The Role of Ocean Space in Contemporary Urbanization

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RÉSUMÉ

L'océan fait l'objet d'investigations dans plusieurs domaines scientifiques. Rares sont cependant les recherches portant sur l'océan en tant qu'espace. A l'heure d'une augmentation incrémentielle de la production d'énergie, de l'exploitation des ressources, des développements infrastructurels et logistiques, on observe un changement radical d'échelle et d'intensité des besoins en espace. Compris de manière globale, l'océan se trouve presque entièrement touché par l'activité humaine. Il devient ainsi le site d'une convergence spatiale et environnementale, une sorte de «hinterland» pour les territoires urbanisés. Souvent éloignés et difficiles à élucider, de nature relativement éphémère en termes d'urbanité, ces développements contribuent néanmoins à faire émerger de vaste portions de territoire et laissent ainsi des traces physiques pérennes. Ces phénomènes demeurent peu étudiés en terme d'articulation spatiale.

L'histoire regorge d'exemples de ces formes radicales d'urbanisation qui touchent l'océan en tant qu'agent d'un réseau d'interactions prenant place en dehors du champ des droits territoriaux. L'intensification des activités mentionées cihaut a cependant ouvert la voie à une territorialisation de l'océan par le biais de la fixation de zones économiques exclusives. Une contradiction émerge ainsi entre des systèmes océaniques ouverts et des espaces circonscrits par des frontières. En opposition à une notion de territoire défini par ses frontières politiques, la présente thèse propose une définition intégrée et cinétique du territoire océanique, fondée sur une interaction entre les forces d'urbanisation et les seuils océanographiques et biologique. Les propriétés inhérentes à l'espace de l'océan, tout comme les interventions culturelles qu'il accueille, forment les composants actifs de cette définition. Sur la base de cette dernière, il s'agit ici d'identifier et de définir des formes spécifiques d'urbanisation étendue (extended urbanization) au sein de l'espace océanique.

La notion d'urbanisation étendue est pensée en lien à l'un de trois moments d'interaction propres au processus d'urbanisation tel qu'il est envisagé par Brenner et Schmid dans le cadre de leur théorie d'une *urbanisation planétaire*.

Cette théorie trouve ses bases conceptuelles dans le double processus urbain décrit par Lefebvre dans *La Révolution Urbaine,* c'est à dire en termes d'*implosion-explosion*. Nous posons la participation de l'espace de l'océan à la genèse de morphologies distendues, inégales et indistinctes – à ce jour encore peu reconnues en tant que formes «urbaines» – comme une catégorie spécifique d'urbanisation étendue. L'urbanisation océane est ainsi abordée, dans un premier temps, au travers la littérature scientifique portant sur ce sujet. Cette recherche s'organise autour de quatre thématiques comprises en tant que parties prenantes des interactions avec l'espace océanique et représentatives d'un vaste champ de la théorie urbaine : réseaux, paysage maritime (seascape), technologie et écologie.

La recherche empirique est ensuite portée par deux cas d'étude: la Mer de Barents et la Mer Baltique. Ces étendues maritimes font l'objet d'une analyse spatiale qui repose sur la définition énoncée plus haut de territoire urbain. Alors que l'urbanisation étendue tisse des réseaux sur les fonds océaniques, le paysage maritime produit de l'énergie, la technologie permet d'observer les écosystèmes et les questions écologiques s'emparent de l'exploration pétrolière.

Cette étude met au jour des propriétés communes entre ces deux mers, tout en discernant les processus urbains qui se manifestent dans chaque contexte respectif. L'identification de neuf principes d'urbanisation étendue en constitue le résultat. Ces espaces maritimes révèlent par ailleurs des intensités dispensées en des lieux spécifiques. Une série de cinq situations ont été choisies et ont fait l'objet d'une étude plus fine permettant de dégager des condition typologiques: interpénétration, contraction, expansion, assemblage and confluence.

Le second objectif de cette thèse vise à mettre en lien les résultats obtenus avec les pratiques actuelles propres à la planification océanique. Quel rôle pour les architectes dans la conceptualisation, la cartographie (mapping) et la gestion des espaces océaniques? La mise en résonnance des résultats de cette étude avec une évaluation critique des pratiques actuelles de planification des océans nous permet d'énoncer la conclusion suivante : l'enjeu architectural réside dans le dessin de nouvelles *limites* en accord avec les dynamiques océanes. Il s'agit aujourd'hui d'initier le projet de l'océan.

MOTS-CLÉS

L'espace océanique, territoire, urbanisation étendue, réseaux, paysage maritime (seascape), technologie, écologie.

ABSTRACT

Although the ocean is investigated by many scientific fields, research about ocean space is scarce. But energy production, extraction of resources, infrastructural and logistical development is increasing incrementally, resulting in a quantum shift in scale and intensity of spatial demands. Almost no part of the global ocean remains unaffected by human impact. The ocean is therefore a site of spatial and environmental convergence, a type of “hinterland” to urbanized territories. While these developments are ephemeral in relative urban terms, often remote and hard to decipher, they also carve out vast territories and leave lasting physical legacies. These phenomena have largely escaped spatial articulation.

History is rich in examples of radical forms of urbanization which engaged the ocean as a network agent, without claiming territorial rights. Intensified activities, however have led to the territorialization of the ocean through the establishment of fixed exclusive economic zones. A fundamental contradiction between open ocean systems and bounded space becomes apparent.

As opposed to to a territory defined by political borders, this thesis proposes an integrated, kinetic definition of ocean territory based on oceanography and biological thresholds with which urbanizing forces interact. Both the ocean’s inherent spatial properties and cultural interventions become active components. Based on this definition, the first objective is to identify and define specific forms of urbanization within ocean space.

Extended urbanization refers to one of the three interacting moments of urbanization proposed by Brenner and Schmid as part of their developing theory on *planetary urbanization*. This has its conceptual roots in the dual urban processes *implosion-explosion* as described by Lefebvre in *The Urban Revolution*. As a specific form of extended urbanization, I argue that ocean space participates in the loose, uneven, and indistinct morphologies we are only beginning to recognize as “urban”. Ocean urbanization is researched first through literature pertaining to four topics which permeate interactions with ocean space and which each represent a rich field of urban theory; Networks, Seascape, Technology and Ecology.

Empirical research is then carried out on two case studies; the Barents and the Baltic Seas. These seas undergo a spatial analysis based on the proposed definition of ocean territory. Under urbanization processes, networks lace the ocean floor, the seascape produces energy, technology monitors ecosystems and ecology embraces petroleum exploration.

The study distills properties common to both seas, but also distinct manifestations of urban processes within each context. As a result, nine principles of urbanization can be identified.

The seas also revealed dispersed intensities in particular locations. Five such situations were chosen as the object of a closer study, which are then proposed as typological conditions: Interpenetration Contraction, Expansion, Assemblage and Confluence.

The second objective of the thesis is to relate these findings to current Marine Spatial Planning. What can architects contribute to the conceptualizing, mapping and managing of ocean space? A critical appraisal of ocean planning practice in relation to the research findings, concludes that the architectural challenge is to redraw *limits* according to ocean dynamics and to launch the ocean *project*.

KEY-WORDS

Ocean space, territory, extended urbanization, networks, seascape, technology, ecology.

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[1] Sperm whale, Kaikoura NZ

1 THESIS INTRODUCTION

1.1 AN INTRODUCTION TO OCEAN SPACE

Concepts of compact urban reality are difficult to reconcile with the space of the ocean. A sense of the hidden dimensions of this space is transported by surfacing whales - an event witnessed once in a lifetime by most [1]. But the sea, alongside providing food, energy and transportation routes, is also a rich spatial resource for urban services. Activities at sea are intensifying. At the same time the urban has become more diffuse, porous, and far-reaching. We perceive that the ocean is enveloped by the convergence of these two processes.

The resulting spaces are the investigative focus of this thesis.

The quantum shift in human activities at sea results in increased attempts to quantify limits and therefore to spatialize an ambiguous, contingent realm. It also results in the realization that conventional methods used on land are effectively impaired in this context. This contradiction calls for alternative perspectives which draw the ocean in as an active participant to urbanization processes.

Research shows that almost no part of the global ocean remains unaffected by human impact.[1] Already in 1974 Lefebvre wrote that natural space is disappearing[2] and described how such spaces have become compartmentalised for a form of consumption subordinate to the dominant strategic modes of production. In their essay Planetary Urbanization, Brenner and Schmid describe the end of the wilderness as one of the four most marked and far-reaching worldwide socio-spatial transformations of the last thirty years.[3]

If natural space is dissolved, one of the challenges of this enquiry is to find appropriate terminology and conceptual references for an environment geared towards the natural laws of flow and a physical body constantly in motion as it interacts with territoriality, fixity and man-made flows. This thesis will attempt to negotiate the largely uncharted territory of ocean space within the context of global urbanization and trace a path towards an understanding of the resulting and embedded spatial potential.

1.1.1 FIXITY AND FLUX

Ocean territory is temporally and spatially in flux. Human interaction with the ocean has traditionally also been of a fluid nature, where agreements, negotiations and alliances were formed according to the demands and objectives of dominating parties. Predominant concepts of control of ocean space are discussed below (s. 1.6 OCEAN PLANNING), however until the relatively recent establishment of a legal basis for ocean activities through UNCLOS, none of these paradigms were absolute and maintaining open maritime trade-routes consistently gained priority over unilateral control.

The Vikings were an example of a skilled group who were well-equipped enough to negotiate the ocean and develop a trading empire

1 Halpern et al., *A Global Map of Human Impact on Marine Ecosystems*.
2 Lefebvre, *The Production of Space*. p 30
3 Brenner and Schmid, *Planetary Urbanization*.

stretching from Greenland and Iceland to the Black and Caspian Sea at its height (ca 900 – 1100 AD). Although, according to historian Alan Palmer, the Vikings became colonisers, anticipating “late Victorian imperialism”[4] in terms of the search for new resources and raw materials, the Vikings were not interested in controlling territory per se, rather settlements and trading posts were established at strategic locations in order to secure the smooth flow of trade. Through their extensive network of settlements however, traces of Viking ancestry can be found in populations from Newfoundland to Byzantium.

