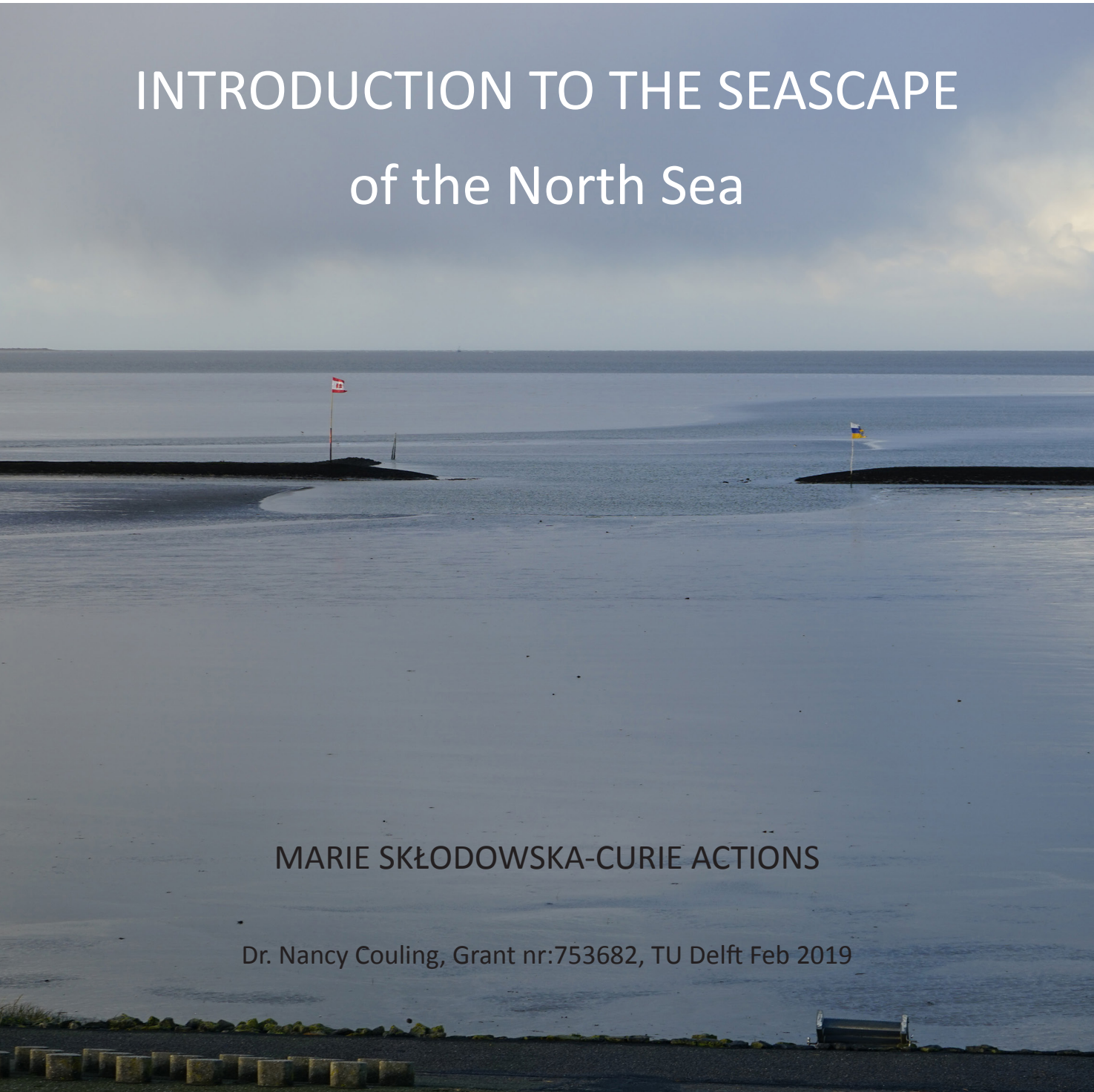
OCEANURB - the unseen spaces of extended urbanisation in the North Sea



INTRODUCTION TO THE SEASCAPE of the North Sea

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Dr. Nancy Couling, Grant nr:753682, TU Delft Feb 2019

Waddensee
source: nationale beeldbank The Netherlands

Waddensee (DE), December 2017 (Couling)

Scheveningen (NL), February 2019 (Couling)

INTRODUCTION

The seascape of the North Sea is an evolving, layered, kinetic body of water, interacting with the seafloor, the atmosphere and the coastal land. Complex processes unfold within this space, which provides habitats and sustenance for large numbers of marine and bird life. The North Sea is surrounded by Europe's most industrialised countries and its freshwater inflow comes from highly controlled and urbanised river systems. Anthropogenic factors have interacted with the sea for centuries and modified its spaces both directly through strategic dredging, construction and reclamation and indirectly through pollutants, overfishing and oxygen depletion.

The North Sea has long since ceased to be a wilderness area, it has provided its littoral countries with great wealth through resources and trade, influencing regions beyond the direct geographic sphere. The seascape is not only a topographical feature, rather it is also the basis for direct production in the fishing industry, which has modified the seabed through extensive trawling and the sea column through removal of biomass. The North Sea region is under EU pressure to increase production in maritime and related industries through "Blue Growth". Therefore, the seascape is today a transforming space of contested human uses and indigenous sea life.

Within OCEANURB, an analysis of the seascape comprises the first step in understanding North Sea urbanisation processes. This approach is based on the argument that the future of the North Sea, as part of the World's Ocean and also as a regional environment, will depend on a more effective balance between ecological systems and exploitative activities. The natural ecosystem is irrevocably intertwined with man-made artefacts and residue- both profiting from introduced habitats, and suffering from habitat loss. An understanding of the sea's inherent spatial system and the unique and valuable places under the surface, can assist in steering ongoing planning efforts towards more imaginative proposals, based on the sea's own well-defined areas and populations. The maps produced in this Work Package aim to roll back the dominant surface layer and reveal the movement, complexity and richness of the water-masses and seafloor. While incorporating detailed GIS data, the maps should also communicate a coherent spatial picture of the findings without losing an overall understanding through scientific detail.

The aim of this report is to;
- provide an overview of the inherent spatial structure of the sea and the systems and cycles influencing its internal composition
- communicate the spatial links between the major groups of bird and sea-life and the geographic area
- demonstrate how new hybrid seascapes are forming through the merger of native sea-life and artefacts introduced by humans.

The report is divided into three parts; part one outlines a theoretical basis for seascapes in relation to urbanisation processes; part two describes the main spatial features of the North Sea ecosystem, and part three introduces research results relating to the merger of sea-life with introduced artefacts.

[1] North Sea morning 13.10.17 (Couling)

I. THEORETICAL BACKGROUND

1.1 INTRODUCTION

The Sea's fundamental "landscape" characteristics hold the key to the economic potential of the fishery, wind, tourism, aquaculture and research sectors. Land- and seascape are topographical, have physical properties and are geographically rooted. I argue that seascapes are also "cultivated", and manipulated over time, although at sea such modification has remained largely unseen and indecipherable.

