|---|---|---|---|
| | | HD[10] | OSPAR[38] | European Red List[39] | UK MCZ FOCI[40] | Natural Environment and Rural Communities Act 2006[30] | NL Red List of Fishes[41] |
| Habitats | Reef | ✔ | | | | | |
| | Subtidal coarse sediments | | | VU | ✔ | ✔ | |
| | Subtidal sand | | | EN | ✔ | ✔ | |
| Species | Ocean quahog *(Arctica islandica)* | | (a) | | ✔ | | |
| | Transparent goby *(cf. Aphia minuta)* | | | | | CR | |
| | Cod *(Gadus morhua)* | | (b) | | | ✔ | |
| | Rock gunnel *(Pholis gunnellus)* | | | | | ✔ | VU |
| | Plaice *(Pleuronectes platessa)* | | | | ✔ | ✔ | |
| | European flat oyster *(Ostrea edulis)* | | (a) | | | | |

(a) OSPAR Species under threat and/or decline (Region II)
(b) OSPAR Species under threat and/or decline (Regions II & III)

Table 1. Features of conservation interest documented in Cleaver Bank during the 2016 Oceana North Sea expedition. UK: United Kingdom; NL: The Netherlands; HD: EU Habitats Directive; CR: Critically Endangered; VU: Vulnerable; EN: Endangered; MCZ FOCI: Marine Conservation Zone Features of Conservation Importance.

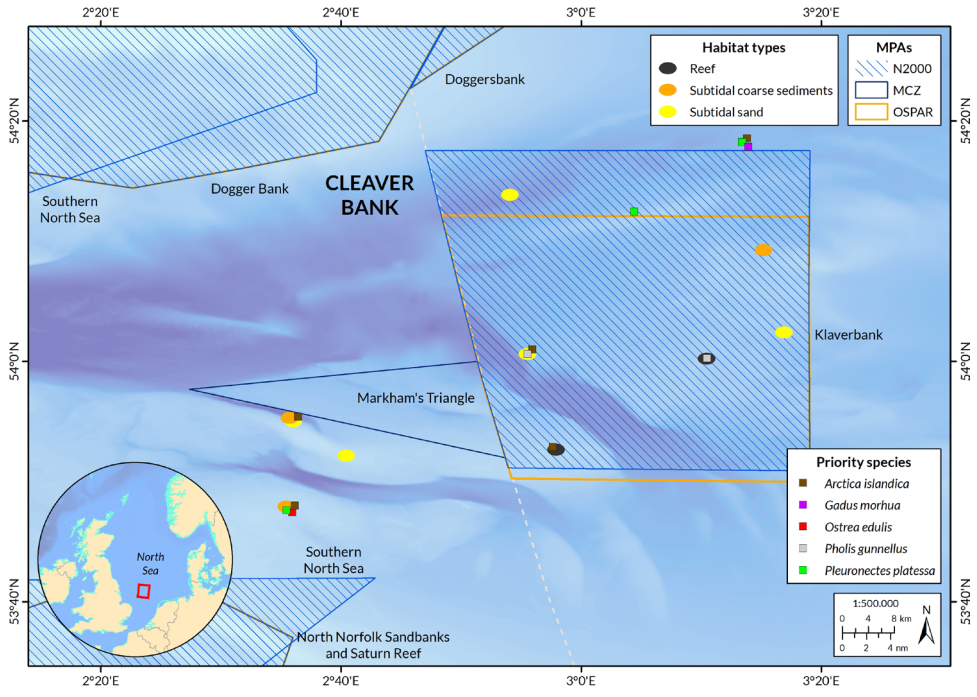


Figure 8. Features of conservation interest observed in Cleaver Bank during the Oceana 2016 North Sea expedition. Marine protected areas are shown by type. Sources: EMODnet,[11] EEA,[12] Natural England,[13] and OSPAR.[14]

***Box 4. Protected Areas in Cleaver Bank***

- *Klaverbank* SAC: This Natura 2000 site was first nominated as a Site of Community Importance (SCI) in 2009, and then designated as a Special Area of Conservation (SAC) in 2016. With a total area of 1539 km$^2$, it was established for the protection of reefs, harbour porpoise, grey seal, and harbour seal.[32] Fisheries management measures for the area have long been pending, and were finally proposed by the Dutch government in April 2019. The main management measure proposed is a prohibition on all mobile bottom-contacting gears in four management zones within the area.[33]

