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Unambiguously defined and recognized seabed protection targets are necessary for successful implementation of MPAs

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ABSTRACT

Bottom-impacting fisheries affect benthic marine ecosystems through extraction of resources and physical habitat impact. To protect natural values against human impacts, marine protected areas (MPAs) are being implemented. In practice, however, these do not necessarily provide full protection against bottom-impacting fisheries. Sometimes only certain types of fishing are prohibited, or only during certain periods of the year. In the Netherlands currently 20% of the North Sea is declared MPA. Most areas include ambiguously defined conservation goals for the seafloor, such as protection against 'note-worthy' impact. The government, fishermen and NGOs state that respectively 4%, 20% and less than 1% of the Dutch North Sea floor is currently protected against bottom-impacting fisheries. These diverging perspectives hamper successful communication, and result in different views on whether the Netherlands meets (inter)national targets. This paper reveals the fact-base and rationale behind these different perspectives, and illustrates these in more detail for three areas in the Dutch North Sea. We suggest five steps to help avoid miscommunication, operationally define Dutch MPAs and ensure their effectiveness; (1) explicitly specify protection goals beforehand, (2) substantiate why and how the protection goals under (1) will be reached with the proposed measures, (3) define measurable targets, (4) ensure enforcement and (5) monitor closely and adapt when needed. The explicit fact-base presented in this paper aims to contribute to a constructive discussion about protection goals and necessary measures, and prevents Babylonian confusion. Recent new developments concerning the 'North Sea Agreement', as well as the EU Biodiversity Strategy for 2030, have the potential to solve several of the abovementioned challenges.

1. Introduction and approach

Worldwide, fisheries have exerted impact on marine benthic habitats through extraction of resources and habitat destruction [1,15,41,45,49,52,90]. In order to protect natural values and related ecosystem services, marine protected areas have been implemented worldwide [16,24,35,62,95]. Aichi Target 11 under the Convention on Biological Diversity states that by 2020, at least 10% of coastal and marine areas should be conserved through "effectively and equitably managed, ecologically representative and well connected systems of protected areas" [16]. This is a legal obligation. The more recent EU Biodiversity Strategy for 2030 states that by 2030 at least 30% of EU seas should be effectively managed and coherent protected areas, and 10% of EU seas should be strictly

protected [31].

The North Sea ecosystem is subject to bottom-towed fisheries for demersal fish (flatfish, cod), shellfish and shrimp [25,26]. Bottom-towed fishing gear can reduce the physical complexity of habitats, the biomass and biodiversity of benthic communities and can change the species composition of the benthic community. The intensity of the effects depends on habitat, gear type and fishing intensity [83,85], and fragile habitat structures such as biogenic reefs are easily damaged or destroyed [15,25,44,45,52,90,93]. For example, in the North Sea bottom trawling activities have reduced native flat oyster beds, and populations of long-living animals such as quahogs (*Arctica islandica*) and whelks (*Buccinum undatum*), and various shark and ray species have been severely depleted [6,15,25,26,39,44,55,64,68,74,87,101]. Even a

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trawling frequency of once every 10 years will affect such populations and the habitat integrity for a long time, as it takes more than 10 years for populations of such species to recover [25,56]. It could be argued that to protect the seafloor, entirely closing such zones to all forms of fishing (and other activities) is desirable. Several studies show that fully protected areas, with no or hardly any activities whatsoever (also called Marine Reserves or no-take areas), are by far the most effective for nature conservation [8,17,57,61]. This is partly explained by such measures being easier to enforce [8], but also by such designations removing all extractive activities with direct and indirect negative impact [8,17,57,61].

In line with European obligations (e.g. the Birds and Habitats Directives & the Marine Strategy Framework Directive) the Netherlands is (along with other North Sea countries) implementing marine protected areas in order to restore and conserve the environmental status and condition of the North Sea, including seafloor communities [35]. Currently (end of 2021), 20% of the Dutch North Sea is officially declared marine protected area (Fig. 1). For five of these six areas, conservation goals for the seafloor are included (the Frisian Front is currently only designated as a specially protected area for a single bird species, the common guillemot) (Table 1). Despite these seafloor conservation goals, demersal fishing activities are allowed in these areas, with the exception of certain specific zones within these MPAs (Table 1). This is a widely seen phenomenon; designating an area as an MPA does not necessarily imply prohibiting activities such as bottom-impacting fisheries [14,17,47,57,63]. Often, different protection zones are implemented, allowing various types of fisheries in some of these zones, sometimes limited to specific seasons [57]. A recent study in the southern and central North Sea even revealed that some fisheries hot-spots lie within marine protected areas, due to the fact that fisheries make use of certain productive environmental habitat features that also give the MPAs their special ecological value [97]. Mazaris et al. [63] demonstrated that in 55% of the studied European MPAs fishing activities have been reported, including active demersal fishing methods, and this was identified as one of the most common threats to MPAs [63].

This phenomenon of so-called protected areas that are still under human (fishing) pressure, has been demonstrated all across the world [14,17,22,63]. An analysis in 2018 of MPAs across Europe demonstrated that trawling intensity was 1.4 times higher within MPAs than in non-protected areas [22]. Claudet et al. [14] demonstrated that 6% of the Mediterranean Sea is designated protected area, but in 95% of these areas regulations are not stricter than outside the area [14]. In line with these findings, Horta e Costa et al. [47] state that bottom trawls and bottom seines correspond to the highest impact and destruction of the ecosystem, weighing heavily in their regulation-based classification of MPAs and resulting in a higher score (corresponding to lower protection levels). On a global scale, Costello and Ballantine [17] calculate that 94% of the assigned MPAs allow fishing. They argue that the international calculations of marine protection, such as by IUCN, are therefore incorrect [17]. This lack of true protection of 'protected' areas is not limited to the sea, but can also be seen on land [50].