Perceived from land, the ocean is an inverse landscape, descending to depths greater than the highest peaks on land. Laced with mountains, valleys and unique topographical features, the immense, inverse realm of the world's ocean accommodates 92% of the space available for life.[1] Ocean space encompasses the vertical zones of the airspace, the sea surface, the water column, the topographical seabed, and the under-seabed. It is this diverse three-dimensionality that most clearly differentiates the spatiality of the sea from that of land.[2] Each stratum has unique spatial characteristics, life-forms, traditions of human interaction, requires particular forms of protection and attracts different colonisers.

1.2 SURFACE AND MASS

In the western world, the surface experience of the sea continues to dominate human perception. Without specialist cultural or technical skills, the open sea is perceived from the surface as a neutral, scale-less, boundless and directionless expanse [1]. This abstraction stands in stark contrast to both the complexity and variety of marine life inhabiting the subsurface world. Deleuze and Guattari have theorised the ocean's seeming lack of visible structure, direction and enclosure suggesting it is "*smooth space*"– rhizomic, non-hierarchical and non-directional.[3] The smoothness of sea-space refers to its isotropic nature and surface texture; appearing homogeneous but possessing de-territorialising properties and capable of accommodating multiple irregularities. Smooth space resists closing off and allocation. Here, Deleuze and Guattari identify a second characteristic unique to ocean space- the possibility of unrestricted horizontal movement over large distances.

The open sea provides the possibility to experience space in its purest, most abstract form. This is the closest we come to a space devoid of spatial information or "visual depth cues" which can mediate between the body and the environment, transmitting information on scale and distance.[4] The lack of enclosure experienced on the ocean surface is augmented by the ultimate boundary of the horizon itself, which like a horizontal curtain enables objects and landmarks to slip behind it. From the natural human viewpoint, this occurs at just under a 5km distance. Hence the spatial experience of the sea surface is in fact one of continuous opening and unfolding. The horizon has stimulated human imagination and spirituality throughout

1 Ballard, ***The Eternal Darkness***.
2 Nolte, "Nutzungsansprüche Und Raumordnung Auf Dem Meer."
3 Deleuze and Guattari, ***A Thousand Plateaus***.
4 Howard and Rogers, ***Perceiving in Depth***. 122

[2] Medieval herring fishing, 1555
source: Roberts, C. 2007 «An Unnatural History of the Sea»

time,[5] and is the subject of much artistic research (see Seascape 2)

Under the surface, ocean water-masses are fluid, malleable, dynamic volumes, determined by chemical exchanges, temperature and salinity; their movement then steered by winds, currents and bathymetry.[6] These volumes also have density and cores, properties we would normally associate with solids. Distinct habitats supporting manifold forms of life are internally embedded. These material properties of the physical ocean further distinguish it from the more rigid, static mass of *land*.

The origins and meanings of Landscape have been well researched and documented, providing a rich terrain from which to approach *seascapes*. Theorists discuss three accepted and distinct understandings of the term landscape; the productive landscape, the essentially visual landscape and the all-encompassing, amorphous hybrid of architectural and natural systems. In all three of the above, landscape exists by definition only in relation to urbanization. J.B. Jackson called these landscapes one, two and three.[7] These categories provide a useful lens for examining seascapes; Seascapes moulded through the habitual interaction of activities associated with the primary production of fishing can be compared to landscape one, pictorial seascapes follow from landscape two, and the parts of the sea which are visibly transformed through infrastructure compare to landscape three.

1.3 SEASCAPE ONE

Landscape research traces the original (medieval) meaning of the German "Landschaft" to be a firstly a socio-political unit of organisation which was then only secondly applied to a spatial unit.[8] This unit was based on community organisation, rather than a dominating power and as late as 1864, some parts of coastal Northern Germany were still organised as "landschaften", withstanding advancing forms of centralised control exercised by ruling parties in Schleswig-Holstein.

Small, regularly-spaced towns predominate along the Norwegian coast. These towns were formed around a combination of fishing and small farms at subsistence level which provided nutrition complimentary to seafood,[9] however it was the abundant "biomass" of the sea that guaranteed a livelihood and provided the excess necessary for trade. Throughout the North Sea, the seascape was well understood by local fishermen, who knew the best locations for the catch and seasonal fish movements. Fishing activities formed the basis of communities, including the land-side processing. This type of seascape was not visibly modified by interactions- more significant is the organisation of community life around regular fishing activities [2].

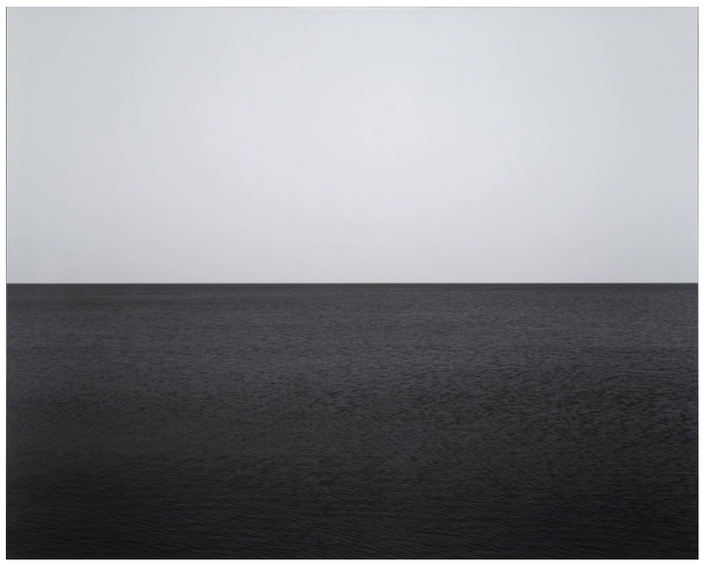
Geographer Phil Steinberg discusses a different example of fishing interactions and describes how, in contrast to the Mediterranean, in the North Sea region of the Late Middle Ages there was a tradition of extending the domain of feudal states to the sea as "annexes to terrestrial

5 Maleuvre, ***The horizon***.
6 Leppäranta and Myrberg, ***Physical Oceanography of the Baltic Sea***.
7 John Brinckerhoff Jackson, ***Discovering the Vernacular Landscape***.
8 Kenneth R. Olwig, ***Landscape, Nature, and the Body Politic***.
9 Jones, "Land-Tenure and Landscape Change in Fishing Communities on the Outer Coast of Central Norway, c. 1880 to the Present."

[3] William Turner, 1844. Rain, Steam & Speed- the Great Western Railway courtesy of www.william-turner.org

[4] Caspar David Friedrich, 1817. Two Men by the Sea

[5] Gerhard Richter, 1970. Seestueck



[6] Hiroshi Sugamoto, 1996. Seascape. Baltic Sea, Ruegen.

territories"[10]. The North Sea boasted excellent fishing grounds, and therefore specific parts of the sea were extremely well-charted and understood intimately as geographical places.

1.4 SEASCAPE TWO

Parallel to the development of the word "Landscape" in modern history, seascape has come to mean a pictorial representation of the sea. The representation of the sea is a way of shaping it, measuring its place within society; *Our relationship with the sea reflects the myths, beliefs and knowledge of our times.*[11] Therefore seascapes can potentially provide insight into how this relationship has changed.