- *Klaverbank* OSPAR MPA: Extending over 1237 km$^2$, this site overlaps almost entirely with the *Klaverbank* SAC. It was designated in 2009, on the basis of the OSPAR criterion for ecological significance, with 'a high natural biological productivity of the species or features being represented', 'high sensitivity', 'high scientific value' and 'high potential for restoration'. The same species of marine mammals listed as designated features for *Klaverbank* SAC underlie the OSPAR MPA nomination. The management plan for the MPA has only been partially implemented.[34]

- *Southern North Sea* SAC: With an area of 36 950 km$^2$, this site was the largest UK and European SAC at the moment of its designation in 2019.[35] It was designated on the basis of its importance for harbour porpoise (*Phocoena phocoena*), which is the sole feature protected by the site. Therefore, it does not imply any protection of benthic habitats such as the sandbanks and gravel beds documented in the area during Oceana's surveys. This area overlaps with the southeastern corner of Oceana's Cleaver Bank survey area.

- *Markham's Triangle* MCZ: This Marine Conservation Zone (MCZ) covers approximately 200 km$^2$ of UK waters immediately adjacent to the *Klaverbank* SAC.[36] Thus, it represents a continuation of the same ecosystems protected on the Dutch side; similar coarse sediment habitats and species are found on both sides of the border.[37] The protection of *Markham's Triangle* represents an important step for improving connectivity among MPAs in the area, not only with *Klaverbank*, but also with the *North Norfolk Sandbanks and Saturn Reef* SAC that lies to the southwest of *Markham's Triangle*.

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***Box 5. Damage caused by fishing to soft and mixed bottoms***

Bottom trawling, particularly with demersal otter trawls and beam trawls, is regarded as the largest anthropogenic source of physical damage to the seafloor globally.[42] [43] The impacts of bottom-contacting gears on the seabed can been classified as geotechnical (i.e., the mechanical interaction of the gear in contact with the sediment) and hydrodynamic (i.e., the resuspension of sediments produced by the turbulence associated with the friction of the geotechnical interaction).[44] The damage generated by the use of these gears extends from the more obvious direct physical impacts to the seabed, destruction of biogenic structures, and resulting decreases in species abundance, biomass and richness,[45] to broadscale potential consequences in terms of changing the structure and functioning of entire benthic ecosystems.[46]

Cleaver Bank corresponds to the ICES 'Central North Sea' Division (IVb), which is one of the most intensively fished areas in the North Sea.[47] The fleet is composed of vessels flagged to Belgium, Denmark, France, Germany, the Netherlands, Sweden and UK, which spend an average of 280 days per year in Cleaver Bank.[48] [49] Demersal otter trawls, beam trawls, and seines represent the main fishing gears used in the area.[50] [51]

Gravel areas such as the Cleaver Bank are relatively scarce in the North Sea, and support benthic species that are longer-lived than those found in sand or mud, which are therefore more sensitive to trawling practices.[52] The rich benthic composition of Cleaver Bank is associated with the presence of a mosaic of coarse sediments, alternating between cobbles, boulders, and shell remains, which can vary over small scales.[53] Sediments with grain sizes larger than 3 cm can be colonised by sessile organisms which, in turn, play a role in aggregating loose sediments, thereby enhancing the three-dimensional structure of the seabed.[54] This increased habitat complexity also helps to provide new substrate for additional organisms to colonise, thereby augmenting the biodiversity, and making this an especially valuable area in the North Sea.[1]

In the case of Cleaver Bank specifically, regular beam-trawling since at least 1979 has resulted in the deterioration of both the structure and function of its habitats.[1] Ongoing bottom trawling in the area represents a serious threat to the fragile ecological equilibrium of Cleaver Bank.

# PROPOSAL FOR PROTECTION

Cleaver Bank represents the largest area of hard substrate in the Dutch North Sea, and its biodiversity importance has been repeatedly recognised. The combination of oceanographic and geological patterns found in the area (e.g., depth, low currents and light penetration) makes Cleaver Bank a unique enclave of marine life in the Dutch EEZ. Thus, it has already been designated under various figures of protection (see Box 4). However, current management measures for these areas fail to secure the preservation of the area's fragile combination of features.

A considerable advance towards effective protection of the area was made in June 2019, when a package of proposed joint recommendations for fisheries management measures in *Klaverbank* SAC was presented by the Netherlands to the European Commission. These proposed measures include the prohibition of destructive fishing gears (i.e., beam trawls, bottom otter board trawls, dredges, and demersal seines) within four management zones that strictly comply with the definition of "open-sea reefs". These zones represent only 46% of the total area of *Klaverbank* SAC. Under the proposed measures, the remaining area, which also includes zones with substrates described as "gravelly sand" and "sandy gravel", would be left open to any fishing not specifically restricted under other pieces of legislation.