The occurrence of fisheries within MPAs in the Netherlands leads to varying opinions about whether the seafloor in these areas can be considered protected. The Dutch government was confident it would reach (inter)national goals in 2020 [66]. Fishermen state that current levels of seafloor protection are adequate or even unnecessary, and that the Netherlands is too restrictive towards fishing [51,99,100]. Dutch NGOs, on the other hand, state that the protection measures in the Netherlands are far from adequate and insufficient to protect the seafloor against adverse effects of fisheries [92,103]. Interestingly, all three

Legally designated MPA's 2020

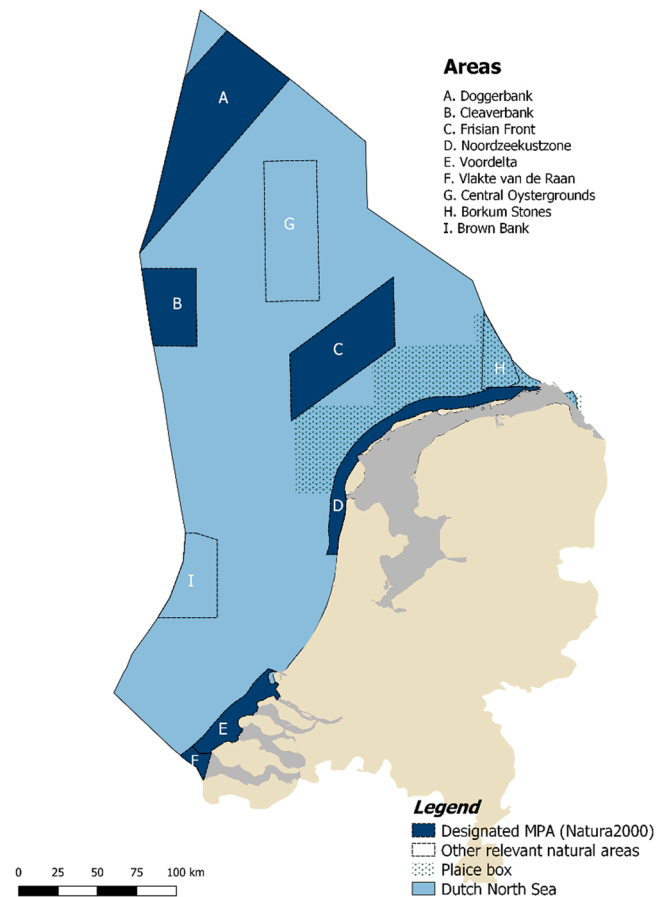


Fig. 1. Since 2016 20% of the Dutch North Sea is officially declared marine protected area (MPA) according to Natura 2000 (status at the end of 2021).

opinions are based on the same fisheries measures, leading to the question of what could explain these different interpretations. What do the different stakeholders mean when they talk about 'protection' and what are the consequences of this for the North Sea floor area that they consider to be protected?

This paper reviews the underlying data and interpretations resulting in different conclusions about the percentage of the Dutch North Sea floor that currently is, and projected to become, protected against bottom-impacting fisheries, according to the government, fishermen and NGOs. We will briefly outline the legal and policy context of marine protection in the Netherlands, after which we will present current (as it is per the end of 2021) bottom-fisheries restrictions in the designated areas. We will then apply the three different stakeholder interpretations of seafloor protection to the data, and calculate the subsequent percentages of seafloor protection according to these three views. In addition, we will present the future percentages according to these differing interpretations, for the already agreed MPA plan for 2020 (scenario 1), and for a future scenario (scenario 2) that has recently been developed (the North Sea Agreement, see Section 4 of this paper). The outcomes reveal the urgent need for unambiguously defined and recognised seabed protection goals, targets and definitions, as a basis for useful discussions and appreciable and successful nature conservation

management.

The research area covers the Dutch North Sea, from the shore to the boundaries of the Dutch North Sea (territorial sea and Exclusive Economic Zone, EEZ), excluding the Wadden Sea (Fig. 1).

2. Legal and policy context for benthic habitat protection in MPAs

According to a number of international conventions and directives, the Dutch government had to protect parts of the North Sea seafloor habitats by 2020, mostly via designation of MPAs. Coastal states are responsible for implementation of regulations concerning MPAs in their national law, and subsequently translate them into measures for waters that fall within their jurisdiction. For benthic habitat protection, the following international legal instruments are most relevant for MPAs and spatial fisheries measures:

- EU Birds and Habitats Directives (also known as the EU Nature Directives). The main objective of the EU Nature Directives is to conserve the natural habitats and wild fauna and flora in the EU through, inter alia, the creation of an ecological network of protected areas called Natura 2000 [32,33]. The EU Commission recommends protecting between at least 20–60% of the habitats that qualify under the Habitats Directive. The Nature Directives have been transposed in Dutch law in the Nature Conservation Act (in force since 1 January 2017) [23]. Since 2016, the Dutch North Sea harbours six Natura 2000 areas, of which one is protected under the Birds Directive and five are protected under the Habitats Directive. These five areas have specific conservation goals in relation to the seafloor habitat (Fig. 1 A, B, D, E, F, Table 1) [73]. Inherent to the process of Natura 2000 protection is a set of jurisdictional steps in time, which result in a timeframe of up to several years between designation of the area and the implementation of (fisheries) measures [27,28]. For the three coastal areas (Fig. 1 D, E, F) measures are in place (Table 1), for the two offshore Habitats Directive areas (Fig. 1 A, & B) measures are not yet in place. Since 2016, management plans for these areas are under development (expected 2021, see Table 1 and Section 4 of this paper) and the fisheries measures are being discussed at EU level, in line with the Common Fisheries Policy (see below). However, once areas are formally designated under Natura 2000, they fall under a strict protection regime as described in Article 6 of the Habitats Directive [32,33]. Therefore, allowing fisheries activities in Natura 2000 areas without a thorough impact assessment convincingly demonstrating that the activity will not significantly affect the protection values, is in breach of European law.
- Marine Strategy Framework Directive (MSFD). The MSFD, established in 2008, aimed to achieve Good Environmental Status in EU marine waters by 2020, through (amongst others) the creation of a coherent and representative network of marine protected areas (Article 13(4)) [36]. The MSFD has been transposed in Dutch law in the Water Decree under the Water Act in 2010. In order to contribute to conservation of descriptor 1 (Biodiversity), 3 (Populations of commercial fish species), 4 (Food webs) and 6 (Sea floor integrity) of the MSFD, the Dutch government stated the ambition to protect 10–15% of the Dutch North Sea floor from ‘note-worthy’ bottom impacts (the meaning of this term will be discussed in detail later) [69]. In addition to the Natura 2000 areas, two areas have therefore been proposed for seafloor protection measures under the MSFD:

Frisian Front and Central Oyster grounds (Fig. 1 C & G) [66]. The potential measures for seafloor protection are still under discussion with other member states, in line with the Common Fisheries Policy (see below), and are also addressed in the North Sea Agreement (see Section 4).