Throughout history, spaces of settlement have been nourished and complimented by spaces of transit and flow through trade, exchange and the diversification of culture. This view is shared by Massey:

> “What gives a place its specificity is not some long internalized history but the fact that it is constructed out of particular constellation of relations articulated together at a particular locus.”[5]

and Larsen et all:

> “Places are seen as constructed through, as Clifford (1997) would say, routes as well as roots… Communities are impure and porous. Travel is central to communities, even those characterised by relatively high levels of apparent propinquity and communion”.[6]

The ocean has also provided a flowing medium through which the energy of human ambitions can be channelled. Taking advantage of the embodied energy of ocean currents and winds such as the Atlantic trade winds, led to periods of unprecedented expansion of trade and territory in Western Europe.[7] The Lapita people, the predecessors of the Polynesians, are renowned for traversing vast distances using the opposite tactic as early as 1200 BC. Scientists believe they departed on voyages from island to island only during the period when the predominant easterly winds were reversed.[8] The prevailing Pacific trade winds are from East to West, which led to several theories that the Polynesians originated from South America and to the gross underestimation of the Lapita’s maritime skills.

But dynamic urbanization processes are also inextricably linked to regimes of property and ownership and revolve around fixed points of reference and development. Brenner and Schmid describe the annexation process of vast, remote territories in the name of capitalist urbanization as a form of displacement.[9] UNCLOS – the international law governing ocean space- legitimized the establishment of fixities within this space, and also fixed the boundaries of the space itself. In the ocean, the outcomes of boundary definition are not necessarily spaces of human settlement, rather specialist spaces with a range of purposes – both productive and protective – permitted for a particular period of time. The lack of settlement qualifies these spaces to become either mono-functional semi-industrial landscapes, or protected areas for important ecosystems, to name the two extremes. In both cases, further planning processes have been subsequently unleashed.

A second effect of the lack of settlement is the lack of habitual interaction with ocean space. Since the ocean does not contain places of

4 Palmer, *Northern Shores*. p 20
5 Doreen Massey, *Space, Place, and Gender*.
6 Larsen, Urry, and Axhausen, *Social Networks and Future Mobilities*.
7 De Landa, *A Thousand Years of Nonlinear History*.
8 Von Borries, *Wagnis in der Südsee – das Rätzel der Polynesier*
9 Brenner, *Implosions / Explosions*.

dense human occupation, offshore spaces appear increasingly autonomous, incomprehensible in terms of scale and similarly inaccessible in both visual/conceptual and physical terms. Their specialised nature and distance from settlement areas prevents "organic" contact. Our relationship is mediated and technicized. Specialist knowledge and skills are required to enter its realm on an individual basis, and therefore the ocean takes on an abstract, remote status which fuels the imagination but also determines the sequence and form of development in the majority of cases. The offshore oil industry is an example of such a case, an industry motivated by the aim to find reserves outside territory dominated by national oil companies (NOCs) and therefore moving to deeper and more remote locations.[10] Oil has an ubiquitous, pervasive presence within our society, and yet is surrounded in corporate secrecy and concealment, making it extremely difficult to *site* as well as *sight*.[11] Swiss video artist Ursula Biemann echoes this observation:

> "I see this level of abstraction in the representation of oil as yet another way to keep it firmly in the hands of market dynamics, a remote and inaccessible entity, supposedly too big and complex to grasp for the average citizen."[12]

The ocean as a *territory* becomes the recipient of paradigms of enclosure, yet the physical materiality of this space flows through all boundaries and defines its own thresholds through constant interchange with natural forces. Tension between fixities and flux is thus a recurring motif throughout this discussion. As the argument develops, I aim to demonstrate the interpenetration of these two conditions, and how ocean space can reconcile, and in fact productively accommodate both.

1.1.2 MOTIVATION

This examination of ocean space stems from the conviction that the oceans participate spatially in urbanisation processes, that the current approach to ocean planning is conceptually and operationally limited and that an understanding of the cultural, ecological and physical specificities of ocean space will serve to inform such planning. While the interface between land and sea is a highly active realm in urban terms and has been the object of architectural intervention since man first put a boat to water, it is not the focus of this thesis, rather the ocean space further offshore which has not been the subject of critical reflection and yet is being modified by interventions of an unprecedented scale.

1.1.3 DEFINITION

Ocean space is defined here as the full volume from below the seabed to ocean airspace, lying outside the national territorial boundary of 12 nautical miles offshore. This space therefore includes both the Exclusive Economic Zones out to 200 nautical miles offshore and the high seas, which are international waters outside of national jurisdiction. The dimensions of the two seas under analysis in this thesis however, never exceed the exclusive economic zones. This thesis firstly interrogates the space itself, its inherent dynamics and spatial properties. A definition of oceanic territory is proposed (s. 1.9) which collates these physical and biological layers with

10 Martin, *Deeper and Colder*.
11 Wilson and Pendakis, Sight, Site, Cite. Oil in the Field of Vision.
12 Ibid.

the socio-political activities. It is through the interaction of inherent ocean space and social practice that urbanization processes within this realm can be more clearly understood.

1.1.4 VOCABULARY

This research addresses the results of urbanization processes on ocean space, in particular the relative influence of Networks, Seascape, Technology and Ecology within these processes. Vocabulary pertaining to the ocean originates in specialised scientific fields such as oceanography, geography, geology, ecology, navigation and logistics. I claim that ocean space has largely been excluded from urban discourse. Therefore through both an adaptation of urban discourse to ocean space, and a translation of inherent characteristics of the ocean into an architectural language, a vocabulary should be established to merge these two realms. The four topics of Networks, Seascape, Technology and Ecology have been established as a common ground between the parallel ocean sciences mentioned above, and urban theory.

The ocean is an arena rich in spatial concepts which have been developed through the history of exploration, mobility, global trade and the construction of infrastructure. An important task set by this thesis is to extrapolate relevant vocabulary from these contexts which can be tested, verified and adapted through spatial analysis at specific ocean sites. Such a vocabulary should enable inherent ocean space to make a unique contribution and to enrich the urban debate.

1.2 OBJECTIVES AND SCOPE

This thesis addresses a research gap in the field of urban studies. Although the ocean is investigated by many scientific fields, research about ocean *space* is scarce.

I claim that this is because the oceans have, until recently, not been understood as a territorial space, rather a natural environment and a common resource far removed from the urban sphere. Although methods of scaling and spatializing the ocean have a long tradition, these have been unfamiliar to comparable methods on land, which has been the "home-base" of urban discourse. Oceanographer Robert Ballard claimed that we know more about the surface of the moon than the depths of the ocean.[13] Other specialists relate this lack of knowledge to technology;

> "The limits of the commons and even awareness of their existence have been defined by the current state of exploration and technology."[14]

WHY INVESTIGATE OCEAN SPACE?

Our preliminary research has shown that pressure on ocean space for energy production, extraction of resources, infrastructural and logistical development is increasing incrementally, resulting in a quantum shift in the scale and intensity of ocean activities. The ocean is becoming a site of a spatial and environmental convergence, a type of "hinterland" to urbanized territories. While these developments are ephemeral in relative urban

13 Ballard, *The Eternal Darkness*. p 3
14 Vogler, *The Global Commons*. p 6

terms, they also carve out vast territories and leave lasting physical legacies. Technology is in the process of defining limits to the commons and parallel to this, urban theory has advanced to include these previously unconsidered hinterlands.

However, perhaps more significantly, the ocean is itself a differentiated spatial mass in constant movement, with specific local properties and a range of seasonal inhabitants. These aspects of ocean dynamics also have spatial implications which have not been articulated. For this reason the scope of the investigation focuses on, and is restricted to, the realm dominated by a predominantly ocean condition – and therefore outside of the coastal zone. This excludes both ocean reclamation, which eliminates the water condition, and urban systems integrating both liquid and solid ground. The choice of this realm is based on the proposition that here, a particular "balance of power" exists between ocean and urban dynamics- an as yet unexplored dialogue. Which forms of urbanization, and which planning strategies can be developed with the ocean itself as an "active" agent?

The objectives of this research are defined as follows under the three categories of Theory, Practice and Outlook:

Theory

– To propose a definition of ocean territory derived from the interaction of inherent ocean space- as defined by the ocean's own dynamics and the urbanization processes unfolding within it. These processes are linked to the theory of planetary urbanization.[15]

– To test the relevance of urban discourse for ocean territory under the four topics of Networks, Seascape, Technology, and Ecology. It is expected that through this selective thematic investigation of ocean spatiality, important links to land-based urbanization will be established.

Practice

– Using two case-study seas, to investigate the relationship between forces of urbanization and the sea as an environmental force with its own spatial traditions. The proposed definition of oceanic territory is tested, the respective influence of Networks, Seascape, Technology and Ecology is brought into relief, and previously unrecognized forms of urbanization are exposed and identified.

– To propose a selection of spatial typologies within the two case-study seas. The typologies should be determined by combined interactions between Networks, Seascapes, Technology and Ecology, which are either exemplary, extreme or contradictory. Hence they express specific relationships between ocean space and urbanizing forces.

Outlook

– To evaluate the relevance of such typologies for strategic ocean planning.

WHAT IS THE RELEVANCE OF SUCH RESEARCH?

I argue that ocean territory is an emerging field of investigation, and that it is characterised by a lack of tools and methods with which it can be approached. This research firstly offers a conceptual framework for the spatiality of the sea – a framework rooted in established fields of urban research and debate. Secondly, the research provides an example of territorial

15 Brenner and Schmid, *Planetary Urbanization*.

analysis for two diverse seas, from which it is able to draw conclusions about urbanization processes embedded within them. It is expected that the principles derived from this analysis will deepen the understanding of the dynamics and spatial consequences of ocean urbanization. Thirdly, the concrete typological examples proposed, pinpoint critical conditions which have not been spatially examined in their full dimensions, despite appropriating large areas of ocean space. While their infrastructural connections are "urban" and their magnitude "territorial", they are floating in an undefined realm characterized by engineering and habitat displacement. Other typologies relate less to constructed interventions than to inherent, emergent phenomena which are predominant, if not unique in ocean space and therefore have implications for planning this space.

Current ocean planning is struggling with the contradiction between spatial definition and transversal, dynamic ecosystem properties. The research proposes ways of reconciling these apparently divergent streams. The particular contribution lies in the proposition that ocean territory has its own inherent spatial rules, which interact with urbanization processes, and hence produce particular spatial typologies. The under-the-surface sea is topographical and highly differentiated. The extrapolation of typological *conditions* provides a more detailed scale of examination which can capture some effects of urbanization less perceptible at the scale of the whole sea.

The research addresses urban theorists, urban designers, architects, planners and administrators dealing with fluid spaces. It aims to contribute to the body of knowledge in urban studies, crossing the disciplines of landscape, infrastructure, territorial planning and architecture.