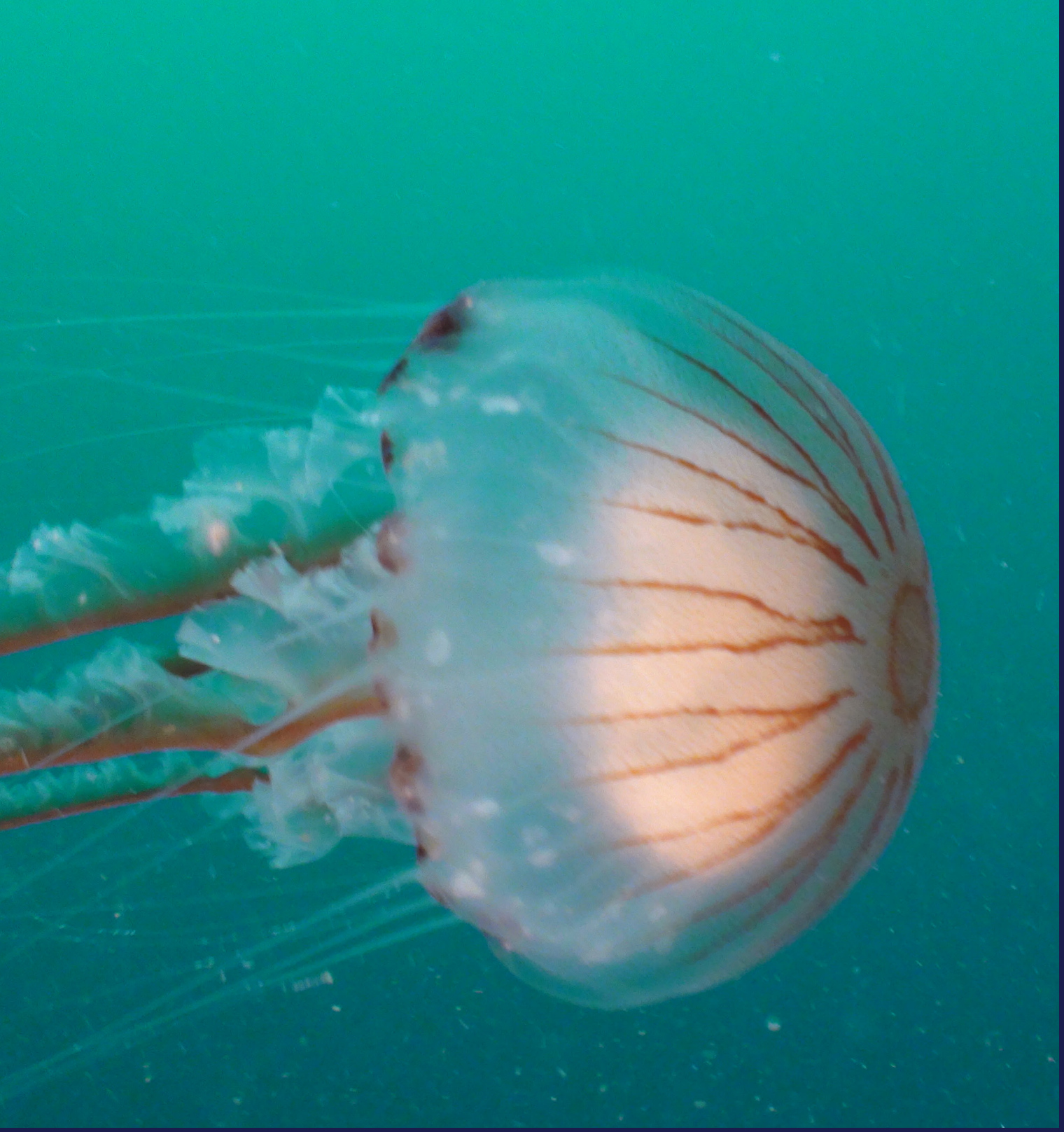
A review of the proposed measures by the Scientific, Technical and Economic Committee for Fisheries (STECF) concluded that the proposed measures were likely to help maintain and restore the conservation status of the designated features within the site.[51] However, it also noted that a small proportion of reef area occurs outside the four zones and would therefore not be managed, and that the lack of any buffer zones around the reef areas was not in line with the precautionary approach. Moreover, the STECF assessment stated that the rationale for the selection of the management zones was not transparent.