- Common Fisheries Policy (CFP). According to the CFP, fishermen are subject to a set of rules and regulations, in order to manage the European fishing fleet and conserve the stocks of the fished species. The Plaice Box (Fig. 1) is an example of a spatial measure under the CFP, intended to protect young plaice. The Plaice Box is an area along the Dutch, German and Danish Wadden Sea coast, closed to beam trawlers > 300pk [77]. Although it can be argued that the Plaice Box is not an MPA, as it does not concern conservation objectives, fishermen often perceive and discuss it as such. It is therefore included in this analysis (see Section 3.2.). Even some researchers treat it as such [4,5]. The CFP further entails that any fisheries measures that occur outside territorial waters (i.e. beyond 12-mile from the coast), as described under the MSFD above, need to be discussed and agreed on EU level before implementation (Art. 11 of regulation 1380/2013). To this end the ‘initiating’ member state provides scientific information and a rationale for the proposed measures to all other member states having direct management interest. The member states may then collectively submit a ‘joint recommendation’, including the measures and the underlying information, which will then be judged by the European Commission. In case the countries don’t come to an agreement, the Commission may submit a proposal for measures themselves [37].

In addition, the following two international conventions require measures that partially overlap with aspects of the three EU instruments mentioned above:

- Convention of Biological Diversity. Aichi Target 11 of this international treaty states that “By 2020, at least [...] 10% of coastal and marine areas [...] are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas” [16].
- OSPAR convention. In the Oslo/Paris convention for the protection of the marine environment of the North East Atlantic, 16 nations decided to cooperate to protect the North-East Atlantic. The precautionary principle and the ecosystem approach are central, and a network of MPAs is one of the main OSPAR objectives [75]. Five of the six Dutch Natura 2000 areas are enlisted as OSPAR marine protected areas: the Dogger Bank, Cleaverbank, Noordzeekustzone, Voordelta and Vlakte van de Raan (Fig. 1 A, B, D, E, F). It is not explicitly stated whether (bottom-impacting) fisheries should be prohibited in the OSPAR marine protected areas.

Based on the above regulations, the Dutch government had committed itself to protect 10–15% of the Dutch North Sea floor from so-called ‘note-worthy’ bottom impact (concept and definition is discussed in detail later) by 2020, through imposing measures in eight ecologically valuable areas in the North Sea: the Dogger Bank, Cleaverbank, Frisian Front, Central Oystergrounds, Noordzeekustzone, Borkum Stones, Voordelta, and Vlakte van de Raan [59,60]. Table 1 describes the various fisheries restrictions that are in place or were proposed for the Natura 2000 and MSFD areas in the Dutch North Sea, along with their conservation goals regarding the seafloor.

Table 1

Dutch North Sea Natura 2000, Marine Strategy Framework Directive (MSFD) and CFP areas and their conservation goals, current and proposed fisheries measures related to the seafloor habitats.

Protection Framework	Area name and % of the total Dutch North Sea area	Habitat Directive Habitat type	National status of Habitat type (HD) ^a or assessment of Good Environmental status (MSFD) ^b	Conservation goal regarding surface of Habitat type (HD) or Good Environmental status (MSFD)	Conservation goal regarding quality of habitat (HD) or Good Environmental status (MSFD)	Fisheries measures related to seafloor habitat (end of 2021)	Proposed (additional) fisheries measures, originally due 2020 but not implemented yet (scenario 1).	Proposed (additional) fisheries measures as agreed within the NSA, due 2023 (scenario 2) [76]
Natura 2000	Doggerbank (8.06%, Fig. 1 A)	H1110 – Sandbanks slightly covered by seawater all the time	Unfavourable-inadequate (2013) ^c [70]	Preservation	Improvement	100% Unprotected	28% (two management zones) closed to most bottom- impacting gear, still allowing flyshoot	40% (two management zones) closed to all bottom-impacting gear, partly outside original area.
	Cleaverbank (2.62%, Fig. 1 B)	H1170 - Reefs	Unfavourable-inadequate (2013) ^c [71]	Preservation	Improvement	100% Unprotected	44% (4 management zones) closed to all types of bottom-impacting gear	80% (two management zones) closed to all bottom-impacting gear
	North Sea coastal zone (Noordzeekustzone) (2.46%, Fig. 1 D)	H1110 ^d – Sandbanks slightly covered by seawater all the time	Unfavourable-inadequate (2013) ^c [70]	Preservation	Improvement	10% No-take 28% Only non-bottom-impacting fishing techniques & innovative techniques (e.g. pulse fishing), based on license ~40% No beam trawl with tickler chain allowed, other trawling fisheries is allowed (the rest is inside the Plaice Box, see below) [65,67]	No additional measures proposed	No additional measures proposed
	Voordelta (1.42%, Fig. 1 E)	H1110 ^d – Sandbanks slightly covered by seawater all the time	Unfavourable-inadequate (2013) ^c [70]	Preservation	Preservation	2.26% No-take zone; 3.1% No bottom-impacting fisheries; 35.7% ('Seafloor protection area') closed to trawlers > 260 hp 64.3% No beam trawl with tickler chain allowed, other trawling fisheries is allowed [82,65]	No additional measures proposed	No additional measures proposed
	Vlakte van de Raan (0.30%, Fig. 1 F)	H1110 ^d – Sandbanks slightly covered by seawater all the time	Unfavourable-inadequate (2013) ^c [70]	Preservation	Preservation	100% No beam trawl with tickler chain allowed, other trawling fisheries is allowed [65,81]	No additional measures proposed	No additional measures proposed
MSFD ^e	Borkum Stones (Fig. 1 H)	Not applicable, but partly covering H1170 [9]	Not applicable yet, area not yet formally designated.	Tbd	Tbd	100% Unprotected	17% of site closed to all bottom-impacting fisheries ^f [65]	100% of site closed to all bottom-impacting fisheries
	Frisian Front (4.91%, Fig. 1 C)	Not applicable	Unknown, GES not reached (2018) [68]	Improving size, condition and global distribution of populations of the community of benthos species. Improvement of the quality of the assessed areas and habitats on the Dutch part of the North Sea (Benthic Indicator Species Index). The diversity of benthos is not decreasing, trend in the areas assessed (OSPAR assessment value). [68]		100% Unprotected	35% of site closed to all types of bottom-impacting gear [66]	57% of site closed to all fisheries, bordering area (size 12% of site) closed to all bottom-impacting fisheries,
	Central Oyster grounds (5.88%, Fig. 1 G)	Not applicable				100% Unprotected	29% of site closed to all types of bottom-impacting gear [66]	60% of site closed to bottom-impacting fisheries, partly outside original area.
CFP	Plaice Box (Fig. 1)	Not applicable, but partly covering H1110	Not applicable	Not applicable		Closed to fisheries with vessels > 300 hp		Fisheries measures to be lifted.