The rising importance of maritime trade and naval power in the 16th century, in particular in the Dutch Republic, provided new artistic subject material. Important personalities, events as sea, plus accurate renderings of ships themselves, were all popular subject material. Early 18th century seascapes revealed the fascination with ocean creatures and the ocean as a chaotic, mysterious wilderness.[12] As romanticism took hold at the end of the 18th century, largely in response to the Industrial Revolution, seascape paintings were an avenue through which artists could express "*a sublime environment of Nature, beyond history..*".[13] However, the British painter Turner also included references to industrialization in his paintings. Gugger & Costa describe his painting *Rain, Steam & Speed- the Great Western Railway* as "*an impressionistic hazy landscape of industrial mist*", [3] which illustrates the forced co-existence of two antagonistic conditions- urban and nature.[14]

Contemporary seascapes represent a condition beyond history in a less romantic way, focusing on the essential elements of horizon, sea & sky. Indicators of this direction are already present in "Two Men by the Sea" (1817) [4] by the well-known German romantic painter David Caspar Friedrich. Here "aesthetics" are minimised and the subject matter is simply the space itself, with none of the allegorical intention that prevailed during this period. Gerhard Richter constructed exercises aimed at "a principle avoidance of the subject"[15] in his series of seascapes "Seestücke" (Atlas- 1970) [5]. He cut and reassembled photos of seascapes across the horizon, resulting in mismatched reflections, colours and light, which were then the basis for a series of paintings of the sea, sky and horizon. Hiroshi Sugimoto produced long-exposure photographs of the sea in his series "Seascapes" (1996-) [6], describing the subject matter of the horizon as being both "everything" and "nothing"- both essential to our existence and so commonplace.[16]

These artists represent the sea as a space of absolutes- abstract, visually minimalist but at the same time aiming to capture the vastness of infinity and the enigmatic line of the horizon- "a shifting line where perception trails off....rife with transcendental openness".[17] The legacy of seascapes discussed above traces a parallel line to territorial developments, moving from cartography where the sea is more vital than the land, to an abstract

10 Steinberg, ***The Social Construction of the Ocean***. p 70
11 Brown, ***Seascapes***.
12 Stilgoe, ***Common Landscape of America, 1580 to 1845***.
13 Steinberg, ***The Social Construction of the Ocean***. P119
14 Gugger and Costa, "Urban-Nature: The Ecology of Planetary Artifice."
15 Buchloh, ***Photography and Painting in the Work of Gerhard Richter***. P 63
16 Sugimoto.
17 Maleuvre, ***The horizon***., xiii

[7] North Sea gas installations by night (Couling)

[8] Maurice Meewisse artist, 2018. Still from video «Eight Working Hours», Zandmotor, NL

space of transcendental reflection, a nostalgic void which exists alongside the crowded site of transport and extraction.

Current marine planning and management efforts also attempt to incorporate the "open" visual quality of the physical seascape into policy documents- recognising the importance of such intangible qualities, but also facing difficulties in executive measures to protect them. German legislation does not permit the construction of offshore windfarms within the sight-range for example, precisely for this reason, and Dutch authorities are discussing possible exceptions to this rule, while aiming to preserve "the view of the horizon".[18] However, the intangible value of the sea, in particular in the case of the Netherlands, lies well behind all other economic considerations of economy and security, and is associated mostly with recreation and tourism.[19]

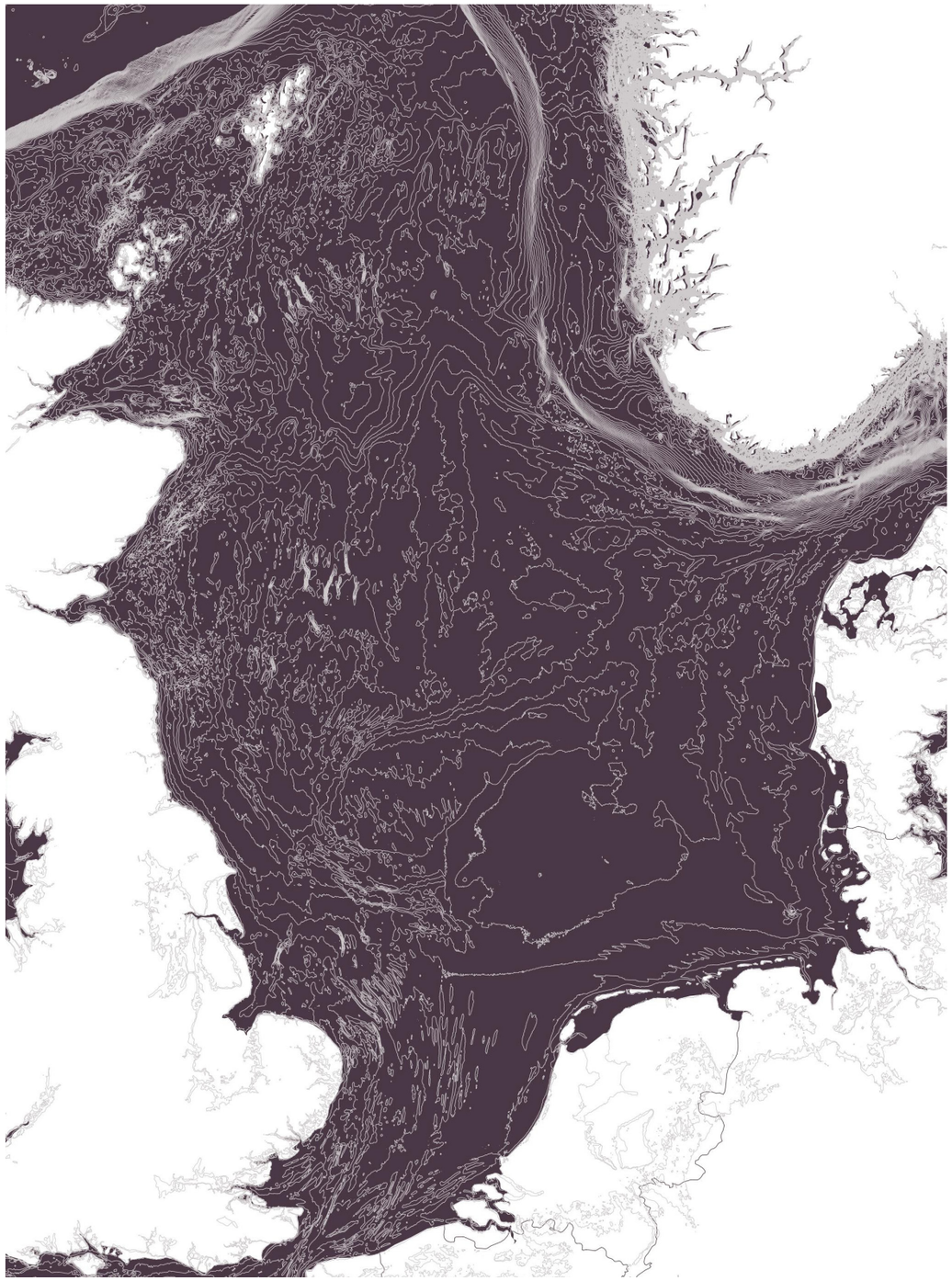
1.5 SEASCAPE THREE

The introduction of more permanent structures into the marine environment through the oil, gas and wind-energy industries provide the most tangible example of the third type of landscape as discussed by Jackson.