As described in Box 5, the elevated biodiversity of Cleaver Bank is due to the diversity of its bottom substrates, the composition of which is highly variable even at small scales.[53] Protecting only the proposed management zones ignores the importance of the non-reef habitats in the area, as well as the ecological interconnections between habitat types.

Bearing in mind that the disappearance of the former rocky banks in Dutch waters was caused by their direct removal in bottom trawls, and the threat that fishing activities pose to the fragile and varied seabed of Cleaver Bank, Oceana proposes that the entire area of *Klaverbank* SAC should be closed to all type of bottom-contacting gears. Continued bottom-contact fishing in *Klaverbank* represents a clear threat to the fragile benthic ecosystems found in the area.

On the UK side, Oceana's findings have further confirmed that Cleaver Bank as a whole (both the Dutch and UK sides) is characterised by very similar habitats and communities. Oceana urges the UK government to carry out more detailed habitat mapping, in order to better identify the range of features present, and determine which conservation and management measures are needed to preserve and restore the ecological integrity of Cleaver Bank.

Dead man fingers (*Alcyonium digitatum*) and crab (*Liocarcinus* sp.)



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# ANNEX: LIST OF SPECIES

| Species | Netherlands | United Kingdom |
|---|---|---|
| Annelida | | |
| *Amphictene* cf. *auricoma* | | X |
| Annelida | X | X |
| *Hydroides* sp. | X | X |
| *Nephtys* sp. | X | X |
| *Oxydromus flexuosus* | X | |
| *Pectinaria* sp. | X | X |
| *Placostegus tridentatus* | X | |
| Polychaeta | X | X |
| *Sabella pavonina* | X | X |
| Sabellida | | X |
| Sabellidae | X | |
| Serpulidae | X | |
| *Spirobranchus triqueter* | X | X |
| *Terebellida* sp. | | X |
| Arthropoda | | |
| *Achaeus cranchii* | X | |
| Amphipoda | X | |
| Balanidae | X | |
| *Balanus balanus* | X | |
| *Balanus crenatus* | X | |
| *Balanus* sp. | X | |
| *Callianassa* sp. | X | |
| *Cancer pagurus* | X | X |
| *Caprella linearis* | X | |
| Copepoda | X | |
| *Corystes cassivelaunus* | | X |
| Crustacea | X | |
| *Diogenes pugilator* | X | |
| *Ebalia* cf. *cranchii* | X | |
| *Ebalia cranchii* | | X |
| *Ebalia tuberosa* | X | |
| *Galathea* sp. | X | |
| *Galathea strigosa* | X | |
| Gammaridae | | X |
| *Goneplax rhomboides* | X | |
| *Hippolyte varians* | X | |
| *Homarus gammarus* | X | |
| *Inachus* cf. *dorsettensis* | X | |
| *Inachus phalangium* | X | |
| *Inachus* sp. | X | |
| *Liocarcinus* cf. *depurator* | X | |
| *Liocarcinus* cf. *holsatus* | | X |
| *Liocarcinus depurator* | X | X |
| *Liocarcinus holsatus* | X | X |
| *Liocarcinus marmoreus* | | X |
| *Liocarcinus* sp. | X | X |
| *Macropodia rostrata* | X | |
| *Necora puber* | X | |
| *Nephrops norvegicus* | X | |
| Paguridae | X | |
| *Pagurus bernhardus* | X | X |
| *Pagurus cuanensis* | X | |
| *Pagurus* sp. | X | |
| Pandalidae | X | |
| *Pandalina brevirostris* | X | |

Table A. Taxa documented in the Cleaver Bank study area during the Oceana North Sea research expedition in 2016. Taxa are listed according to whether they occurred in the waters of the Netherlands (NL) or the United Kingdom (UK).