1.3 METHOD

This thesis is a result of qualitative architectural research with a grounded theory approach where a preliminary theory of ocean space is derived from the data, rather than the research aiming to prove a preconceived theory.[16] The method is multi-focused, drawing material from a range of sources in order to connect theoretical and practical knowledge. This has involved a literature review of architectural and urban theory, historical research into ocean spatial articulation, collection and analysis of specialist subject data, reports and interviews and empirical research in the Barents and Baltic Seas.

A preliminary research phase was carried out as preparation for the Barents Sea design and research project for master students studying at laba under Professor Harry Gugger during the academic year 2011 – 12. This can be understood as a test phase during which important inputs from local experts and ocean specialists was gained and field work in the Barents Sea was carried out. The project interrogated the Barents Sea as an urbanized realm. As a result, critical aspects of ocean urbanization in this particular context clearly emerged. Five "Territorial Constitutions" – long-term development strategies- were proposed for the Barents Sea and architectural projects conceived within these strategies as "proof of concept."[17] The Barents Sea was therefore chosen as the first case-study for this doctoral

16 Wang and Groat, *Architectural Research Methods*.
17 Gugger, Couling, and Blanchard, *Barents Lessons. Teaching and Research in Architecture*.

research. This preliminary work taught us that in a similar way to land-based territories, each sea was the result of a unique combination of historical, political, cultural and environmental forces. Experience gained in the Barents Sea also revealed that:

– Ecosystems and oceanographic conditions are key to understanding the sea's dynamics and its cultural history

– The interaction between oceans and urbanization is characterized by a lack of theory or critical reflection.

– The Barents Sea is an extreme environment on many levels; remote, ecologically sound, rich in resources, and in terms of seasonal differences of temperature and light.

In order to test the validity of an analytical approach to researching the urbanization of the sea, the Baltic Sea was chosen as a second case- study. By choosing the same analytical criteria for each case, the basis for a comparative study was constructed. While the same general urban phenomena appeared in both seas, their specific manifestation took on different forms. In this way it was possible to ascertain whether certain characteristics appear only in extreme situations, or whether the underlying urban mechanisms pre-exist and will be activated by a combination of factors. The objectives of comparative research are described by Christian Schmid:

> "The challenge is to develop a comparative approach that can apprehend the general tendencies of urbanization, while at the same time illuminating the specificities of each urban area."[18]

Because this study is focused on two seas, it does not claim to be a full comparative study, rather it offers a basis for further comparative studies. Referring to Jennifer Robinson's summary of comparative strategies and causality assumptions, I place this method in the "variation-finding" category, where the cases studied are "most different" instead of "most similar."[19] Robinson defines this category as one using historical and qualitative methods, and where two or more cases are chosen which have more differences than similarities. The forms of difference and variation between the two seas are expected to be wide. Yet through a closer examination of particular interactions being carried out within the sea space, I also aim to establish a preliminary typology of spaces found.

The spatial analysis utilizes data from a wide range of sources and collates this information in the form of maps. Map-making is a research methodology in its own right, which is not only analytical but also "redraws" the territory.[20] The maps are intended to construct a multi-dimensional territory through a series of thematic stata which "deepen" the spatial understanding and avoid a flat, surface view. Despite the complexity of ocean systems, several factors converge in the ocean to form distinct spatial units. The analytical maps aim to locate these convergences. Urbanization processes can then be traced back to certain territorial configurations.

In order to address the lack of urban theory in ocean studies, this research has been positioned within the developing theory of planetary urbanization, and the seas tested as examples of extended urbanization.[21] Further to this, a four-channel foundation for the spatial analysis has been

18 Schmid, *Patterns and Pathways of Global Urbanization: Towards a Comparative Analysis*.
19 Robinson, *Cities in a World of Cities*.
20 Corner, *The Agency of Mapping: Speculation, Critique and Invention*.
21 Brenner and Schmid, *Towards a New Epistemology of the Urban?*

provided by the literature review, which is structured around the topics of Networks, Seascape, Technology and Ecology. These topics permeate the relationship between urban processes and the seas and produce specific physical manifestations of these processes.

Typologies of ocean space are then extruded which illustrate how the topics interact in “producing space”. They are chosen through the analysis at the territorial scale, reinforced by the thematic literature. The same method of territorial analysis is applied to the immediate context. The typology hence evolves out of a combination of all factors; oceanography, life-forms, urbanization processes and the relative influence of the four topics Networks, Seascape, Technology and Ecology. The interaction between these variables creates a specific *condition*, of which the physical manifestation described may only be one resulting form.

The typologies are a preliminary result, which then would ideally be applied to further situations in order to verify and refine their essential properties. In addition to their spatial properties, the typologies are presented together with relevant research literature, from which their name is derived in some cases. The links reinforce the potential field of relevance of each conceptual model.

Architects are specialised in spatial knowledge – we are trained to orchestrate, optimise, direct and innovate spatial practise, operations which require a command of complex and interconnected scales, disciplines and technologies. Spatial research has the potential to link phenomena previously considered unrelated, where space itself is both the synthesis and the site where these relationships are manifest. Ocean territory as a cultural product is comparable to land-based territory. However, its dimensions are multiple and many are unknown. It requires a holistic approach capable of reconciling poles of interest which currently occupy positions at far greater extremes than those on land.

Global concerns cross these seas. Oceans are interconnected. It is expected that even through this precise, limited examination, critical conditions and processes will emerge which are relevant for the larger context of urbanization processes across the globe.

1.4 STRUCTURE

This thesis is divided into five parts, two of which belong to the domain of theory and two to the domain of practice. The final part contains the conclusions. The scale of reference moves through these parts from the more general to the particular in order to approach the complexity and scale of ocean urbanization in both a holistic and precise way.

Part One introduces the scope, context and foundation of the thesis, outlining the key referential concepts, theories and projects. Objectives and methods have been described above. An introduction to the interdisciplinary and geographic nature of the inquiry as well as the background to ocean planning is included in this part. A proposition for the definition of ocean territory concludes this introductory thesis presentation.

Part Two comprises the literature review. This part is structured around four topics; Networks, Seascape, Technology and Ecology. Through preliminary observation and research, these themes emerged as the major fields of activity which claim ocean space. They are broad investigative categories which both describe concrete ocean uses and provide a rich investigative terrain in urban studies from which to approach ocean space. They therefore provide a link between specialist areas of ocean research and urban theory.

Network theory is more interested in the abstract properties of a system than its spatial aspects. This gives rise to contradictions when applied to abstract, fluid ocean space, which is however composed of dense materiality. Networks are a vehicle through which urbanization extends long-distance in a systematic way, utilizing both virtual and physical connections. Maritime transport systems, cables and pipelines construct networks in ocean space whose traces are inherently ephemeral but also resilient, extendable and demanding in spatial terms.

Landscape exists by definition in relation to urbanization, but due to the uninhabited and shifting nature of the sea, traces of sea-*scaping* are hard to perceive. This chapter tests the transfer of the three types of landscapes according to J. Brinkerhof Jackson to the ocean context and sketches out the possible properties of Seascapes One, Two and Three; a productive unit of organization, an image, a synthetic and a synthetic, man-made space.

Technology is an interface for our interaction with the sea on all levels. Due to the extreme dependence of western culture on technology for physical access to the ocean and to its body of knowledge, the spatial implications of technological infrastructure for ocean space are vast. This chapter reviews important texts and reports dealing with the relationship of technology to urban development in order to assess its role in transforming ocean space.

The ecological importance of the world's ocean systems cannot be overstated. A review of ecology theory, including the systems ecologists, leads to an understanding of the planetary interdependence of the organic and the inorganic and provides a central platform from which to launch an integrated spatial model of open ocean systems.

Such thematic channelling of chapters as described above represents an artificial research device, since these topics are intrinsically connected and it is in fact the sites of their mutual interpenetration which provide the greatest insights. Nevertheless, likening these topics to parallel streams, they have first been treated separately here, to then merge in specific ways in the subsequent chapters.

Part Three is the beginning of the practice-orientated section and contains the Spatial Analysis, which represents the major original research contribution. Firstly the Barents and Baltic Seas are introduced through their similarities and differences. The same themes of analysis and hence the common components are used for each sea, which allows differences to emerge through the analysis. This analysis is based on the proposed definition of ocean territory; it therefore includes the fundamental spatial oceanography, the organic life-forms, and the socio-political forces and sets of relationships. The topics of Networks, Seascape, Technology and Ecology splinter, merge and overlap throughout the different levels of analysis in this part, since, for example networks can be both organic and inorganic. The seascape is also formed through fundamental oceanography, fish populations and inorganic technological management systems.

The comparative study of the Barents and the Baltic Seas results in nine principles of urbanization. Out of these principles, typological examples are sought which both expose specific situations in greater detail, and provide the basis for understanding a generalized condition. Five critical "nodes" have been selected for closer examination and are proposed as typologies in the subsequent chapters. The second section of part three translates the principles of ocean urbanization into proposed typologies. The typologies are presented systematically at a specific location within the two seas, are described in architectural terms according to their hardware and spatial configuration, are contextualized with relevant architectural references and are defined according to their role within the urbanization of the sea. They provide a testing ground for preliminary conclusions reached,

which are then validated, completed or refuted.
Interpenetration is marked by the Nysted windpark in the southern Baltic Sea, where the wide dispersal of individual turbine installations and the open boundary condition allow for the interpenetration of systems, in particular ecological and technological systems.

Contraction is marked by the Nord Stream pipeline, a combination of technology and networks, which runs through the Baltic Sea from Vyborg in Russia to Lubmin, Germany. The spatial dimensions of a network system in ocean space can be critically observed through this pipeline.

Expansion is enabled by the opening of space at sea, due to the scale effects of the horizon. Non-channeled shipping movements activate this condition. Ports mark the transition to contraction.

Assemblage describes loose, changing densities and intensities in ocean space, marked by temporary events and spaces such as the polar front and the marginal ice-zone in the Barents Sea. The interaction of Ecology, Seascape and Networks make up this typology.

Confluence is marked by the overlap of Technology, Ecology and Seascape in the production and sharing of knowledge for both the installation of petroleum infrastructure and environmental protection in the Barents Sea.

The five typologies can be summarized as a preliminary catalogue of spaces occurring within an ocean territory modified by urbanization processes.

Part Four examines current ocean planning initiatives in the Baltic and Barents Seas against the proposed typologies. It presents the origins and State of the Art of Marine Spatial Planning and discusses differences between planning, strategy and design. The extent to which the inherent spatial properties of the ocean are reflected in these plans and the relevance of the new knowledge produced by the typologies, is evaluated.

Part Five contains the concluding sections and Outlook.