^a Article 17 of the Habitats Directive requires member states to report every six years about the progress made with the implementation of the Habitats Directive. This means that the conservation status of the habitat types should be assessed and reported every 6 years [38]. This should be done based on monitoring data – monitoring is an obligation under the HD. The habitat types are assessed according to three parameters; distribution, surface and quality. Quality in turn is assessed based on “typical species” and “structure and functions” [34].

^b Article 17 of the MSFD requires member states to review and report every six years on the assessment and determination of the Good Environmental Status (GES), environmental targets, the monitoring programmes and the programme of measures. The GES is based on various descriptors and criteria [29].

^c Should have been re-assessed in 2019, however, documents cannot be found.

^d These coastal Natura 2000 areas are designated for more habitat types than H1110. As these are mostly terrestrial, such as dunes, they are not relevant for this study.

^e The Frisian Front is also protected under the Natura 2000 Birds Directive. The Borkum Stones will likely be protected under the MSFD.

^f This was decided within the North Sea Coastal Zone fisheries agreement (Noordzeekustvisserijakkoord) [65], in which it was decided that if the shrimp fishery would meet certain sustainability goals, the remaining part of the North Sea Coastal Zone (Noordzeekustzone) would stay open to them. In turn a section of the Borkum Stones will be closed.

3. The three perspectives in spotlight

We combined the sizes of the Natura 2000, MSFD and CFP areas with the three interpretations on what percentages of those areas are protected against bottom-impacting fisheries, and calculated the total percentage of the Dutch North Sea floor that is currently considered protected against fisheries (Table 2). The background of these interpretations is given below.

3.1. Government perspective: Ministry of Agriculture, Nature and Food Quality - nature department

The Dutch government set itself the goal to protect 10–15% of the Dutch North Sea floor from ‘note-worthy’ human impact by 2020, under the MSFD [68]. It attempts to do this partly within the Natura 2000 areas, and partly within two newly appointed MSFD areas (see Table 1). The government definition of ‘note-worthy’ seafloor impact is, however, not clearly stated. To substantiate, the government refers to the so-called ‘impact assessments’ of an activity. If an impact assessment concludes that the activity will not impair the conservation goals of the area in question, the government considers it to not have ‘note-worthy’ seafloor impact. Shrimp fisheries with beam trawls in the coastal zone are, for example, not considered to have a note-worthy impact on the conservation goals [53]. Additionally, demersal seine fisheries on the Dogger Bank were, when the conservation measures for the area were drawn up, not considered to have note-worthy impact on the benthic ecosystem. A full impact assessment had, however, never been conducted. Instead, this conclusion was based on expert judgement [21]. For the perspective of the government, we analysed the percentage of the Dutch North Sea with protection against ‘note-worthy’ seafloor impact, according to their own definition. This currently occurs in 4.2% of the Dutch North Sea floor (Fig. 2a, Table 2). This analysis was verified with the Dutch Ministry of Agriculture, Nature and Food Quality [72].

3.2. Fisheries perspective: VisNed, overarching producer organisation

For many fishermen a large part of the North Sea floor is inaccessible to fish in, and subsequently considered protected from fisheries in some way or another. Fishermen therefore consider all areas that have some kind of temporal or spatial fishing restriction for one or more bottom-impacting gear protected, including some areas that are not (within) MPAs. For the fisheries perspective we thus analysed the percentage of the Dutch North Sea with any kind of temporal or spatial fishery restriction for one or more types of bottom-impacting gear. This includes areas in and surrounding windfarms and platforms, where fisheries are not allowed due to safety reasons, as well as the Plaice Box (closed to beam trawlers > 300pk). According to this perspective, bottom-fisheries restrictions currently occur in 20.2% of the Dutch North Sea floor (Fig. 2b, Table 2) and include, for example, exclusion of large beam trawlers with tickler chains from the coastal Natura 2000 areas, the Plaice Box, and areas around production platforms and windfarms. This analysis was verified with a representative of a major fisheries organisation [80].

3.3. NGO perspective: North Sea Foundation

The North Sea Foundation considers bottom-towed fisheries one of the main pressures on the seafloor and the ecosystem. Especially in the second half of the twentieth century, the scale of bottom-towed fisheries has greatly increased, with increasingly powerful engines [11]. Given the damage one fishing trawl already can bring, the North Sea Foundation opposes the statement of the government that demersal seine and shrimp fisheries have no significant impact on the seafloor and can therefore be allowed in (large parts of) MPAs. For the NGO perspective, we therefore analysed the percentage of seafloor that is year-round and fully closed to all bottom-impacting fisheries, for the purpose of nature

Table 2

Calculation of percentage of the Dutch North Sea floor currently (end 2021) protected against fisheries, according to the three perspectives (see Table 1 for description of the measures).

Area	Surface (ha)	Government ^a			Fishery sector ^b			North Sea Foundation ^c		
		Protected (ha)	% of area	% of DCS	Protected (ha)	% of area	% of DCS	Protected (ha)	% of area	% of DCS
Doggerbank	473,477	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
Central Oystergrounds	345,300	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
Cleaverbank	153,868	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
Frisian Front and bordering	288,197	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
Borkum Stones	69,777	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
Noordzeekustzone	144,474	144,475	100.00	2.46	144,474	100.00	2.46	13,797	9.55	0.23
Voordelta	83,530	83,530	100.00	1.42	83,530	100.00	1.42	2590	3.10	0.04
Vlakte van de Raan	17,521	17,521	100.00	0.30	17,521	100.00	0.30	2143	12.23	0.04
Brown Bank	127,851	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
Plaice Box ^d	914,500	0	0.00	0.00	914,500	100.00	15.57	0	0.00	0.00
Windfarms	15,160	0	0.00	0.00	15,160	100.00	0.26	0	0.00	0.00
Production platforms	12,645	0	0.00	0.00	12,645	100.00	0.22	0	0.00	0.00
Dutch Continental Shelf (DCS)	5,874,929			4.18			20.22			0.32

^a Closed to 'note-worthy' bottom-impacting fisheries according to government definition.

^b Areas with any kind of fisheries restriction in time, place or for bottom-gear type.

^c Closed year-round to all bottom-impacting fisheries for the purpose of nature conservation.

^d Plaice Box surface excluding Noordzeekustzone.

conservation (so within MPAs). This currently occurs in 0.32% of the Dutch North Sea floor (Fig. 2c, Table 2). This analysis was verified with the North Sea Foundation [86].