| Species | Netherlands | United Kingdom |
|---|---|---|
| *Pandalina profunda* | X | |
| *Pandalina* sp. | X | |
| *Pandalus montagui* | X | |
| *Perforatus* cf. *perforatus* | X | |
| *Pilumnus hirtellus* | | X |
| *Pisidia longicornis* | X | |
| *Scalpellum scalpellum* | X | |
| *Sessilia* sp. | X | |
| *Upogebia deltaura* | | X |
| Brachiopoda | | |
| *Novocrania anomala* | X | |
| Bryozoa | | |
| *Alcyonidium diaphanum* | X | X |
| Bryozoa | X | X |
| *Bugula* sp. | X | |
| *Bugulina turbinata* | X | |
| *Cellepora pumicosa* | X | |
| *Cheilostomatida* sp. | X | |
| *Crisia* sp. | X | |
| *Crisularia plumosa* | X | |
| cf. *Einhornia loricata* | X | |
| *Eucratea loricata* | X | |
| cf. *Eucratea loricata* | X | |
| *Flustra foliacea* | X | X |
| *Palmiskenea skenei* | X | |
| *Pentapora foliacea* | X | X |
| *Reptadeonella violacea* | X | |
| *Schizomavella (Schizomavella) linearis* | X | |
| *Schizomavella* sp. | X | |
| *Securiflustra securifrons* | X | |
| *Vesicularia spinosa* | X | |
| cf. *Vesicularia spinosa* | X | |
| Chlorophyta | | |
| *Ascidiella* sp. | X | |
| Chordata | | |
| *Agonus cataphractus* | | X |
| *Ammodytes tobianus* | X | X |
| cf. *Aphia minuta* | X | |
| *Arnoglossus laterna* | X | |
| *Ascidia conchilega* | X | |
| Ascidiacea | X | |
| *Ascidiella aspersa* | X | |
| *Ascidiella scabra* | X | |
| *Branchiostoma lanceolatum* | X | X |
| *Callionymus lyra* | X | X |
| *Callionymus maculatus* | X | |
| *Callionymus reticulatus* | X | |
| *Callionymus* sp. | X | |
| *Clavelina lepadiformis* | X | |
| *Echiichthys vipera* | | X |
| *Enchelyopus cimbrius* | X | |
| *Eutrigla gurnardus* | X | |
| Gadidae | X | |
| *Gadus morhua* | X | |
| Gobiidae | X | |
| *Labrus mixtus* | X | |

| Species | Netherlands | United Kingdom |
|---|---|---|
| *Limanda limanda* | X | X |
| *Merlangius merlangus* | X | |
| *Microstomus kitt* | X | |
| cf. *Molgula manhattensis* | X | |
| *Molva molva* | X | |
| *Myoxocephalus scorpius* | X | X |
| *Pholis gunnellus* | X | |
| Pisces | X | |
| *Pleuronectes platessa* | X | X |
| *Pleuronectidae* sp. | X | |
| *Pleuronectiformes* sp. | X | X |
| *Pollachius* sp. | X | |
| *Pomatoschistus* cf. *microps* | X | |
| *Pomatoschistus* sp. | X | |
| Trachinidae | | X |
| Cnidaria | | |
| *Abietinaria abietina* | X | |
| *Actiniaria* sp. | X | |
| *Alcyonium digitatum* | X | X |
| *Alcyonium palmatum* | X | |
| *Bougainvillia muscus* | X | |
| *Cerianthus lloydii* | X | |
| *Chrysaora hysoscella* | X | |
| *Cyanea capillata* | | X |
| *Dynamena pumila* | X | |
| *Ectopleura larynx* | X | X |
| Haleciidae | | X |
| *Halecium halecinum* | X | X |
| *Halecium* sp. | X | |
| *Hydractinia echinata* | X | X |
| *Hydrallmania falcata* | X | |
| cf. *Hydrallmania falcata* | | X |
| Hydrozoa | X | X |
| *Leptothecata* sp. | X | X |
| *Metridium senile* | X | |
| *Nemertesia* sp. | X | |
| *Obelia geniculata* | X | X |
| *Obelia longissima* | X | |
| Plumulariidae | X | |
| cf. *Schizotricha frutescens* | X | |
| *Sertularia cupressina* | X | |
| Sertulariidae | X | X |
| *Tubularia indivisa* | X | X |
| *Urticina eques* | X | X |
| *Urticina felina* | X | |
| *Urticina* sp. | X | |
| Ctenophora | | |
| *Pleurobrachia pileus* | X | |
| Echinodermata | | |
| *Amphiura filiformis* | X | X |
| *Asterias rubens* | X | X |
| *Astropecten irregularis* | X | X |
| *Brissopsis lyrifera* | X | |
| *Brissus unicolor* | | X |
| *Echinocardium cordatum* | X | X |
| *Echinocardium flavescens* | | X |