In the North Sea, clusters of platforms and turbines forming an industrialised, "energy" seascape are not readily visible to the public. In the case of oil and gas, their location is determined by geological formations- in the North Sea, these form a central spine in the northern part, and a more dispersed formation in the southern part. In the case of wind-energy, the position of windfarms is a planning decision, based on a combination of practical factors such as water-depth, network availability, wind-speeds and visibility from the coastline as described above. Therefore, the most extreme forms of seascape three are hard to perceive [7]. This distance from sites of human settlement has enabled a particular type of development, linked to the concept of "operationalised landscapes"[20] and the theory of planetary urbanisation.[21] In particular, sites of extended urbanisation, including the world's seas and oceans, have been enveloped by urbanisation processes including the laying of infrastructure and extraction of resources, linked to and in service of, urban areas of settlement agglomeration.[22] The Seascapes in category three are no longer "natural" or maritime wilderness areas- Brenner and Schmid argue that the end of the wilderness is one of the four most marked and far-reaching worldwide socio-spatial transformations of the last thirty years.[23]

A second example comprises the Dutch coastline, which over the centuries has been modified, constructed, extended and most recently "renaturalised" through strategies of "Building with Nature". In order to secure the coastline in a process of "sand nourishment", 12 million m^3 of sand each year is currently extracted from the North Sea and deposited on Dutch beaches- a figure which could reach 66 million m^3 by 2100. The Buil-

18 Dutch Ministry of Infrastructure & the Environment and Dutch Ministry of Economic Affairs, "Policy Document on the North Sea 2016-2021."p. 87.
19 Interdepartmental Directors' and Consultative Committee North Sea, "Integrated Management Plan for the North Sea 2015."p 47.
20 Katsikis, "On the Geographical Organization of World Urbanization."
21 Brenner and Schmid, "Planetary Urbanization."
22 Couling, "Formats of Extended Urbanisation in Ocean Space."
23 Brenner and Schmid, "Planetary Urbanization."



[9] Bathymetry of the North Sea in 10m contours (Couling)

ding with Nature approach aims to utilise natural processes and materials to protect against climate change[24], the "Zandmotor" being the most prominent example.[8] In 2011, the Dutch authorities deposited 21.5 million m^3 of sand at one coastal site between the Hook of Holland and Scheveningen in a strategy to utilise the natural dynamics of water and wind in the further formation and distribution of the sand along the coastline, avoiding additional coastal and seabed disturbance. The sand also created a new recreational landscape, including two "lakes" which are currently intensively used by kitesurfers and is monitored in its transformation by researchers.[25] In this example, the synthesis of apparently natural features and human construction has reached new levels, so that this type of seascape three appears almost entirely "natural".

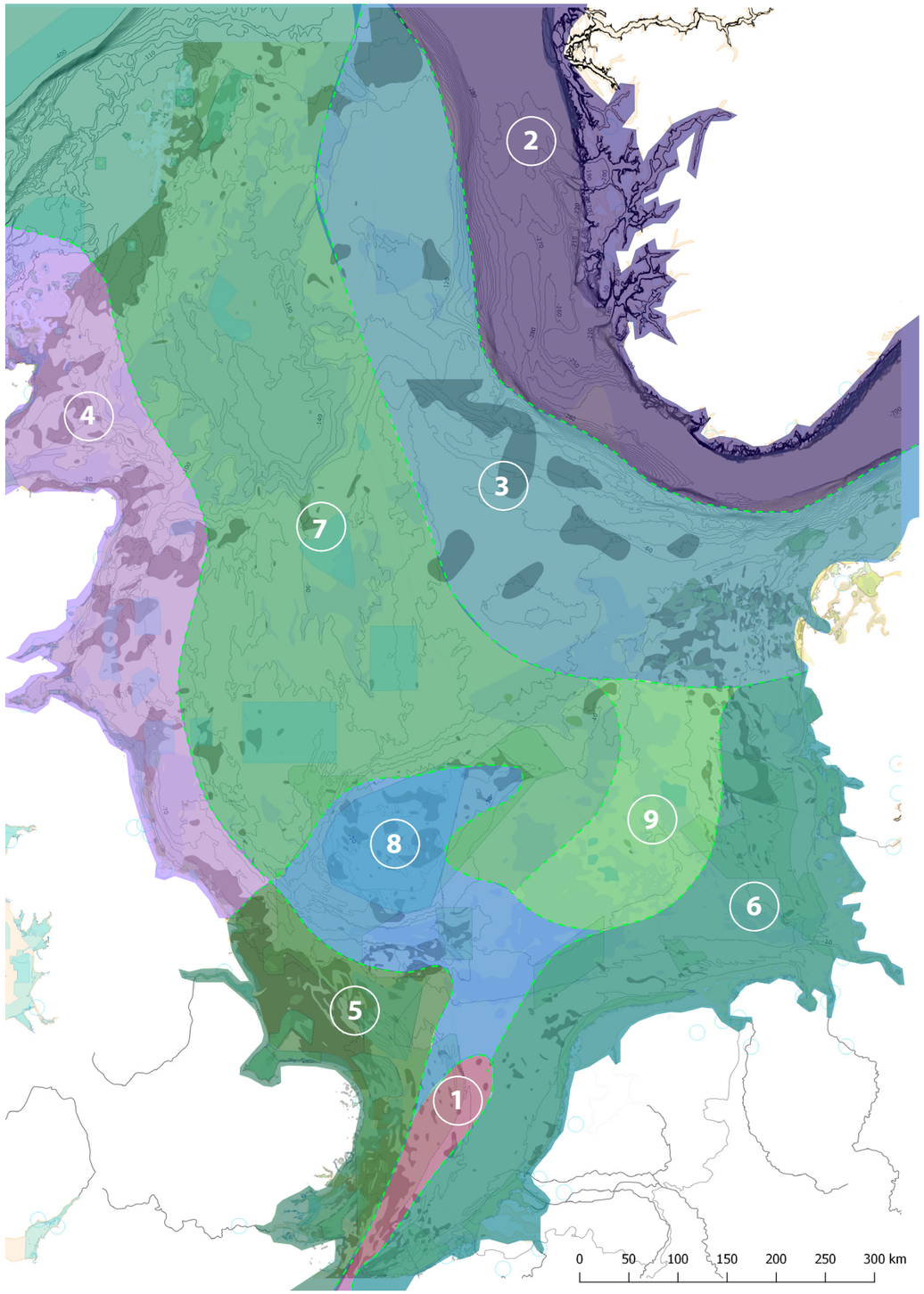
II. GEOGRAPHICAL SEASCAPE

Urbanisation processes in the North Sea unfold within a shallow but stormy sea between the latitudes of 51 and 61 degrees North, deepening and opening to the north, with offshore banks that make it difficult to navigate, rich fishing grounds, the inflow of freshwater and affluent from major European rivers (Elbe, Rhine-Meuse, Humber, Thames), and a surrounding population of 60 million people in the watershed area. Population densities of around 1000 / km^2 along the Belgian and Dutch coastal areas are the highest in Europe. It is the strongest economic region in the EU, and contains Europe's 3 major ports: Rotterdam, Hamburg & Antwerp. The sea space reflects this intensity.