1.5 GEOGRAPHY

Oceans are geographical features, exceeding the normal scale of urban investigation. In the oceans, urban encounters with the geographical take on specific forms; activities can be located far offshore and be connected by visually tenuous links which are materialized through specific technologies. The topologically-orientated networks present in the ocean emerge at pre-determined locations with a material force that in turn shapes topography. Urban markers are sparse, protection from environmental conditions minimal and distances are of geographical dimensions. Is this the urban at its most vulnerable, its most extreme?

Following Lefebvre's claim that the whole world has been urbanized, and the subsequent theory of planetary urbanization (s. 1.7 THEORY) a holistic examination of urban phenomena demands a large-scale perspective. This thesis is positioned within an urban debate based not on *citiness,* density and centrality, but on the long-ranging impact of urban systems. Architects and urbanists such as Le Corbusier, Doxiadis and Frank Lloyd Wright have all embraced the concept of extra-urban development at large-to-global scales as a form of project.[22] Edward Soja expanded the idea of the city

22 Katsikis, *On the Geographical Organization of World Urbanization*.

to the “postmetropolis” and recognized the new attention being paid to the spatiality of human life, which he called the “spatial turn.”[23] For geographer Jacques Lévy, the spatial turn is intrinsically connected to the emergence of the individual as a social actor, and the range of mobility speeds and choices, which together create a multitude of solutions to “co-presence”, and redefine place at all scales. Levy recognized the increasing relevance of spatial issues in human life in the mid-nineties and called this the “geographical turn”.[24] He defined the three components of this tendency as being; firstly the ability of individual actors to determine their own spatiality, secondly the change towards a more dynamic, communicative and philosophical form of geography itself, and thirdly the increasing demand on scientists to produce insight into the spatial dimensions of society. Growing interest from other disciplines in the questions of globalization, decentralization or the construction of Europe, called for an understanding of the geographical components of these questions.[25] The urban debate has extended its boundaries, encompassing distant, dispersed zones while reassessing the porous, multi-scalar and simultaneously diverse forms of space developing from within.

A geographical perspective on urban processes is however more than a question of scale and morphology. The relationship between urban systems and infrastructure, ecology, physical geography and geology – domains which have traditionally been treated as sectorial specialist areas – has gained the attention of architects and urbanists, resulting in critical discussions on geographical urbanism and a call for greater collaboration. Bernardo Secchi has articulated this point of view in an interview with Monu magazine, stressing that while natural (physical) geography offers lessons, for example in areas such as water management, the work of an architect necessarily produces artificial geography.[26]

The research statement of the The New Geographies doctoral research group at Harvard GSD is entitled *Geography as Paradigm.*[27] The lab proposes that a synthesis is possible, and even necessary, between architecture and these previously disassociated parallel tracks of inquiry. This necessity is connected not only to the issue of globalization, as affirmed by Lévy above, but also to the Anthropocene, the unofficial name for a new geological era characterized by a “man-made” layer of carbon over the earth’s crust. The implication is that it is part of the responsibility of architecture to include these dimensions in its creative production.

Architect and geographer Rania Ghosn works at the intersections of these disciplines, in particular the idea of “Energy as a Spatial Project.”[28] In her editorial contribution to *Landscapes of Energy* she describes one of the fundamental, yet unseen realities located precisely at this intersection:

> “Energy needs space. It exploits space as a resource, a site of production, a transportation channel, an environment for consumption and a place for capital accumulation… The creation of value in energy regimes has long internalized benefits and accrued them to the urban centre while “externalizing” costs – sliding

23 Edward W. Soja, *Postmetropolis*.
24 Jacques Lévy, *Le tournant géographique*.
25 Lévy, *Eine Geographische Wende.*
26 Upmeyer, *Working with Geography. Interview with Bernardo Secchi.*
27 New Geographies Research Lab, *Research Statement. Geography as Paradigm*.
28 Ghosn, *Landscapes of Energy*.

them to the periphery, out of sight."[29]

The urban at its most vulnerable, its most extreme? In the light of the positions outlined above, the appearance of urban systems in ocean space reflects a geographical condition – the urban has piggy-backed geography and morphed into unfamiliar yet resilient typologies which connect geology to the ocean surface and meteorology to the seabed. These connections may not be unique to the ocean, but they defy standard relationships of scale and distance and therefore demand closer examination. In which ways does the ocean facilitate and participate in establishing extended urban systems within its spatial realms?

1.6 OCEAN PLANNING

Man's interaction with the sea in western civilization is accompanied by his instruments of measure and control, both of which are a prerequisite to planning. Spatializing – that is producing a particular space – is according to Lefebvre,[30] Soja[31] and Steinberg,[32] a social act. We are intrinsically spatial beings, continuously engaged in the collective activity of providing spaces and places.[33] Formalization of these spaces into legally-bound units is a political act carried out either through negotiation or the execution of power. The history of the formalization of ocean space into legal categories is therefore as long as the history of negotiation and political power itself. Alliances and rivalries between tribes, political units or confederations at sea were fluid and dynamic, similar to the situation on land. However, the first fundamental legal territorial concepts of an international dimension were initially discussed and ratified in relation to the ocean.[34]

1.6.1 MARE NOSTRUM

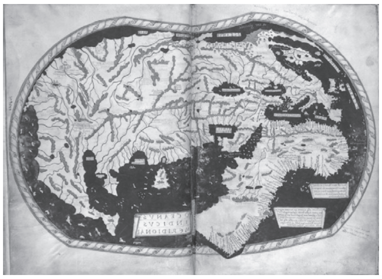
Mare nostrum – latin for "our sea" – referred to the whole of the Mediterranean under the Roman Empire. The death of Cleopatra in 31 BC marked the fall of Egypt to Roman control, closing the empire's ring of political power around the Mediterranean- a situation which the Romans maintained until 200 AD. Even though under this title the Romans claimed the sea as their own, modern legal research concludes that the way they went about commanding this space was close to the principles of stewardship.[35] The Mediterranean under the Roman empire was a non-possessible space, but a space within which power could be mobilised and asserted in the interests of management, or stewarding its bounty.[36] The Romans claimed *imperium* (the right to command) but not *dominium* (the right to own).

1.6.2 MARE CLAUSUM

Mare clausum – the closed sea – was a concept applied by different regimes during particular periods until it became the centre of a fundamental and historical debate. One example is the northern sea – *Mare Septentrionalis*- presided over by the Norwegian Kings during the 10th – 13th

29 Ibid.
30 Lefebvre, *The Production of Space*.
31 Edward W. Soja, *Postmetropolis*.
32 Steinberg, *The Social Construction of the Ocean*.
33 Edward W. Soja, *Postmetropolis*. p 6
34 Theutenberg, *Mare Clausum et Mare Liberum.*
35 Steinberg, *The Social Construction of the Ocean.*
36 Ibid. p 67

[2] Map of Mare Septentrionalis as a *mare clausum*.


[3] World map by Henricus Martellus, 1489.

centuries, who tried to prevent foreign ships from entering and trading.[37] This sea, today incorporating the Greenland Sea and the Northern part of the Norwegian Sea, was however at the time envisaged as being surrounded by the Norwegian-ruled lands of Greenland and Iceland and therefore a type of internal sea [2 – 3].[38] Special treaties were then established with Great Britain and the Netherlands in response to their requests to conduct whaling expeditions around Svalbard.

A second example of a *mare clausum* is the Baltic Sea. As long as the Danish-Norwegian Kings had control over the three entrances to the Baltic Sea from the 16th to the 17th centuries, the Oresund, the Great Belt and the Little Belt, the Baltic effectively became a *mare clausum*. During the 18th century, unilateral control gave way to a *mare clausum* in the form of a condominium between the Baltic states of Germany, Sweden, Russia and Denmark, aimed at maintaining peace and protecting the neutrality of the Baltic region. This was effective as long as ambitions were aligned and no one country became involved in military activities, which became the case when Russia in invaded Sweden in 1809.

1.6.3 MARE LIBERUM

Mare Liberum was the title of the influential book by Dutch jurist and philosopher Hugo Grotius published in 1609. This was a response to international discussions on the rights of passage at sea, in particular the Pope's famous bull of 1493, resulting in the Treaty of Tordesillas in 1494 which, following the Spanish and Portugese expeditions during the golden age of exploration, divided the globe into two equal halves for Spain and Portugal. Grotius argued for the freedom of the seas in the general interests of mankind- for innocent use and mutual benefit of the seas for all. This position also represented the best interests of the Dutch Republic, which was gaining maritime dominance and had expanded trading interests towards India, part of Portugal's *mare clausum* according to the Papal Bull.

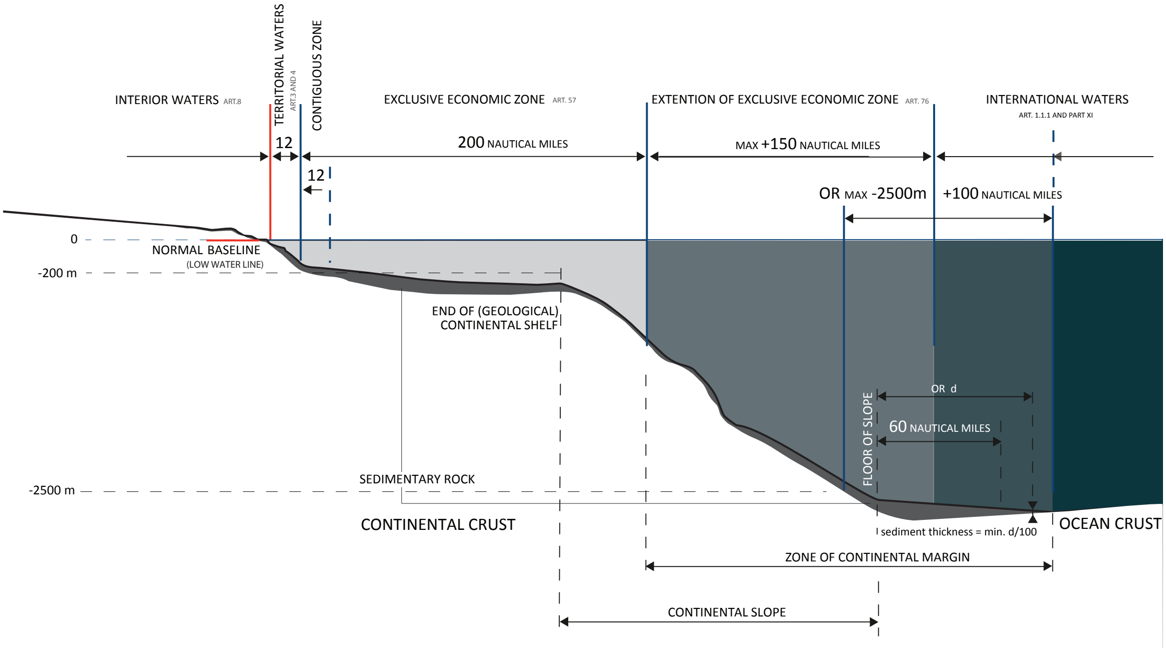
Even though the British had previously argued for *mare liberum* where this concept best matched their ambitions, John Selden published *Mare Clausum* in England in 1635 in response to Grotius's book and in collaboration with King James I of England. Although Selden's argument for the natural dominion of the British crown over neighbouring seas was eloquently executed, the concept of *mare liberum* had already firmly taken hold and could be seen to be of economic benefit for all.