| Species | Netherlands | United Kingdom |
|---|---|---|
| *Echinocardium* sp. | X | |
| *Echinocyamus pusillus* | X | X |
| *Echinodermata* sp. | | X |
| *Ophiothrix fragilis* | X | |
| *Ophiura ophiura* | X | |
| *Spatangoida* sp. | X | |
| *Spatangus purpureus* | X | X |
| Mollusca | | |
| *Abra alba* | X | X |
| *Abra longicallus* | X | |
| *Abra prismatica* | | X |
| *Acanthocardia tuberculata* | X | |
| *Aeolidiella* sp. | X | |
| *Aequipecten opercularis* | X | X |
| *Anomia ephippium* | X | |
| Anomiidae | | X |
| *Aporrhais pespelecani* | X | |
| *Arctica islandica* | X | X |
| Bivalvia | X | |
| *Buccinum undatum* | X | X |
| *Calliostoma zizyphinum* | X | |
| Cardiidae | | X |
| *Cerastoderma* cf. *ciliatum* | X | |
| *Chamelea striatula* | X | X |
| *Chlamys* sp. | | X |
| *Corbula gibba* | X | X |
| *Diaphorodoris luteocincta* | X | |
| *Donax* sp. | | X |
| *Donax vittatus* | | X |
| *Doris pseudoargus* | X | |
| *Dosinia* cf. *exoleta* | | X |
| *Dosinia exoleta* | X | X |
| *Dosinia* sp. | X | X |
| cf. *Dosinia* sp. | X | |
| *Ennucula tenuis* | X | |
| *Ensis* cf. *ensis* | | X |
| *Ensis ensis* | | X |
| *Ensis* sp. | X | X |
| *Epitonium* cf. *clathrus* | | X |
| *Epitonium* sp. | X | |
| *Euspira catena* | X | X |
| *Euspira* sp. | | X |
| *Facelina bostoniensis* | X | |
| *Gari fervensis* | X | |
| *Gouldia minima* | X | |
| *Heteranomia squamula* | | X |
| cf. *Heteranomia squamula* | | X |
| *Janolus cristatus* | X | |
| *Jorunna tomentosa* | X | |
| *Laevicardium crassum* | X | X |
| *Laevicardium* sp. | | X |
| *Limecola balthica* | X | X |
| *Macoma calcarea* | | X |
| *Macoma* sp. | | X |
| *Mactra* sp. | | X |
| Mactridae | X | |

| Species | Netherlands | United Kingdom |
|---|---|---|
| *Mya arenaria* | | X |
| *Mya* sp. | X | |
| *Mya truncata* | X | |
| *Mysia undata* | | X |
| Naticidae | | X |
| *Neptunea antiqua* | X | |
| *Nucula nitidosa* | X | X |
| *Nucula nucleus* | | X |
| Nudibranchia | X | X |
| *Odostomia* sp. | | X |
| *Ostrea edulis* | | X |
| *Palliolum tigerinum* | | X |
| *Panomya norvegica* | X | |
| *Parvicardium exiguum* | X | |
| *Parvicardium pinnulatum* | | X |
| *Pecten maximus* | X | |
| *Phaxas pellucidus* | X | |
| *Polititapes rhomboides* | | X |
| *Polycera faeroensis* | X | X |
| *Polycera* sp. | | X |
| *Prosobranchia* sp. | X | |
| *Retusa truncatula* | X | |
| Semelidae | | X |
| *Simnia patula* | X | |
| *Spisula elliptica* | X | X |
| *Spisula* sp. | | X |
| *Spisula subtruncata* | | X |
| *Steromphala cineraria* | | X |
| *Tellina* sp. | | X |
| cf. *Tergipes tergipes* | | X |
| *Thecacera pennigera* | X | |
| *Thracia convexa* | X | |
| *Thracia phaseolina* | X | |
| *Thracia* sp. | X | |
| *Thracia villosiuscula* | X | |
| *Thyasira* sp. | X | |
| *Timoclea ovata* | X | X |
| *Trochidae* sp. | X | |
| *Turritella communis* | X | |
| Veneridae | X | |
| *Venus casina* | X | X |
| *Venus verrucosa* | | X |
| Porifera | | |
| *Cliona celata* | X | X |
| *Demospongiae* sp. | X | |
| *Halichondria (Halichondria) panicea* | X | X |
| *Halichondria* sp. | X | |
| *Haliclona (Haliclona) oculata* | X | |
| *Leucosolenia variabilis* | X | |
| cf. *Mycale (Carmia) micracanthoxea* | X | |
| *Polymastia* sp. | X | |
| Porifera | X | |
| *Suberites ficus* | | X |
| *Suberites* sp. | X | |
| Rhodophyta | | |
| *Lithothamnion* sp. | X | |

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# PROTECTING THE NORTH SEA: CLEAVER BANK


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