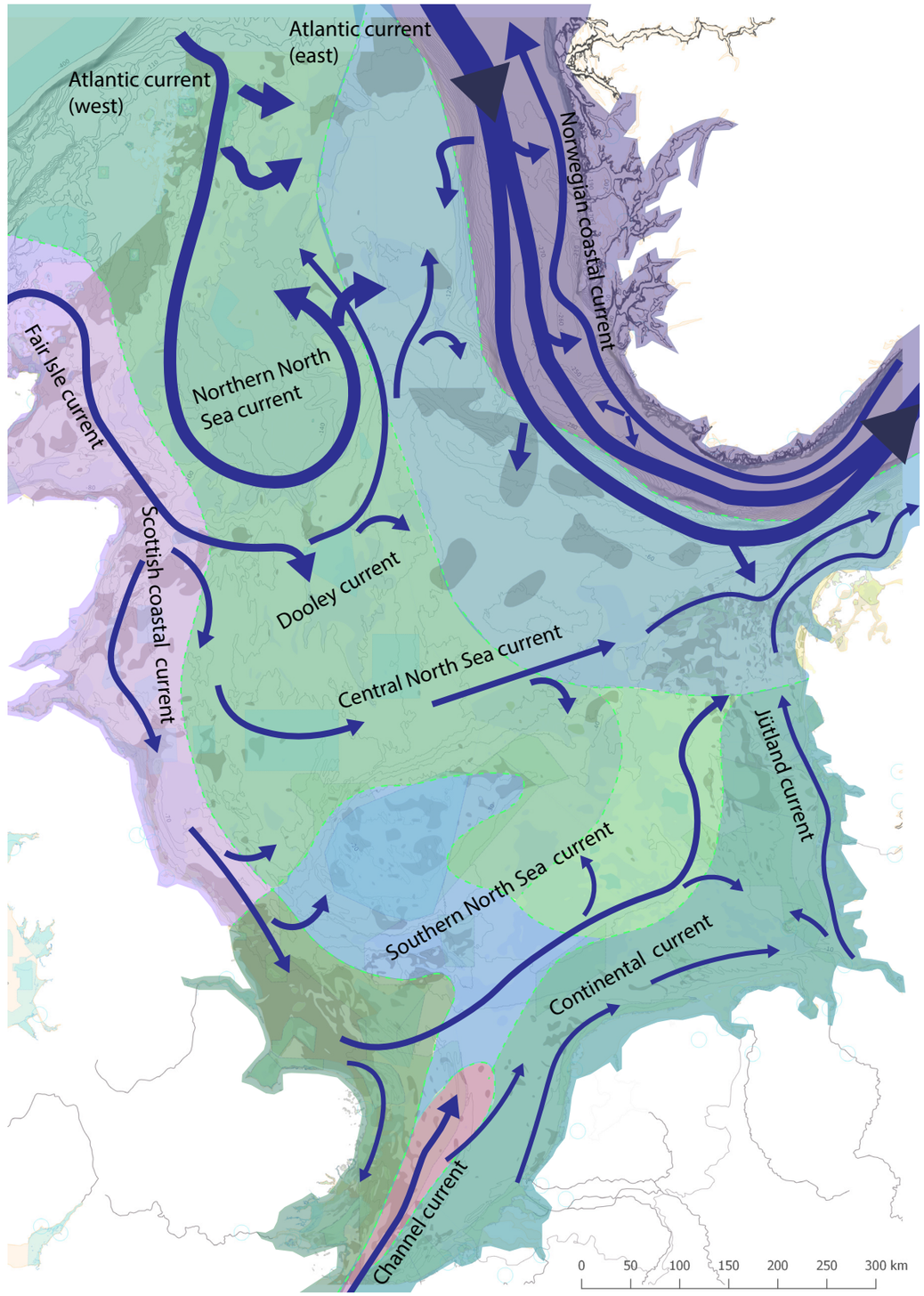
The North Sea is defined as a Marginal Sea of the Atlantic Ocean by the International Maritime organisation, meaning it is a sub-division of an ocean, partly enclosed by islands or peninsulas and open to the ocean at the surface. It covers an area of 575,000 km^2, is around 970km long and 580 km wide. Being a relatively shallow sea, with an average depth of just 95m, and a maximum depth of 700m in part of the Norwegian trench, it is therefore a "shelf" sea- mostly lying on the continental shelf.

The southern part of the North Sea is only 20-40m deep, with depths increasing northwards at around the half-way mark of 58° North. This bathymetric feature retraces the outline of the higher parts of prehistoric "Doggerland", which was vast, low-lying plain with river valleys and a large population of Mesolithic people. Scientists estimate that it was washed over and submerged by the sea around 10,000 years ago.[26] Doggerland is named after the Dogger Bank – an area of shallow waters located in the middle of the North Sea, which produces phytoplankton all year round and is therefore a rich feeding ground for fish. [9] The shape and depth of the North Sea's shallow southern bowl, combined with atmospheric pressure and strong currents make this area especially susceptible to storm surges, which have regularly caused great damage to the southern coast. Coastal engineering has exacerbated this problem. Extreme wave heights occur further offshore, and the North Atlantic Ocean is home to the largest extreme

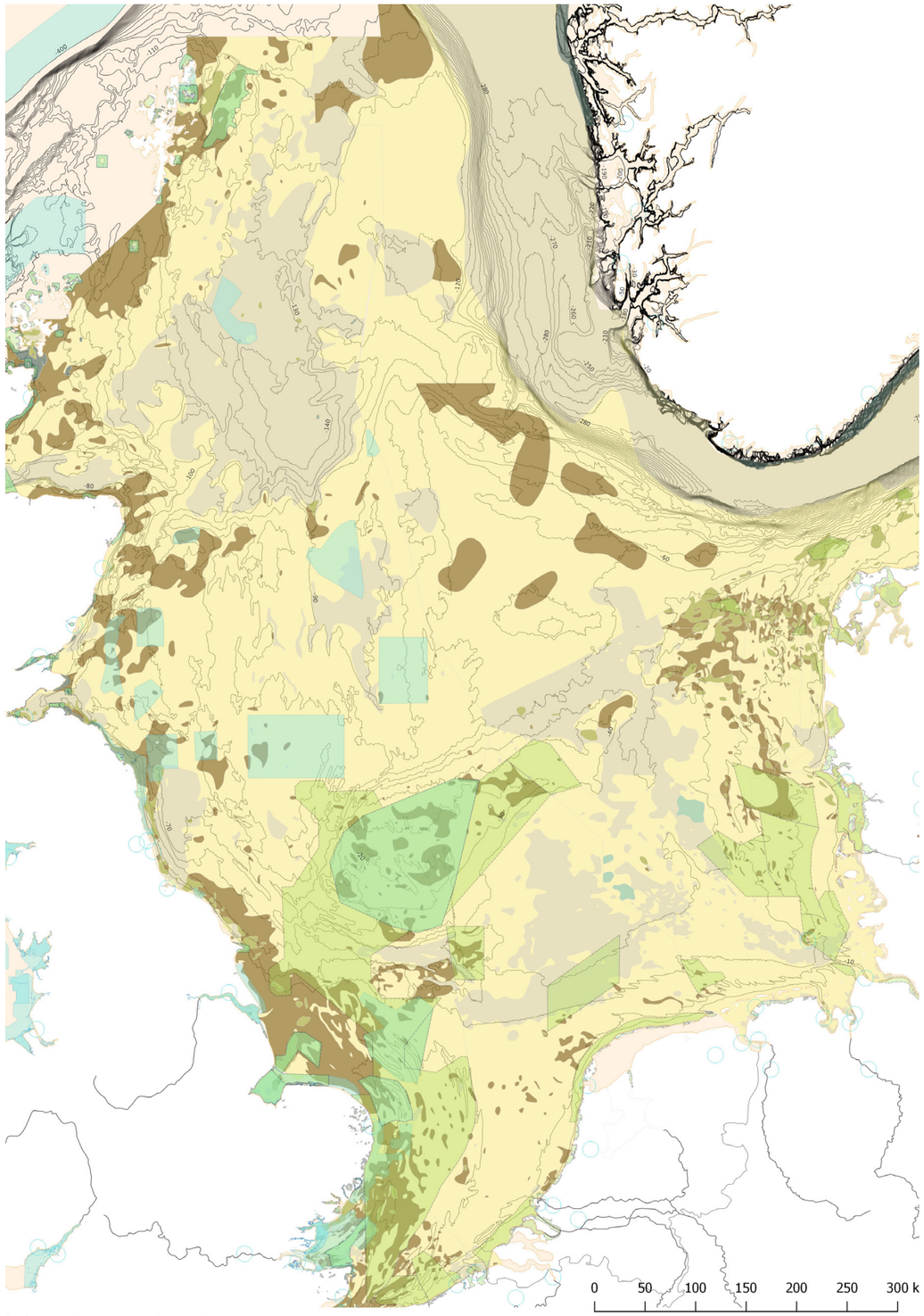
24 https://publicwiki.deltares.nl/display/BTG/Guideline
25 https://www.dezandmotor.nl/en/home/
26 Spinney, "Searching for Doggerland."