At the same time, it was however implicitly understood that nations should have jurisdiction over the territorial seas close to their shores and that other maritime nations could expect a certain amount of protection from pirates and other attacks within this zone. In the early 1700s it was also the Dutch who formalized this idea by issuing a decree to establish a "territorial sea" that was as wide as the hypothetical range of an imaginary cannon. A distance of three nautical miles came to be widely accepted as the width of the territorial sea and necessarily implied military defense of this zone.

1.6.4 UNITED NATIONS CONVENTION ON THE LAW OF THE SEA

Until the mid-twentieth century, the doctrine of the freedom of

37 Ehrensvärd, Kokkonen, and Nurminen, *Die Ostsee*.
38 Theutenberg, *Mare Clausum et Mare Liberum*.



[4] Ocean zones defined by UNCLOS 1982

the seas and the territorial zone had generally been accepted. However, increasing conflicts at sea, threats of pollution, the need to regulate the expanding shipping trade, and multiple claims to territories further offshore, led the United Nations to initiate a comprehensive legal framework for ocean space. This process began in 1949, resulting in the first United Nations Convention on the Law of the Sea (UNCLOS) at the Conference in Geneva in 1958. The third Convention of 1982, subsequently defined a nation's exclusive economic zone to a distance of 200 nautical miles (nm) offshore, and included regulations for the use of this zone.[39] Coastal nations were therefore awarded the right of jurisdiction over resources within the boundaries of their continental shelf, which is represented by the 200 nm limit. In cases where the continental crust itself is deemed to extend geologically beyond 200 nm, the EEZ can also be extended through a series of possible calculations pertaining to this crust [4]. UNCLOS defined two further zones – a territorial sea out to 12 nautical miles offshore over which the country has all rights of governance and the contiguous zone comprising a further 12 nautical miles within which police power can act to enforce the law or to prevent its violation.

In many areas of the globe, for example the Baltic Sea, the Barents Sea, the North Sea, the Mediterranean, large areas of both the China Sea and the Pacific Ocean, the maximum 200 nautical-mile limit cannot be met and the spatial division is negotiated between the exclusive economic zones of neighbouring countries. The definition of an offshore Exclusive Economic Zone through UNCLOS enabled coastal nations to clarify and coordinate diverse spatial demands. Marine Spatial Planning is an example of such a process and is an initiative also supported by the UN.

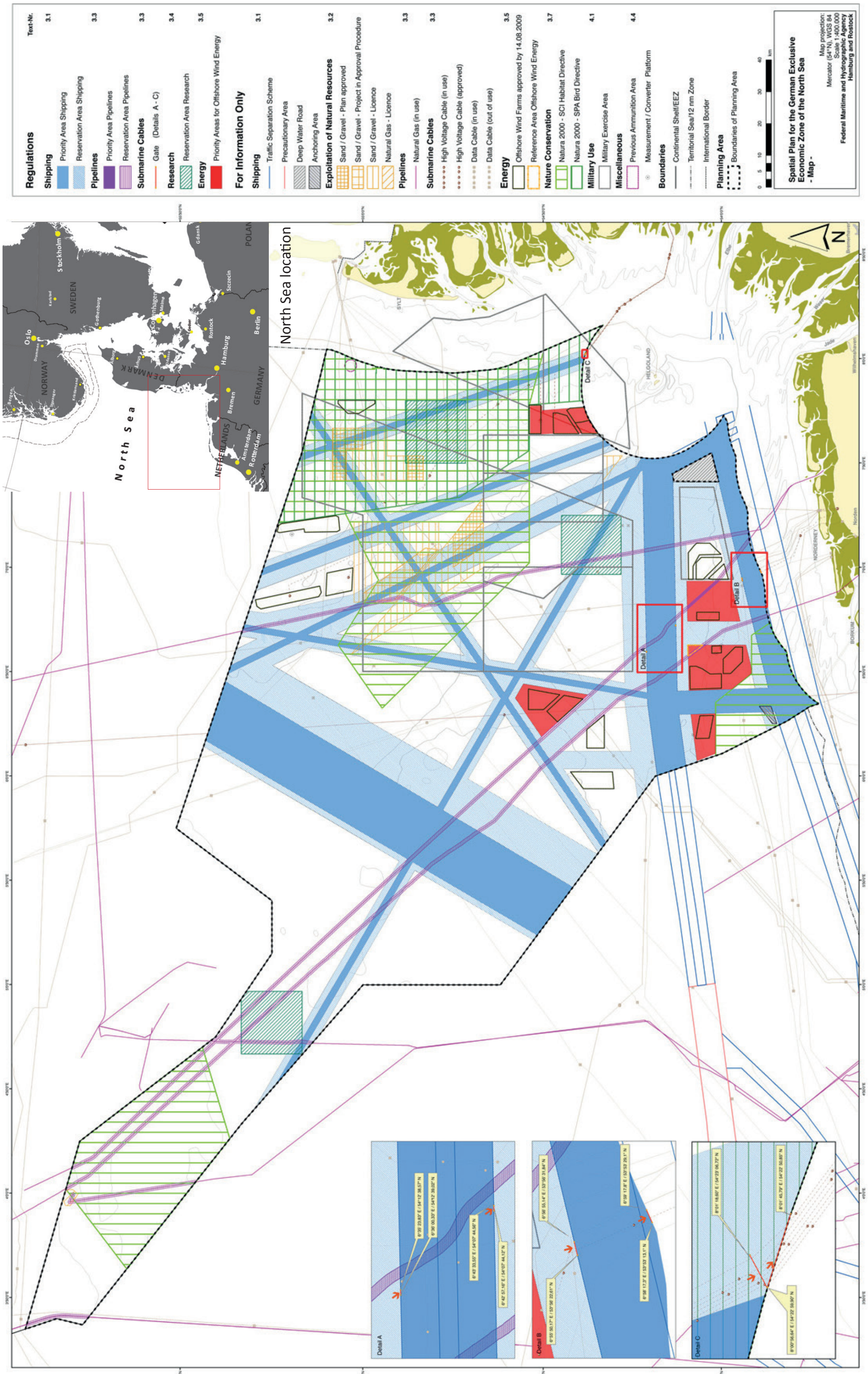
In the light of the historical overview above, the appearance of this zone as a legal entity marks the re-emergence of the *mare clausum* concept, and a restriction to the principle of a *mare liberum*. Further to this, while territorial claims in the ocean have a long history oscillating between *mare clausum* and *mare liberum*, the strategic *planning* of this space is however a new and emerging field. Planning at the scale of the ocean can be regarded as more a form of management than a blueprint for development, but it also relies on fixed co-ordinates to determine areas of ocean space. Within a 200 nm offshore zone, economic priorities such as shipping corridors and fields designated for energy production become clearly legible in a plan such as the Spatial Plan for the German North Sea [5].

At the same time, the visualisation of overlapping ocean uses which has only recently been undertaken in a systematic way due to the advent of ocean planning, presents a strong case for the need to resolve spatial conflicts [6]. This thesis proposes a re-evaluation of the *plan* as a method of organising ocean space and proposes instead a fluid *project* which is capable of incorporating the ocean's own spatial characteristics.

1.7 PRECEDENTS

The ocean as a spatial entity has been alluded to, but only rarely been the subject of a full architectural, urban or territorial investigation. Precedents are the Multiplicity study *Around a Solid Sea* led by Stefano Boeri and John Palmesino and the Singapore *Hinterland* investigation headed by

39 UN, *UNCLOS 1982*.



[5] Spatial Plan for the German North Sea, 2009

Milica Topalovic at the Future Cities Laboratory ETHZ/Singapore.[40] Using different research methodologies, these precedents reveal complex fields of relationships which are established in ocean space, yet which have remained uncharted and little understood. The emerging spaces documented by these studies are a result of urban dynamics, yet are unfamiliar – even unrecognisable – in territorial terms.

1.7.1 AROUND A SOLID SEA

Boeri is interested in clarifying the human geography of the Mediterranean and how identities are impacted by the intensification of flows across the sea. The project reveals specialized, highly controlled trajectories which are mutually exclusive and seldom provide the possibility of natural exchange. Flows are distorted through the effects of *funnels, bridging points, collision points, compression points* and *clearings*. Because the Mediterranean Sea is in itself "the only certain territory" in a volatile region of shifting boundaries, Boeri compares it to a liquid continent, but a continent"ploughed by predetermined routes and insuperable boundaries and subdivided into strictly regulated bands of water. A solid space, crossed at different depths and in different directions by distinct flows of people, goods, information and money."[41]