4. Future protection

In addition to how the current protection status is assessed, we analysed how the future protection would be perceived following the same principles as explained above. We did this for two future scenario's. The first scenario (scenario 1) entails the measures that were proposed for the various areas within different policy frameworks

(MSFD, Natura 2000 etc.). These measures (described in Table 1) were originally due 2020 but are not yet implemented (as per the end of 2021). Table 3 shows the expected percentage of protected seafloor according to the three described stakeholder viewpoints (Table 3, Fig. 3a, b & c).

The second scenario (scenario 2) entails that of the North Sea Agreement ('NSA', [76]). For this agreement, a consultative body (the so-called North Sea Dialogue) was developed in 2019 under an independent chair, in which higher functionaries of all North Sea stakeholders are represented, including the government [18,76]. Together, they were tasked to come to a North Sea agreement, with agreed

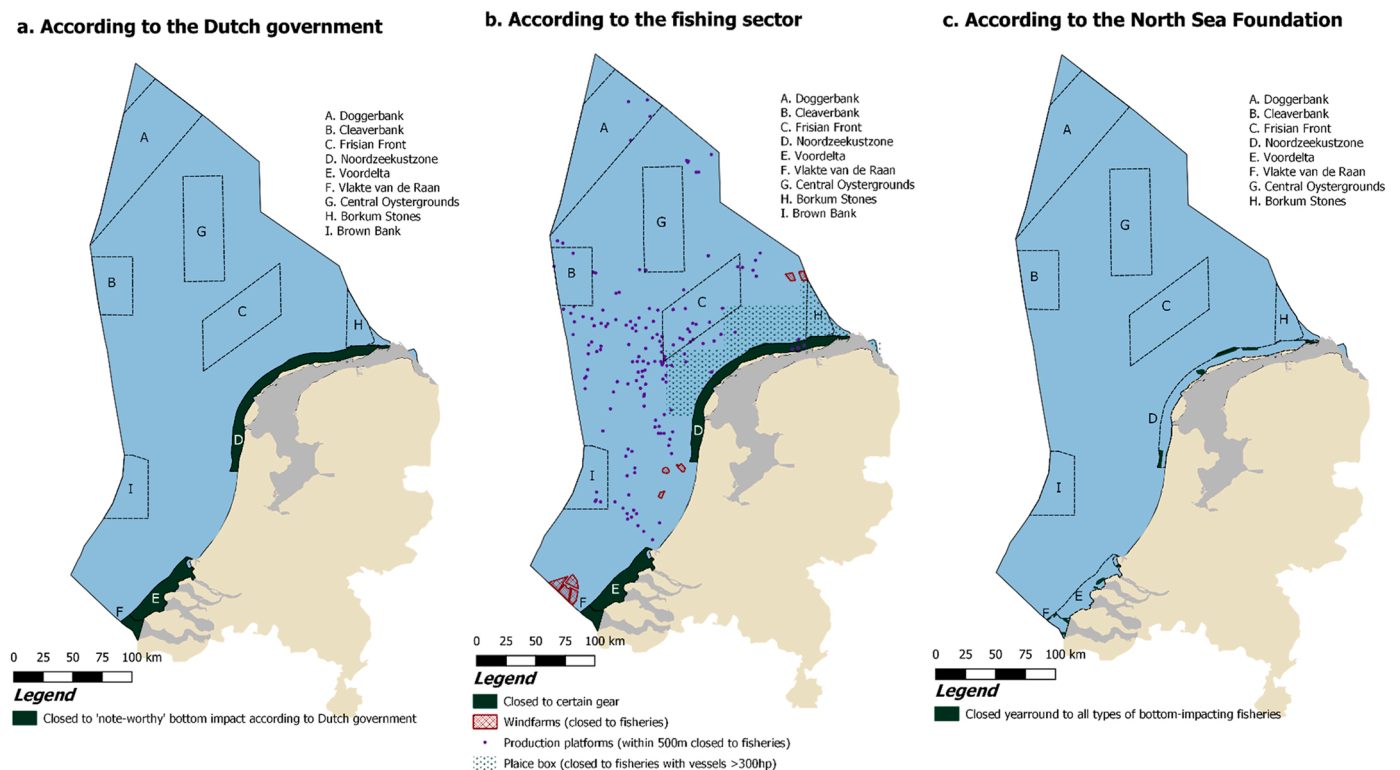


Fig. 2. Areas protected (end of 2021) according to the protection definition of (a) the Dutch government, (b) the fishing sector and (c) the North Sea Foundation. See Table 1 for measures and Table 2 for calculations.

Table 3

Calculation of percentage of the Dutch North Sea floor protected based on the proposed measures (2020) for the various areas (scenario 1, see Table 1 for description of the measures). This does not include the measures agreed and described in the recent NSA (scenario 2).

Area		Government ^a			Fishery sector ^b			North Sea Foundation ^c		
Area	Surface (ha)	Protected (ha)	% of area	% of DCS	Protected (ha)	% of area	% of DCS	Protected (ha)	% of area	% of DCS
Doggerbank	473,477	132,574	28.00	2.26	132,574	28.00	2.26	0	0.00	0.00
Central Oystergrounds	345,300	100,000	28.96	1.70	100,000	28.96	1.70	100,000	28.96	1.70
Cleaverbank	153,868	68,803	44.72	1.17	68,803	44.72	1.17	68,803	44.72	1.17
Frisian Front and bordering	288,197	100,000	34.70	1.70	100,000	34.70	1.70	100,000	34.70	1.70
Borkum Stones	69,777	12,000	17.20	0.20	12,000	17.20	0.20	12,000	17.20	0.20
Noordzeekustzone	144,474	144,475	100.00	2.46	144,474	100.00	2.46	13,797	9.55	0.23
Voordelta	83,530	83,530	100.00	1.42	83,530	100.00	1.42	2590	3.10	0.04
Vlakte van de Raan	17,521	17,521	100.00	0.30	17,521	100.00	0.30	2143	12.23	0.04
Brown Bank	127,851	0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00
Plaice Box ^d	874,500	0	0.00	0.00	874,500	95.63	14.89	0	0.00	0.00
Windfarms	15,160	0	0.00	0.00	49,560	326.91	0.84	0	0.00	0.00
Production platforms	12,645	0	0.00	0.00	12,645	100.00	0.84	0	0.00	0.00
Dutch Continental Shelf (DCS)	5,874,929			11.22			27.78			5.10

^a Closed to 'note-worthy' bottom-impacting fisheries according to government definition.

^b Areas with any kind of fisheries restriction in time, place or for bottom-gear type.