[10] Hydrographic regions of the North Sea (Couling)
compiled using information from Huthnance, "Physical Oceanography of the North Sea.



[11] North Sea currents (Couling)
compiled using information from MEFEPO, «North Sea Atlas»



[12] Seabed composition (Couling)
compiled using data from EMODnet Geology, Geological survey of Finland

waves in the world, which has important implications for the oil and gas industries.[27] Data on wave heights hardly existed at the beginnings of North Sea oil & gas, and it was the platforms themselves that doubled as sensors and measuring instruments. The famous “Draupner wave” broke all records on 1 January 1995 – a freak rogue wave reaching a height of 25.6m and recorded at the Draupner platform, 200 km west of Stavanger on the Norwegian continental shelf. Research points to the steady increase of significant wave-heights.[28]

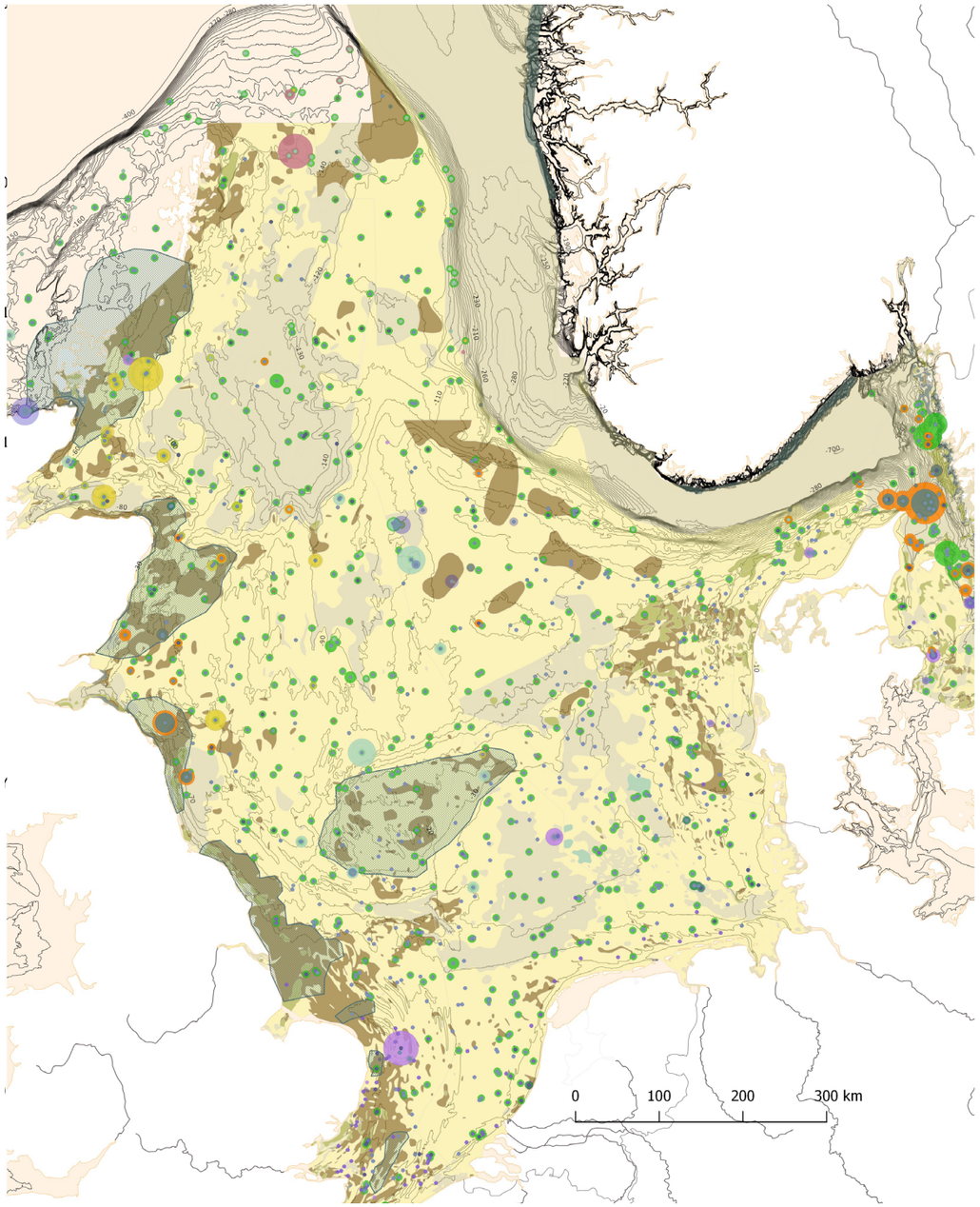
In oceanographic terms this is a complex sea. Salinity and temperature characteristics of the North Sea waters result in a natural division of water-masses into nine hydrographical regions, which are also closely related to currents and bathymetry. [10, 11] Warm, saline North Atlantic Water enters the North Sea from the English Channel moving northeast [1], and from the Norwegian Sea moving southwards [2]. Currents circulate around the sea in an anticlockwise direction. Less saline water enters from the Baltic Sea [3]. Scottish, English and Continental Coastal waters [4,5,6] are influenced by river inputs. The regions between the Norwegian trench and North Atlantic inflow [7] and east of the English coast [8] are areas of mixing and transition, and the region north of the German Bight is characterized by increasing salinity and early summer stratification [9].[29]