1.7.2 ARCHITECTURE OF TERRITORY- HINTERLAND

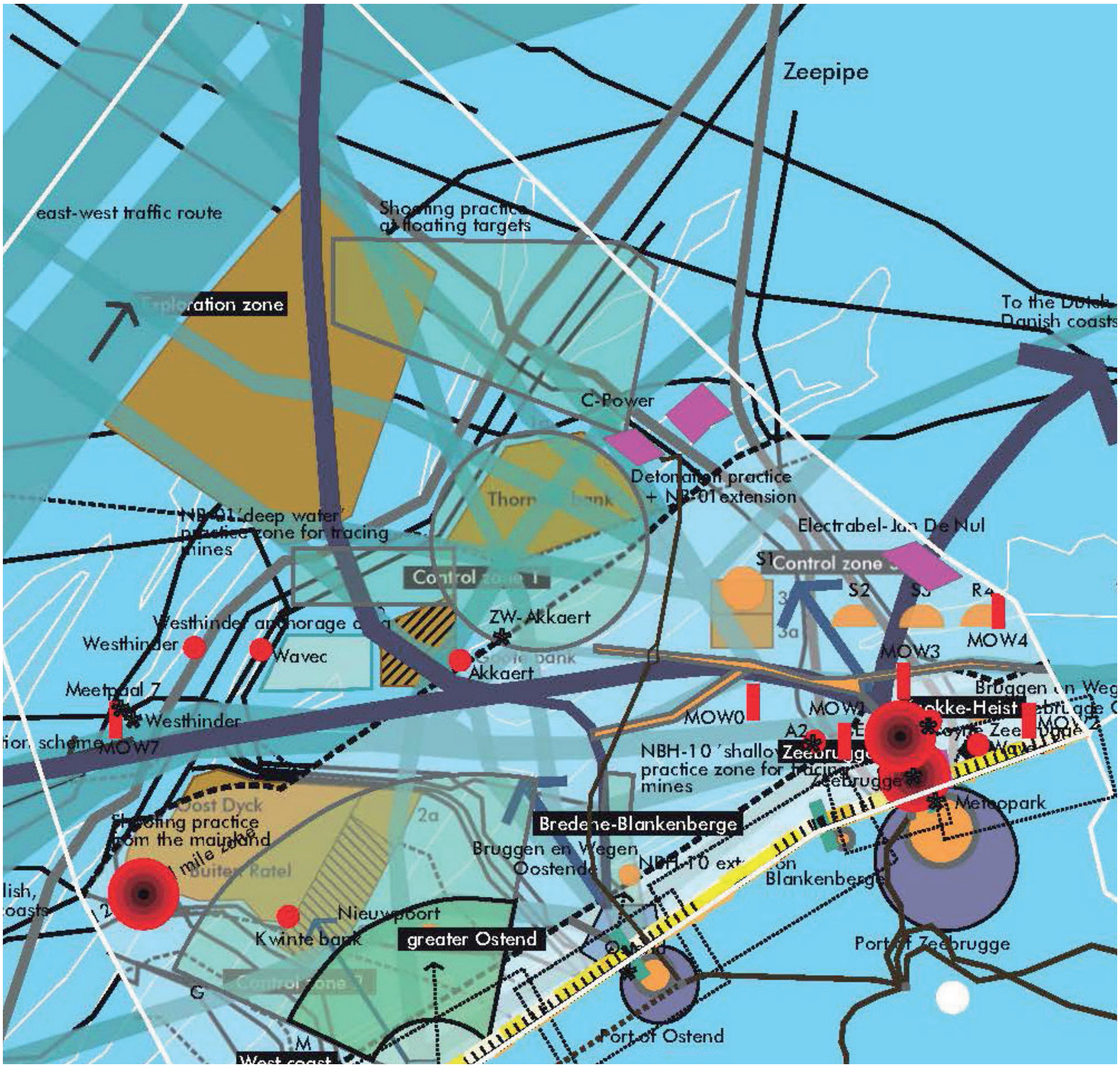
The relationship between city and territory is the departure point for Topalovic's investigation. Singapore is an island state ostensibly without a hinterland territory, but which relies on imports of around 30,000 people/year to maintain it's growth dynamic. This raises questions and demands a closer examination of the surrounding region – the areas which are being "emptied out."[42] Labour, goods and material sources are located in the surrounding countries, but the site of its major economic activity of shipping, is Singapore's ocean territory. Singapore has consistently remained within the world top 5 container ports in terms of volume since 1980, holding position number 2 behind Shanghai in 2011.[43] Each square centimetre of its maritime space is planned.

The Hinterland study demonstrates how the Singapore and Malacca Straits occupy a key territorial position, and how the spatial demands of the shipping industry in fact expand back towards land. Shipping activities and their related requirements such as security, have been the drivers for the transformation of most of Singapore's coastline, where only 7.5% is accessible to the public as a result.

1.7.3 SYNTHESIS

These precedents provide an inspiration to this thesis, suggesting methods and modes of representation in a largely unresearched domain. They also have a strong project character- spatial analysis has provided the raw material for the postulation of principles and for forming conclusions. Each example is firmly rooted in its specific geographical, cultural, and political context. Oceans are understood here as a cultural artefact bearing

40 Topalovic et al., *Architecture of Territory – Hinterland*.
41 Boeri and Palmesino, *Around a Solid Sea*.
42 Topalovic, *The Missing Map – Exploring Singapore beyond the Border*.
43 Fossey, *Top 100 Container Ports 2012*.



[6] A Sea of Chaos, overlapping spatial claims in the Belgian EEZ, North Sea.

historical knowledge which is adjusted and transformed by human interaction over time. In order to deal with the scale of the Mediterranean, and to match this with the scale of human identities, Boeri develops what he calls an "eclectic atlas" which picks out a range of diverse personalities crossing this sea and follows their trajectories. Each single story reveals information about the patterns of flow and contributes towards the construction of a new reading of this space. In a similar way, specific areas and phenomena within the Barents and Baltic Seas have been chosen for deeper analysis. Through a translation into typologies, I maintain that a clearer understanding of both local conditions and the dynamics of ocean space in general can be gained.

1.8 PRIMARY THEORETICAL SOURCES

1.8.1 HENRI LEFEBVRE

> "The city… had been superseded by a process of urbanization or, more generally, of the production of space, that was binding together the global and the local, the city and the country, the centre and theperiphery in new and quite unfamiliar ways."[44]

David Harvey's afterword to the English translation of *The Production of Space* summarizes Lefebvre's position on the process and nature of global urbanization. Flows of energy, raw materials, labour and information dominate the capitalist economy of production. This process produces not only contradictions between such flows and fixities, but also new types of space itself which, in turn, become a marketable commodity. *The Production of Space* was the culminating work of Lefebvre's theory written while he was professor of Sociology at the University of Paris-Nanterre and which spanned seven volumes published between 1968 and 1974 beginning with *Le droit à la ville*.

The Urban Revolution (originally La Révolution Urbaine, 1970) begins with the provocative hypothesis: "Society has been completely urbanized."[45] In this work, Lefebvre presents an all-pervasive urban phenomenon whose scale and complexity has outstripped our tools to understand it. He argues that the rural, the industrial and the urban succeed one another, calling them "fields," which refer not only to successive facts of phenomena but also to "modes of thought, action and life."[46] Blind fields are formed between the three, where fragments of both new and existing modes co-exist side-by side but cannot yet be attributed to an «historical totalization». For this reason we cannot yet recognise the urban, which appears in unfamiliar forms and rejects the space-time characteristics of industrial rationality. Lefebvre describes this new urban field as:

> "A highly complex field of tensions, a virtuality, a possible-impossible that attracts the accomplished, an ever-renewed and always demanding presence-absence."[47]

The conceptual framework offered by Lefebvre in order to understand this urbanity is structured around *levels* and *dimensions*. Particular to his framework, is the inclusion of both virtual and real manifestations of urban processes; the global level, for example includes abstract relationships

44 Lefebvre, *The Production of Space*. p 431
45 Lefebvre, *The Urban Revolution*. p 1
46 Ibid p 32
47 Ibid p 40

involving the exercise of power. This level also comprises the parts of the built environment which result from strategic or political decision-making, for example institutions and large-scale urban projects. Two further levels are defined; the mixed level, which creates direct and immediate places of public life and exchange, and the private level, which comprises primarily the space for habitation. It was in this level that Lefebvre saw the potential for true change, that is, an inversion of order from "bottom-up".

Having established his arguments for the emerging urban society, Lefebvre examines the nature of space itself and its relationship to production in *The Production of Space,* first published as L*a production de l'espace* in 1974. The spaces produced by social interactions take on many forms which co-exist, interpenetrate and can be superimposed on one another. Lefebvre offers an overview of important forces at work throughout the history of civilisation from the perspective of social space, including the watershed moments and achievements, such as the transferral of the marketplace from outside the city into the town centre during the Middle Ages. The market was established as a new type of commercial space, including the space of communication, exchange and networks, and ultimately operated in direct competition to the church. According to Lefebvre, the reign of the product was heralded in during the 16th century in Western Europe as the merchants gained supremacy and the town took over from the country in practical, social and economic importance.

Lefebvre argues that space itself has taken over the role of nature in respect to production, that it is consumed as a commodity and that it is politically instrumental in reinforcing relations such as production and property. He also describes the symbolic and virtual nature of space as a set of institutional and ideological superstructures which produce an outwardly blank, neutral kind of space – abstract space – but which are deceptively powerful.

Our investigations show that urban systems have extended beyond terrestrial boundaries and out into the sea and that new spatial typologies are emerging, that is, they are being produced. Further to this, these kinds of spaces are closely linked to processes of production, for example in the energy sector, as well as spaces of global flows in the form of maritime transportation. Lefebvre's perspective therefore provides valuable insights into the possible nature of this urbanization and how the spatial effects can be traced to social actions. His descriptions of abstract space – a context which superficially appears homogeneous and where its true heterogeneity, its conflicts and contradictions do not appear as such[48], potentially opens pathways to an understanding of such spatial contradictions apparent in the abstract nature of ocean sites under investigation here.

WHY IS THIS RELEVANT NOW?

The publication of *La Révolution Urbaine* sparked heavy criticism, in particular from Manuel Castells,[49] who had been one of Lefebvre's students, and who was a key developer of Marxist urban sociology, in particular the role of social movements in the transformation of the city. While Lefebvre argued that urbanization had taken over from industrialization as

48 Lefebvre, *The Production of Space*. p 306
49 Castells, *La question urbaine*.

the primary force of change, Castells disagreed that the urban could be the serious object of social science enquiry. He rejected the idea of an urban culture and ideologies that relate a particular way of life to the city instead of linking them to capitalist industrialization.[50]

Castell's position, plus a similar criticism from David Harvey arguing for industrial capitalism as the driver of urbanization, meant that Lefebvre's work subsequently remained undervalued and under-examined.[51] The spatial dimension of this work, however was fresh and new. Lefebvre described a kind of space not bounded by the Euclidian geometry that had dominated western thinking, but rather a dynamic, evolving spatial environment which was in itself a small revolution. Neil Smith describes this achievement in the foreword to the Urban Revolution:

> "The very shift in political thinking to embrace a spatialized view of the world, in significant part due to Lefebvre's work, makes it difficult today to see how genuinely iconoclaustic that position was."[52]

For this reason, and corresponding to their relatively recent translation into English, these works have subsequently inspired and re-invigorated discussions on the urban. The following section highlights one important example. In the light of current urbanization processes that are as yet little understood, Lefebvre's thinking stands out as being highly relevant and still contemporary. Although criticising Lefebvre's theories at the time, much of David Harvey's thinking was also aligned, so much so that it is David Harvey who has written the Afterword to Donald Nicholson-Smith's translation of *The Production of Space* (1991).