^c Closed year-round to all bottom-impacting fisheries for the purpose of nature conservation.

^d Plaice Box surface excluding Noordzeekustzone.

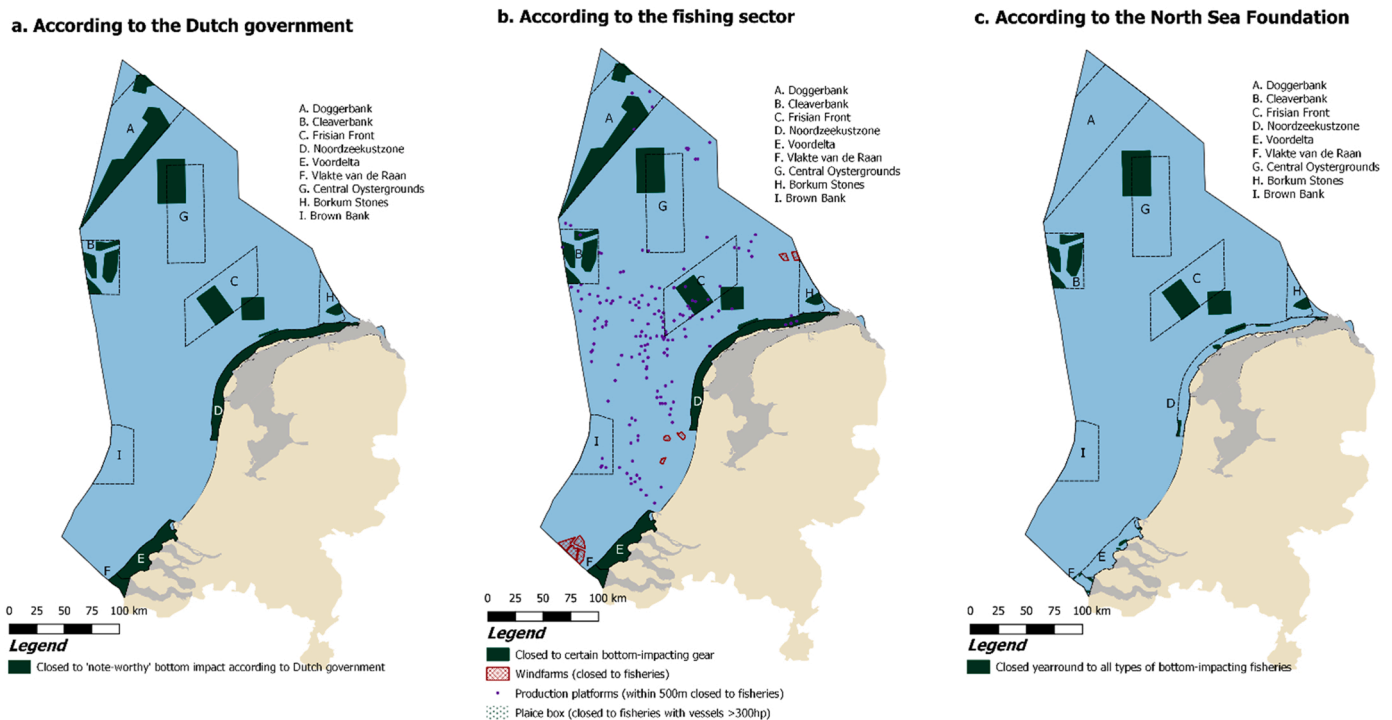


Fig. 3. Scenario 1: Areas to be protected in 2020, based on proposed plans, according to the protection definition of (a) the Dutch government, (b) the fishing sector and (c) the North Sea Foundation. See Table 1 for measures and Table 3 for calculations.

arrangements (amongst the members) for the North Sea until 2030. This includes agreements concerning offshore windfarms, fishing activities and marine protected areas [18]. The agreement was finalised in June 2020, and contained some additional plans for fisheries restrictions (Table 1). The area of the Dutch North Sea floor that would be fully, year-round protected from all bottom-impacting fisheries would increase from 0.32% to 13.7% in 2023 and to 15% in 2030 [76] (Fig. 4,

Table 4). The NSA measures build upon the situation planned under scenario 1 described above, with some additions and changes (e.g. enlarging the Frisian Front closed area and lifting the Plaice Box measures). As a result, the measures under scenario 1 will be implemented according to plan but will now be considered an intermediate step, after which the measures as agreed within the NSA for 2023 will be implemented. The additional measures for 2030 have not been determined

Measures for bottom-impacting fisheries in NSA

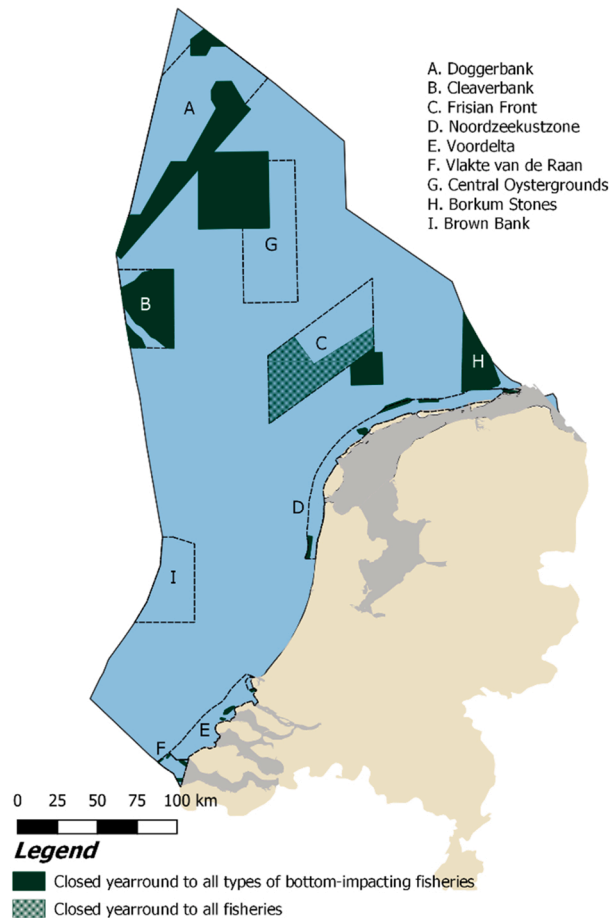


Fig. 4. Scenario 2: Areas to be closed to bottom-impacting fisheries, or all fisheries (area C) in 2023 as agreed in the North Sea Agreement (NSA) (data source [76]).

yet.