III. MARINE LIFE

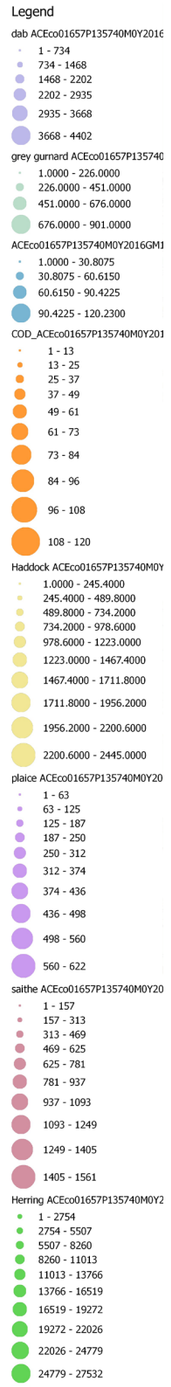
The North Sea is home to around 230 fish species, of which 95% of the biomass comes from only 20% of the species. Saithe and haddock make up about 50% of the biomass in the Northern North Sea, along the slope edge. This area is also home to Norway pout, whiting, blue whiting and cod. In the central North Sea at depths of 50- 200m, haddock is dominant with whiting and cod.

In the shallower, southern parts common dab and whiting make up 50% of the biomass, grey gurnard and plaice 20%, and horse mackerel and sand-eel are also in abundance. The pelagic species herring and mackerel move around the North Sea from spawning and feeding grounds, also using the Baltic Sea and the North-east Atlantic.[30] North Sea herring populations spawn on gravelly substrates and can be divided into three main groups according to spawning time and area; the Scottish and Shetland coasts are the autumn spawning areas for the Buchan/Shetland herring; the Central North Sea (Dogger Bank) and off the English coast are autumn spawning grounds for the Banks or dogger herring, and the English channel is the winter spawning ground for the Southern Bight or downs herring. Both cod and herring populations have collapsed due to overfishing, and since been subject to recovery strategies such as the introduction of the “cod-box” an area closed for cod fishing or to certain fishing gear or vessel size, around

27 Bell, Gray, and Jones, “North Atlantic Storm Driving of Extreme Wave Heights in the North Sea.”
28 Ducrotoy, Elliott, and de Jonge, “The North Sea.”
29 Huthnance, “Physical Oceanography of the North Sea.”
30 Ducrotoy, Elliott, and de Jonge, “The North Sea.”



[13] North Sea Fish (Couling)
compiled using information from ICES Fish map



areas of young cod.[31]

The map in figure 13 illustrates the abundance of fish in the North Sea and their general geographical distribution. Countings made by ICES often document different species at the same location, therefore the dominance of one species in the uppermost layer of this map is misleading. Different species are found together, apart from the main differences between species on the edge of the slope and the northern North Sea, and the shallower waters of the southern North Sea.

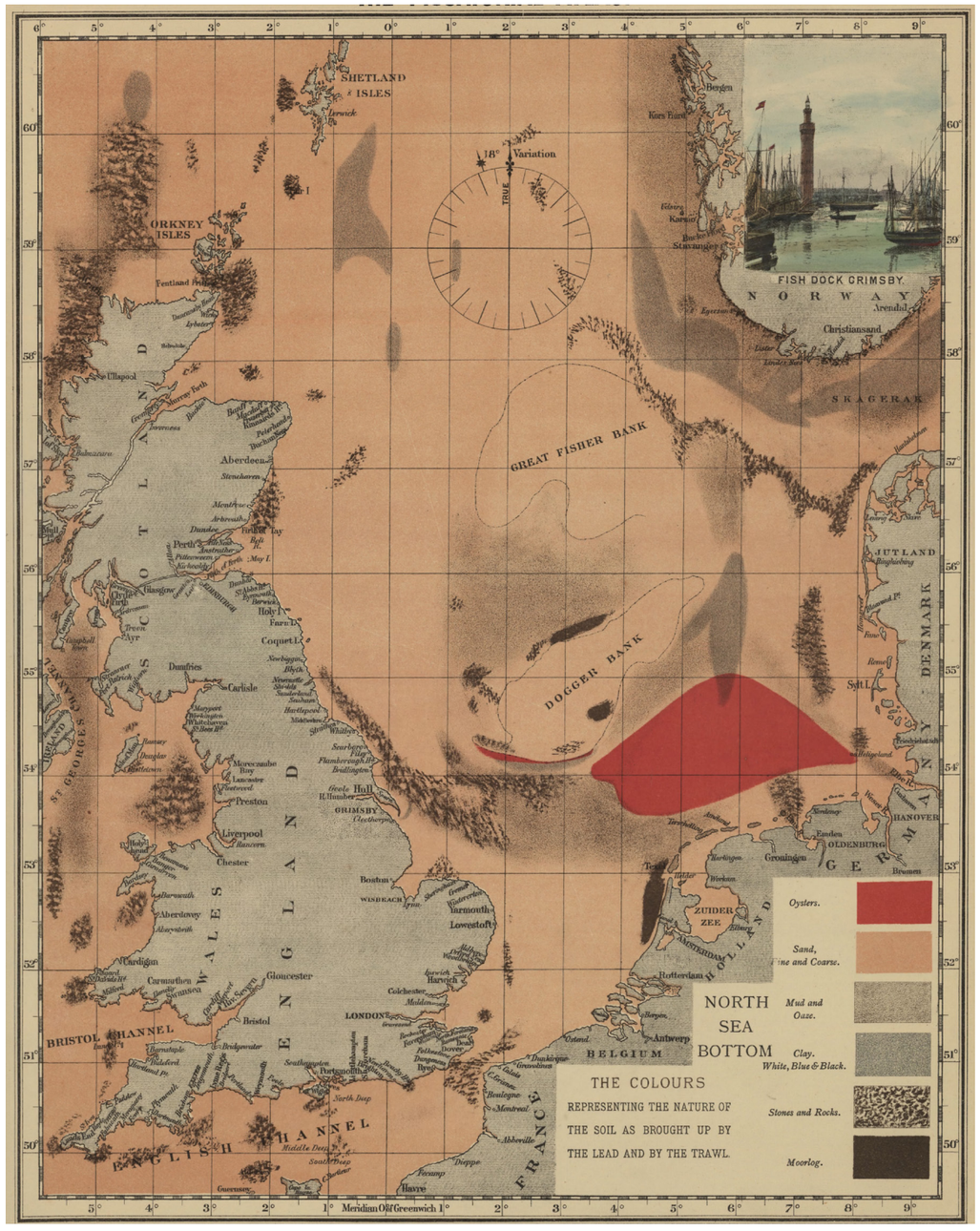
This map therefore conveys a view of the North Sea, full of geographic features, specific places and habitats and also full of fish. The data from this map is provided by the ICES “fishmap” of 2016, therefore represents a snapshot in time, as the composition of fish species is changing. Some species are moving north to cooler waters, some are returning to the North Sea for reasons that are unclear, and some invasive species are still arriving.

The North Sea is of global importance for breeding and feeding seabirds; 4.25 million birds from 28 species breed there and 10 million seabirds spend most of the year offshore in the open North Sea.[32] Estuaries and the Wadden Sea are particularly important areas, the latter accommodating 12 million birds. The North Sea is also located on the Eastern Atlantic flyway and provides feeding areas in the shallow, inshore waters during migrations.