1.8.2 PLANETARY URBANIZATION: BRENNER AND SCHMID

Lefebvre's work, including the two publications described above, not only heavily influenced Edward Soja and David Harvey, but also provided an important basis for a new generation of urban theorists discussing his concept of global urbanization, including Andy Merrifield,[53] Neil Brenner and Christian Schmid.[54]

The study of Planetary Urbanization as pursued by Brenner and Schmid, calls for an epistemological shift and a radical reconceptualization of the urban.[55] Urban discourse, so the authors argue, has been focused on methodological *cityism*[56] – the continuous intellectual insistence on the idea of the city (inside), determined by certain characteristics which make it distinct from the non-city (outside). This focus has meant that little investigative attention has been paid to the large-scale effects of urbanization processes – the production of unfamiliar spatial configurations which cannot be categorized under the previously assumed dichotomy of urban/non-urban or city/hinterland.

This approach illuminates the need to investigate the morphology of specific territories emerging within the dynamic, uneven texture of global urbanization, of which cities under modern capitalism are just one form. Parallel to the expansion of urban agglomerations around the world,

50 Stanek and Henri Lefebvre, *Henri Lefebvre on Space*.
51 David Harvey, *Social Justice and the City*.
52 Lefebvre, *The Urban Revolution.* p XIII
53 Merrifield, *The Urban Question under Planetary Urbanization*.
54 Brenner and Schmid, *Planetary Urbanization*.
55 Brenner, *Implosions / Explosions*.
56 Ibid. p 15

planetary urbanization sees the formation of vast yet distant "operational landscapes" which serve the "accelerating, intensifying process of urban industrial development."[57] The unfolding of this process is both synchronized and asychronized with rhythms of urban expansion. These landscapes are frequently the sites of infrastructural investments, dispossession and ecological degradation, completing the links in the global chain of extended urbanization, yet they themselves, and their mutually interdependent relationships with flows of energy, materials and capital, remain largely unresearched.

Through his studies, Brenner has begun to investigate the strategic terrains of extended urbanization and their possible modes of representation. Departing from perceived urban voids, the white spots on the global map of urbanization, these studies include the desert, the oceans and outer space.[58] He stresses the need to understand the site as (in Lefebvrian terms) a "concrete abstraction," – both concrete, territorialized fragments and generalized, universalized processes simultaneously.[59]

This investigation on ocean space makes reference to the idea of "operational landscapes" as proposed in the *outline of an urban theory without an outside*, Neil Brenner's introduction to *Implosions/Explosions.*[60] Ocean space is increasingly becoming a premium commodity – regulated and amalgamated within both local and global territorial systems. A quantum shift in the scale and intensity of ocean use is apparent in both traditional maritime sectors such as fishing and maritime transport, and in new, previously land-based industries such as off-shore energy production and the extraction of minerals. These developments are accommodated within national EEZs through politics and in international waters through other processes of legitimization. They bring concrete physical changes to ocean space, thickening the loosely-woven urban mesh into hard, technological materiality. However the distended and punctual nature of these physical manifestations, together with their lack of real social interaction, demands the addition of a further, abstract layer of analysis, capable of coupling these typologies to the largely invisible processes and infrastructural networks within which they are firmly embedded. I also argue that the perceived abstract void of ocean space, delineated by the horizon, serves another social purpose, adding to the layers of the ocean's complexity.

Further to this, the ocean is not a passive bystander, rather commands and determines space in its own right, ranging in character from what Lefebvre would call "natural space" to enviro-technical hybrids of combined intelligence and energy.

1.9 OCEAN TERRITORY – A PROPOSED DEFINITION

1.9.1 OCEAN TOPOGRAPHY

Spatial delineation of the world's oceans and seas was undertaken by the International Hydrographic Organization in 1952, in the common interests of sailors and mariners.[61] These limits were roughly based on bathymetry, had no political significance and are still frequently referred

57 Ibid. p 21
58 Brenner, *Theses on Urbanization*. p 107
59 Ibid. p 95
60 Brenner, *Implosions / Explosions*. p 22
61 International Hydrographic Organization, Limits of Oceans and Seas.

to today. The Barents Sea, for example occupies a shelf of an average 230 metres in depth, which drops down into the Atlantic Ocean to the west and the Arctic Ocean to the north. The Baltic Sea is a semi-enclosed sea, but its internal divisions of 14 parts are determined by a series of gulfs and sub-basins.

Primary oceanographic spaces and topographical limits therefore exist outside of political demarcation. Topography, flora and fauna, geological formations and water flows are landscape characteristics shared by both land and sea, but which relate to the *surface* condition. Not only is the sea more topographic than the land,[62] but it is deep, composed of different masses in constant flux according to seasons, currents, temperatures, salinities, and densities. Compared to land, the surface condition is inverted to the seabed, and a new "surface" – the abstract, seemingly non-directional ocean plane – takes its place on the horizon. Within this volume, multiple exchanges create spaces and conditions which support the ocean's richness of life. These resources, including topographic features such as natural harbours, wind and water currents, have then structured human interaction with the sea. I claim that the spatial entity of a bathymetrically-defined sea can be conceived of as territory, even if the Latin *terra* means land.

1.9.2 OCEAN TERRITORIALIZATION

In his investigations of the conceptual basis for understanding territory, Stuart Elden argues that territory has come to mean a politically contested and controlled space, depending on techniques of land surveying and cartography. He then defines territory as "political technology."[63] Critical to Elden's argument, is his claim that the concept of bounded space as a product of geometry, existed before the instruments implemented to define it. According to Elden, the 15th – 16th century way of "grasping space is still the overriding geographical determination of our world."[64]

WHERE DOES OCEAN SPACE STAND WITHIN THESE CONCEPTUAL FRAMEWORKS?

I argue that ocean space has a history of territorialization distinct from land. The "political technology" Elden describes has only partially, and then only recently, been applied to the ocean. Efforts to politically control ocean space and the historical debate between the paradigms of *mare clausum* and *mare liberum* have been described above. There are three reasons why the concept of bounded ocean territory did not take hold:

Firstly, the Papal Bull of 1493 dividing the globe assumed absolute power of the pope. Yet other states and authorities possessed a greater maritime strength and therefore contested this authority. The concept of *mare liberum* – an unbounded ocean space, was accepted amongst these powers as a prerequisite for profitable maritime trade.

Secondly, I argue that a coherent spatial concept for the oceans at large existed only in specific cases where political power or unity was united with geography, creating a unified ocean "space." The examples of *mare clausum* described above provide a clear illustration of this. At the

62 Ocean depths exceed the highest mountains: Mt Everest = 8,848 m high, depth Challenger deep in the Mariana Trench= ca. 11,000 m.
63 Elden, *Land, Terrain, Territory*.
64 Elden, *Missing the Point*.

time of the development of geometry as a tool for surveying and marking *landspace*, navigation of ocean space was still haphazard. Sobel's fascinating account of the competition to accurately calculate longitude, which resulted in the prize being awarded to the English watchmaker John Harrison, in 1774, (38 years after his first instrument H1 made its trial voyage) is an example of this lapse between technology and the spatial practice of the time.[65] Christopher Columbus had already discovered the Bahamas in 1492 by "sailing the parallel," where trade winds were to his advantage and deviations in a degree of longitude were minimal. Navigating the oceans was not a simple geometrical exercise.

Thirdly; trade, colonization and religious conversion as the motives for the age of exploration, did lead to the rapid territorialization of newly discovered lands in Elden's sense. However, during this period – between 15th and the 17th centuries – the ocean itself was not of political interest as a place to possess or develop. Along with discovery of new lands, the political and intellectual context of Western Europe was transformed due to the advance of technology and science and the restructuring of the papal empire under the Reformation. It is within this context that the Elden also describes the modern idea of state, and the modern concept of territory as concurrently emerging.[66] At the same time, merchant capitalism reigned and sea power was understood as the means to political and economic power. The role of ocean space in these activities is described by political geographer Philip Steinberg as a force-field:

> "The sea was the surface across which transpired much of the channelled circulation that characterised merchant capitalism. It was a space in which state-actors exerted power and sought a degree of control… a special space within world society, but outside the territorial states that comprised its paradigmatic spatial structure."[67]

Therefore the concept of *ocean territory* is yet to be accurately defined. Geometry, politics and concepts of bounded space are not its single determining characteristics.

The arguments outlined above are constructed to match the critical historical period Elden refers to in his research on the origins of the concept of territory. Since the 17th century, the territorialization of the sea has advanced and UNCLOS can be seen as the most influential territorial initiative of the 20th century. Within the theoretical framework of planetary urbanisation the status of the ocean as a territory still needs to be clarified. The age of exploration certainly provides a vivid image of urban *extension* as models of economic & political organisation materialized spatially in European-ruled colonies on the other side of the globe. In reference to globalization, Elden discusses how this phenomenon constructs its own particular territory, being careful to stress, that although this kind of territory is characterised by the dialectic of *territorialisation/deterritorialization*, geography still remains paramount to the globalization project.[68]

As an alternative to a definition based on contained space, French geographer Bernard Debarbieux defined territory as:

65 Sobel, *Longitude*.
66 Elden, *Missing the Point*.
67 Steinberg, *The Social Construction of the Ocean*. p 105
68 Elden, *Missing the Point*.

> "The arrangement of material and symbolic resources capable of structuring the practical conditions needed to support the existence of an individual or a social community."[69]

Ocean space – sparsely populated yet permanently traversed, harvested and tapped for energy – would seem to be better represented by this idea. Territorialization can then be seen to be the result of several forces; superficial (of the surface) legal boundaries, networks of human interests, communities of marine life occupying different zones at different times and natural oceanographic events.

This idea can be clarified by the example of the Barents Sea's oilfields. Superimposing a rich and complex oceanographic system, the Barents Sea's oil and gas community have scanned and surveyed large areas and constructed a geometric mesh of coordinates to systematize the awarding of petroleum exploration licenses [7]. Static geometric fields are created by lines connecting Cartesian coordinates. However, in reality these fields are solely a projection of a piece of seabed back up to the ocean surface, where currently most of the industry's apparatus is located. The intervening water column of up to 400 m in depth is of no relevance to oil extraction. Here the ocean rolls through the boundaries, obeying its own territorial rules, forming temporary zones of high primary production which attract both vast populations of fish and ensuing fishermen.