The negotiations started from a shared fact-base, which would mean that these percentages are supported by all signatories. The NSA was endorsed by the Dutch Parliament in February 2021. It has been signed by most of the parties involved, except the fisheries organisations. Although many fisheries representatives supported the agreement, there was discord among the various fisheries organisations, which in the end made it impossible for the representatives to sign on behalf of the entire

fisheries constituency [18]. Next steps include incorporating the agreed measures in National Water Plans and through that in Dutch law.

5. Discussion

Based on their different points of view on what management measures make an area ‘protected’, stakeholders differ in how they perceive the percentage of the Dutch North Sea floor that can be considered protected. This paper highlights how in the Netherlands this can vary from 20% of the Dutch North Sea floor that is protected against bottom-impacting fishing (fishermen), down to 0.32% (according to the NGO), based on the same information. This is related to the ambiguity of some of the protection goals for the Dutch North Sea floor, such as protection from ‘note-worthy’ bottom impact. Fishermen consider the seafloor to be protected in areas with any fisheries restrictions for bottom-impacting gear, which could be in time (e.g. closure for 3 months) or in fishing methods (some gear types or more powerful ships are not allowed). The North Sea Foundation, on the other hand, considers only those areas protected where the use of any type of bottom-impacting gear is prohibited year-round, and only includes areas with specific nature conservation goals. The government applies yet another definition, resulting in a protection level of 4.2%, which still is less than their own protection target of 10–15% for 2020. In addition to these diverging perspectives, the timing of the different stages of the European process to implement an MPA adds complexity. Before conservation measures such as fishing bans can be implemented, the area first needs to be “designated”. It takes several years between “designation” of an area and the actual “implementation” of (fisheries) measures [27,28]. The time-frame between designation and implementation proves to be a breeding ground for Babylonian confusion, since NGOs, fishermen and the government – in addition to their different perspectives – have different timeframes in mind. The diverging perspectives create distrust and frustration, complicating discussions about whether protection targets are reached and about the necessity for designation of more MPAs or introduction of stricter fisheries management zones within MPAs. This situation possibly also delayed decision making on fisheries closures: the plans for 2020 are still not implemented, due to delays in their national and international approval.

The debates on what counts or should count as an MPA, leading to varying percentages, are not unique to the Netherlands. It has been reported on a more global scale [12]. The same discussions prevail: whether areas without nature conservation as a primary objective, but with increased natural values as possible outcome, could be counted as MPA or whether only fully protected areas should be included [12,88].

The main differences in perspective in the Netherlands can be illustrated with three (large) areas where the perspectives on the level of protection differ the most: the Dogger Bank, the coastal Natura 2000

Table 4

Percentages of the Dutch North Sea seafloor to be protected based on the measures due 2023 as described in the recent North Sea Agreement, and agreed by all signatories (scenario 2). Based on [76].

Area		Closed to bottom-impacting fisheries in 2023		
Area	Surface (ha)	Protected (ha)	% of area	% of DCS
Doggerbank	473,477	188,274	39.76	3.20
Central Oystergrounds	345,300	206,200	59.72	3.51
Cleaverbank	153,868	124,503	80.92	2.12
Frisian Front and bordering	288,197	201,400	69.88	3.43
Borkum Stones	69,777	67,800	97.17	1.15
Noordzeekustzone	144,474	13,797	9.55	0.23
Voordelta	83,530	2590	3.10	0.04
Vlake van de Raan	17,521	2143	12.23	0.04
Brown Bank	127,851	0	0.00	0.00
Plaice Box ^a	874,500	0	0.00	0.00
Dutch Continental Shelf (DCS)	5,874,929			13.73

^a The Plaice Box measures will be lifted.

areas and the Plaice Box. The Dogger Bank is a large underwater sand-bank with sections in UK, Dutch, Danish and German North Sea waters [54,79]. The UK, the Netherlands and Germany designated it as a Natura 2000 area (respectively in 2012, 2007 and 2009), with the main aim of protecting habitat type H1110 ("Sand banks which are slightly covered by seawater all the time"). In a collaborative effort the countries developed a management plan, including designating fisheries management zones [42]. For the Dutch (and UK) sites, all bottom-impacting gear would be prohibited in these zones, with the exception of demersal seine fisheries [42,43]. In the German part, demersal seine fishing too became prohibited. Demersal seine fishing is a fishing method where a net is towed using lead-filled ropes that roll over the seafloor. Fish are herded into the path of the net by the ropes, while the area enclosed by the ropes shrinks [43]. The physical impact of demersal seine fisheries on the Dogger Bank habitat was never studied, and the decision to allow demersal seines was based on expert judgement concluding that demersal seine fishing probably would not significantly impact the benthic community of the area [21].

The Dutch government thus considers the suggested management zones on the Dogger Bank to be protected from note-worthy impact of fishing, and includes it in its calculations. Fishermen also consider it protected, since there will be restrictions for most types of bottom-impacting fishing gear. NGOs on the other hand question the conclusion that demersal seines will not negatively impact the seafloor, and state that for true protection of the seafloor all bottom-towed gear should be prohibited, year-round. The Dutch World Wide Fund (WWF NL) and other NGOs made a formal complaint to the European Commission regarding failure to comply with certain articles (a.o. Article 6) of the Habitats Directive, in relation to the fisheries management measures for the Dutch and UK Dogger Bank.

As mentioned above, allowing fisheries in Natura 2000 areas without a prior thorough impact assessment convincingly indicating that the activity will not significantly affect the protected values, is in breach of the law [102]. Recent impact assessments and literature studies conclude that the Dogger Bank harbours species that classify as vulnerable to demersal seine fisheries [10,84]. The drafted measures were, however, not adapted, so demersal seines would still be allowed in the area. Based on a review by the STECF [91], the EU nevertheless concluded that the joint recommendation and proposed measures should be adapted to exclude demersal seines from all management areas. In 2020, in the North Sea Agreement (see paragraph 4), it was agreed that seine fishing indeed should be excluded from the management zones on the Dogger Bank [76].

For the (three) coastal Natura 2000 areas, the shrimp fisheries that are allowed in large parts of these areas result in diverging calculations. An impact assessment in 2013, based on literature study and expert judgement, concluded that shrimp fisheries with beam trawls likely will not have a note-worthy impact on the seafloor habitat [53]. According to the NGO perspective, beam trawl shrimp fishing does have a negative impact on the seafloor habitat. Unfortunately, a research effort to monitor the actual differences between fished and unfished areas was impaired by lack of enforcement, resulting in fished 'unfished' areas [40, 94]. A few conclusions could still be drawn, including that some species such as razor clams, benefitted from the disturbance, resulting in a lower evenness, one measure of biodiversity. The common cockle and a genus of tunicates decreased with increasing fishing pressure [94], and a negative trend was observed for fragile species such as barnacles and anemones [40]. This example stresses the importance of supporting decision making with realistic impact studies, facilitated by enforcing the no-fishing zone and quantification of the fishing pressure in the fishing zone. Already in 1995, Lindeboom [58] pointed at the importance of protected areas in the North Sea as an absolute need for future marine research on the effects of fisheries. Unfortunately, such areas for scientific research were never established in the Netherlands and therefore still no reference areas are available [58].