The North Sea is heavily marked by intensive human activities- some such as dredging, trawling, habitat infill and the input of pollutants by the rivers, have been carried out for centuries. While general levels of dumping have decreased, the North Sea is overfished,[33] suffers from increased nutrient discharges in the rivers causing eutrophication, seal populations are affected by oil, and it is estimated that around 30% of oil discharges in the North Sea come solely from the day to day operations of platforms themselves.[34] Habitat change and loss is a critical challenge.

The sea is a space in movement – a contingent, relational space. The rising sea levels in the North Sea manifest a phenomenon that we understand to be no longer “natural”, as wa sthe case of the waters submerging Doggerland, but a complex combination of forces including those exerted by accumulated human exploitation over time.

31 Paramor, O.A.L. et al., “MEFEPO North Sea Atlas.”
32 Ducrotoy, Elliott, and de Jonge, “The North Sea.”
33 fisheries remove 30-40% of the biomass of exploited fish species each year (Ducrotoy, Elliott, and de Jonge.)
34 Nihoul and Ducrotoy, “Impact of Oil on the Marine Environment.”



[14] Olsen, 1883. North Sea Bottom, from the.Pescatorial Atlas

IV. HYBRID SEASCAPES

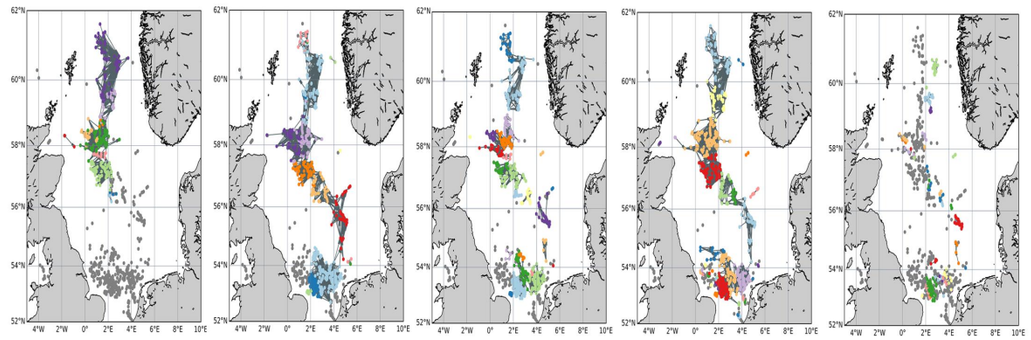
The piscatorial Atlas of 1883, compiled by O. T. Olsen and "illustrating the fishing ports, boats, gear and species of fish" vividly demonstrates the changes in the North Sea seascape.[37] Through the collaboration of local fishermen, Olsen collected knowledge about the North Sea fishing grounds in this Atlas, in the same spirit as his work for the well-known oceanographer and navigator, Lieutenant Maury, in the United States.

Seabed data from the EU Edmonet data-base reports a mainly sandy seafloor in the southern North Sea, and corresponds to reports of trawling destroying the oyster-beds illustrated in Olsen's atlas by the early 20th century. Having been completely transformed over the 150 years, today the seascape is the subject of reconstruction efforts. Oysters are «natural reef-builders and provide important ecosystem services, contributing to seabed stability, offering a micro-habitat for other species, filtering the water, limiting blooms of phytoplankton and preventing symptoms of eutro phication.[38] In the Netherlands, research institutions are investigating the possibility of re-establishing oyster beds in the southern North Sea, including preliminary trials, and thereby reconstructing this ecosystem.[39, 40]

The loss of hard substrate in the North Sea, and therefore a valuable habitat for many species, has been due to trawling as described above, and also to systematic removal of stones and gravel from the seabed, due to the damage they caused to trawling nets.[41] However hard substrate has also been introduced to the North Sea in the form of foundations for the oil, gas and wind industries. These foundations have frequently become habitats for a range of species, improving the local biodiversity in some cases.[42] Studies have shown that offshore installations in the North Sea are to some extent interconnected. For certain protected species, such as corals, oil and gas installations seem to function as stepping stones connecting natural reefs, that are otherwise isolated from each other.[43] With the need for species to adapt to climate change, interconnectivity will become increasingly important. The richness of biodiversity on and around offshore structures is partially caused by the sheer presence of hard substrate, which is a fundamental condition for reef-dependent species to survive. Partially, it is due to the fact that most of the areas around energy installations are closed to all or certain types of fishing and other seabed-disturbing activities and therefore function as small marine protected areas.[44]

The decommissioning of closed oil and gas fields will see the removal of around 8000 structures in the coming decades, including pipelines. However, the hybrid seascapes that have developed around introduced

37 Olsen, The Piscatorial Atlas of the North Sea, English and St. George's Channels.
38 Jackson et al., "Historical Overfishing and the Recent Collapse of Coastal Ecosystems."
39 Smaal et al., "Feasibility of Flat Oyster (Ostrea Edulis L.) Restoration in the Dutch Part of the North Sea."
40 Sas et al., "Shellfish Reef Restoration Pilots Voordelta, The Netherlands."
41 van Duren et al., "Rich Reefs in the North Sea Exploring the Possibilities of Promoting the Establishment of Natural Reefs and Colonisation of Artificial Hard Substrate."
42 Coolen et al., "Benthic Biodiversity on Old Platforms, Young Wind Farms, and Rocky Reefs."
43 Lea-Anne Henry, Claudia G. Mayorga-Adame, Alan D. Fox, Jeff A. Polton, Joseph S. Ferris, Faron McLellan, Chris McCabe, Tina Kutti & J. Murray Roberts. ***Ocean sprawl facilitates dispersal and connectivity of protected species*** (Scientific Reports volume 8, 2018).
44 Jørgensen, "The Energy Transition and the North Sea as a Self-Healing Wilderness."



[15] Connectivity across platform ecosystems in the North Sea- clusters of hihgly connected structures
source: ANChor project - Appraisal of network connectivity between North Sea oil & gas platforms.
INSITE programme- INfluence of man-made Structures In The Ecosystem
https://www.insitenorthsea.org/projects/

[16] Cold-water corals in the North Sea, attached to rig foundations.
source: Original photograph courtesy of Lundin Britain Ltd. Reproduced from Roberts J.M., Wheeler A., Freiwald A., Cairns S. (2009)
Cold-water corals: the biology and geology of deep- sea coral habitats. Cambridge University Press.

substrates deserve closer attention before removal, since they potentially represent a valuable interconnected ecosystem supporting high biodiversity and a stable environment for otherwise threatened species. The map of these species portrays a further concealed aspect of the seascape - potetially a powerful image of what we have inadvertantly created through the utilsation of offshore infrastructure as an agent by certain species. [15,16]

The North Sea is a rich and diverse seascape made up of natural and introduced elements which are intertwined and are continuing to evolve together both ecologically and in the imagination. In this sense the kinetic, contingent aspect of the seascape holds the greatest potential for future «cultivation» - seas are living entities and can partially recover from environmental damage, given the right conditions. Strategies such as «Building with Nature» optimise this property of the maritime environment, and seek to engage the Seascape itself as a partner in the design and execution of ecologically spaces around the coastlines and in the offshore realm.