The "Plaice Box" is the name given to an area covering part of the

Dutch, German and Danish coastal zones, which was established in 1989 with the aim to protect young plaice to support fish stock development [5,48]. It was a measure implemented under the CFP, and not under Natura 2000 or the MSFD. The Plaice Box covers about 40 000 km² in total, and roughly 10 000 km² in the Netherlands. Fishing with beam trawlers of 300 hp or more was prohibited, initially during a part of the year and since 1994 year-round [48]. The Plaice Box has become a fierce point of contention between fishermen and conservationists [98]. Conservationists state the Plaice Box was never a really protected area, since fishing boats smaller than 300 hp could continue fishing there. Additionally, the measures were not intended to protect and restore nature, but to increase the plaice stock. The Plaice Box is, as a result, not located in an area with specifically high or unique natural values, since it was never intended for nature conservation. The plaice biomass, however, declined since implementation of the measures, and the young fish moved to the edges of the area [5]. The fishing industry therefore sees the Plaice Box as proof that area protection does not work. They explain that the plaice decline is the result of the lack of bottom disturbance, resulting in a reduced food supply, a plausible mechanism supported by some studies [46,96]. Additional factors probably also reduced the plaice density, such as increased water temperature, increased nutrient loads, increased predation and increased food supply along the edges [5, 77]. The Plaice Box thus became illustrative of the miscommunication that subsequently blurred discussions about the usefulness of area protection. In the NSA it was agreed that the fisheries limitations for the Plaice Box will be lifted.

The above examples illustrate that there are various aspects that can make stakeholders disagree on important issues, while referring to the same information. We suggest five main steps that could help operationally define MPAs, prevent miscommunication and thus facilitate true discussion and negotiation.

- (1) Explicitly specify the protection goal for a certain area beforehand [2,31,78]. Is the goal to protect a certain habitat (e.g. Natura 2000 area) or to revive a certain fish stock (e.g. Plaice Box)? The latter is not a nature protection goal per se, and may not benefit from enabling the natural development of elaborate biodiversity and food webs in a certain area.
- (2) Substantiate how the protection goal is likely to be reached with the proposed measures [13]. This should be based on available scientific information and/or information from dedicated field experiments. Otherwise, the precautionary principle should be followed (in line with the Habitats Directive), until enough information is available on the consequences of seafloor impacting fishing gear for long-living and other sensitive species. Also consider whether the size of the protected area would be large enough to, for example, substantiate a healthy seafloor community based on the ecological knowledge of the protected or flagship species.
- (3) Define measurable targets related to the core protection goal [2]. These targets should be approached from an ecosystem perspective, so should for example focus on organisms with certain traits (e.g. long-living animals with vulnerable shells) instead of specific species [89]. This makes the targets more robust in the face of natural changes due to, for example, climate change. Ambiguous terms such as 'note-worthy' impact, as used by the Dutch government, should be avoided, as these allow for different interpretations and are not measurable targets. Moreover, there should be a combination between quantitative targets, such as protected area coverage, and qualitative targets, such as habitat diversity, represented trophic levels or development of biogenic reefs [12,20].
- (4) Measures should have public support and be enforceable, and enforcement must be guaranteed [13,24,61]. Lack of enforcement will frustrate the results of the measures and undermine the credibility of future measures. Measures should be

straightforward, without too many details and exceptions. Table 1 and Fig. 2 & Fig. 3 demonstrate that the current Dutch MPA measures include quite some exceptions and fragmented areas with fisheries restrictions. This makes effective enforcement challenging.

- (5) Closely and systematically monitor the effect of the measures, based on agreed indicators and well-chosen endpoints related to the explicit conservation goals. Monitoring should continue over longer, ecologically relevant periods, and the measures adjusted if necessary [61,78]. It might take over 10 years for benthos to recover and decades to reach a succession climax [56], therefore the true effectiveness of MPAs may only become visible after over 10 years [3].

Throughout all the above steps, there should be frequent communication and consultation with stakeholders [18,19,61,78]. Such deliberative governance is gaining popularity in nature conservation [7,19], although it can be challenging with many conflicting stakes. The North Sea Agreement followed this route, and the results include additional and stricter protection of Dutch North Sea areas [18,76].

To conclude, divergent perspectives on conservation goals and measures obstruct effective implementation and assessment of Dutch MPAs. Ambiguous goals and measures that are difficult to implement and enforce can jeopardise the support for MPAs; while bottom-impacting fisheries will experience some restrictions, the restoration and conservation of seabed communities will still not be successful. Unambiguous goals and definitions and defined steps for effective enforcement will contribute to a swifter and more meaningful implementation of MPAs in the future. This will also enable compliance with the EU Biodiversity Strategy for 2030 [31]. The Biodiversity Strategy aims to put Europe's biodiversity on the path to recovery by 2030. One of the actions to be delivered by 2030 reads as follows: "Establishing a larger EU-wide network of protected areas on land and at sea. The EU will enlarge existing Natura 2000 areas, with strict protection for areas of very high biodiversity and climate value." More specifically: "Turn at least 30% of EU seas into effectively managed and coherent protected areas, and 10% of EU sea should be strictly protected." Strict protection is defined as follows: "Strictly protected areas are fully and legally protected areas designated to conserve and/or restore the integrity of biodiversity-rich natural areas with their underlying ecological structure and supporting natural environmental processes." For further information and definitions see [30, 31]. This Biodiversity Strategy offers guidance that, in combination with the recent promising developments related to the North Sea Agreement, has the potential to solve several of the abovementioned challenges.

CRedit authorship contribution statement

Jip Vrooman: Conceptualization, Data curation, Formal analysis, Visualization, Writing – original draft. **Christiaan van Sluis:** Conceptualization, Data curation, Writing – review & editing. **Floris van Hest:** Conceptualization, Writing – review & editing. **Han Lindeboom:** Writing – review & editing. **Tinka Murk:** Conceptualization, Supervision, Writing – original draft.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence

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