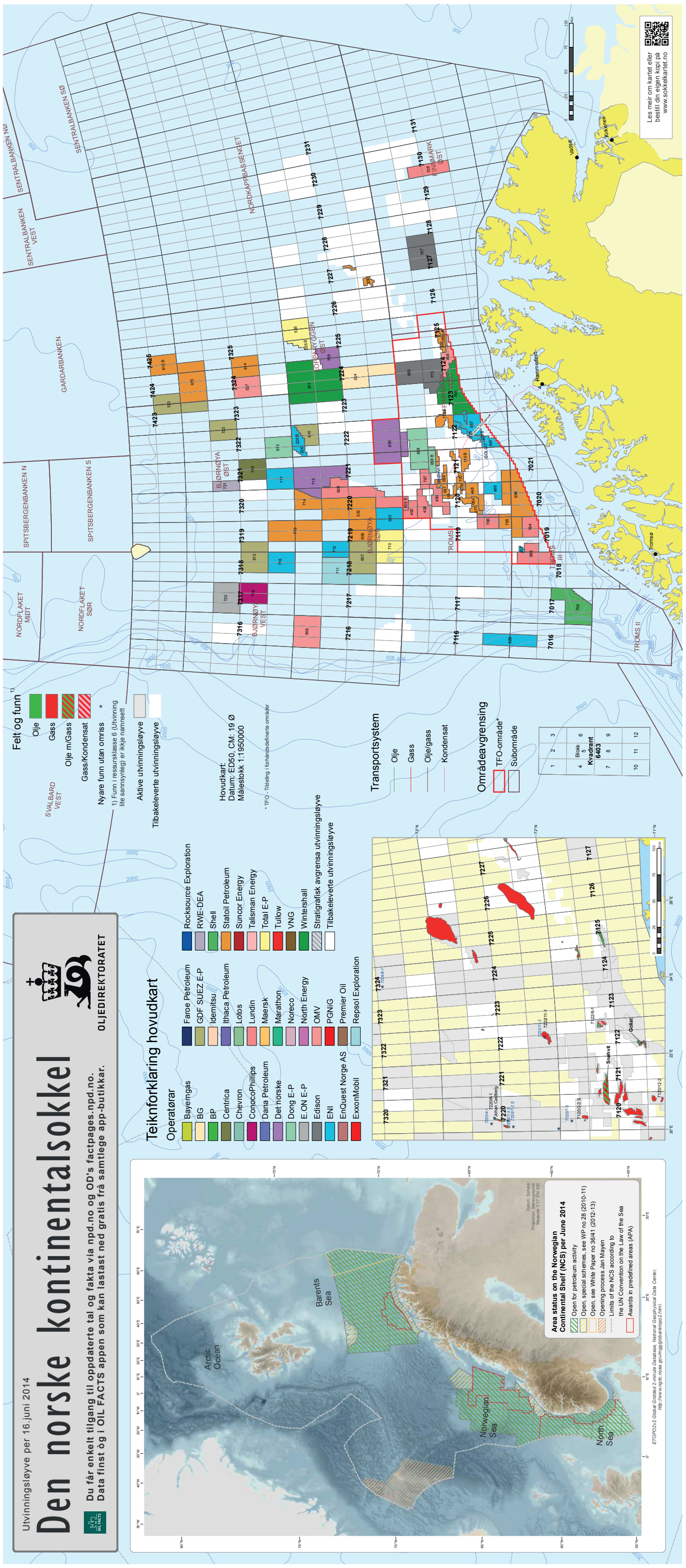
1.9.3 NAVIGATING TERRITORY

A third perspective is offered by Bruno Latour in relation to digital mapping, which he argues has steered maps into a more navigational rather than mimetic direction. With the digital ubiquity of mapping, we are literally entering a "new territory" that is so new it bears almost no resemblance with what was called territory before.[70] Concepts of territory have become almost inseparable from our ability to map them. Latour contributes our conventional conception of territory as a frozen space first of all to a Euclidian concepts of abstract 3-dimensional space through which Galilean objects move without changing, and secondly to our mapping techniques of describing exactly these relationships. As a result mapping reproduces the abstract idea but bears no resemblance to reality. He therefore calls territory a "spurious referent".

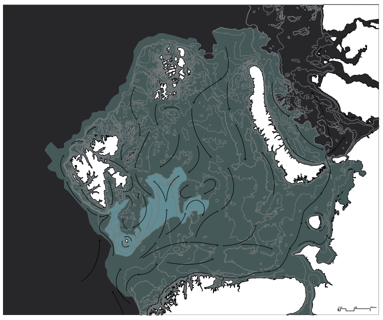
The type of map Latour proposes is not a static representation, rather a more fluid, dynamic, interface, fed by data and in fact made possible through digital practices. Such an interface would be more democratic, more heterogeneous. It would be capable of incorporating a wider range of data, including criteria normally seen as subjective rather than objective and human rather than physical. Risk, he suggests, is the specific area to which such a navigational mapping exercise could be applied, precisely because of its incalculability, its need for features such as anticipation, participation, reflexivity and feedbacks, and the difficulty of mapping risk in traditional ways.

The idea of navigational mapping is analogous to navigating at sea where conditions are dynamic and useful information about direction and position can come from a number of sources – visual landmarks, winds, charts, depth soundings and other moving vessels. Hence the territory such

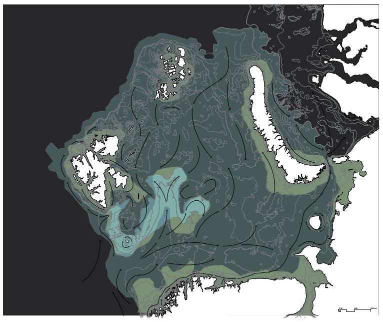
69 Vincent Kaufmann, *Rethinking the City: Urban Dynamics and Mobility*
70 November, Camacho-Hübner, and Latour, *Entering a Risky Territory*.



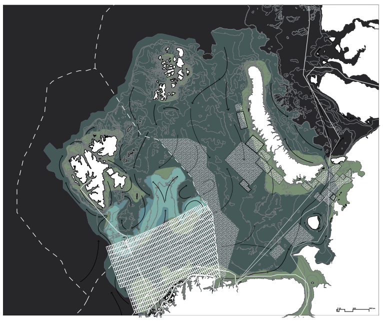
[7] Exploration licensing areas on the Norwegian continental shelf, 2014.



[8] The geo-physical territory- Barents Sea



[9] The biological territory- Barents Sea



[10] The socio-economical territory- Barents Sea

mapping would describe, is also similarly heterogeneous and composed of diverse layers of physical and abstracted realities.

1.9.4 A PROPOSED DEFINITION OF OCEAN TERRITORY

The ocean territory I propose is then composed of two essential elements: its fundamental physical characteristics – the inherently spatial oceanography which forms a differentiated, dynamic, inter-connected hyper-territory – and the range of both organic and inorganic forces which interact with this space. This can be summarized as the interactions between:

– The geophysical territory [8]
– The biological territory [9]
– And the socio-economical territory [10]

The biological territory is closely connected to the geophysical base and together these spaces define the range of oceanic ecosystems, however edges are open and characterized by zones of transition. The socio-political territory, on the other hand, creates political borders, areas of resource extraction and, most importantly static systems of order which are used to define protected areas or to organize extractive or productive activities such as fishing, oil and gas exploration and other forms of energy production.

This definition of ocean territory should provide a basis with which to address the question:

> "Within the context of ocean territory, can inherent ocean space be seen to influence urbanization processes and if so which typologies emerge through this interdependence?"

SUMMARY

This investigation of ocean space aims to expose and identify previously unrecognized forms of urbanization, providing new insights into the spatial characteristics of oceans under urbanization processes, which although intrinsically linked to politics and economics, are also inseparable from the forces of the ocean's own intrinsic spatiality. A summary of the latter is provided by a conclusion drawn from the literature review combined with empirical research in the Barents and Baltic Seas.

Urbanization processes in the oceans are investigated in chapter 2 from the four "cultural" perspectives of Networks, Seascape, Technology and Ecology. These four topics are channels of access into ocean space and represent the most predominant categories of ocean use, for example shipping (Networks), fishing (Seascape), energy production (Technology) and conservation (Ecology). At the same time they each stand for a body of theoretical work in the field of urban studies which can be used as a lens of examination. Ecology takes the dynamics of "natural" criteria such as fish and bird populations, weather and seasonal ocean patterns as its departure point. However ecology is not defined through natural systems alone, rather the interactions between natural organisms and their surroundings, both organic and inorganic.[71] In short, ecology, from the Greek *oikos*, meaning the study of the household, relates to the planetary scale and to all interactions within it.[72] In the Anthropocene the planet has become our household. Ecology therefore provides a way of understanding both the oceanic cycles and

71 Næss and Rothenberg, *Ecology, Community and Lifestyle*.
72 Patterson, *Ecological Economics of the Oceans and Coasts*.

urbanization processes as open, interconnected, planetary systems.

A closer examination of how these systems interact in the contexts of the Barents and the Baltic Seas is carried out in the spatial analysis.[73] Here, situations are sought which demonstrate the mutual influence and interdependence of the four topics in particular combinations. Out of the analysis of these situations, spatial typologies are extruded. In part 4, the ability of the spatial typologies to inform current ocean planning methods is tested.

The high seas are the oldest recognised commons.[74] Throughout history they have facilitated radical forms of urbanization which have resisted traditional (land-based) appropriation. They have provided trading corridors, food and energy, yet have defied delimitation and maintained a unique, if not contradictory spatial status.

But this is becoming a dense and contested terrain. Symmetrical pressure of preservation and production increasingly demands a clarification of limits. The architectural challenge, then, is to redraw limits according to ocean dynamics. As the ocean reveals itself to be a highly urbanized entity, could the reverse be true – can an understanding of complex ocean systems enrich and inform our understanding of urban systems?

73 See 3.9 ASSEMBLAGE
74 Vogler, *The Global Commons*.

2 LITERATURE REVIEW

INTRODUCTION: A BRIDGE TO OCEAN SPACE

The literature review is based on the proposition that four interconnected topics have highly influenced the urbanization of the sea; Networks, Seascape, Ecology and Technology. The spatial significance of each of these topics is as obvious as it is difficult to pin down.

Since the double revolutions of containerization and mechanized bulk transport in the 1960s, shipping volume has increased exponentially, initially encouraged by low fuel prices and the move away from state control to market economy approaches.[1] Today 80% of world merchandise trade by volume is carried by sea. Shipping networks are a primary structuring element of ocean space, yet outside of predetermined shipping lanes, each passage may follow a singular path which is registered electronically, but which leaves only temporary physical traces in its wake. Seascape refers to the landscape of the sea, which has a range of dimensions unseen from the ocean surface. It follows that our manipulation of the ocean's materiality also goes largely unseen. This is true for traditional, habitual interaction such as fishing, but also for infrastructural modification of the seascape for the purposes of pipeline and cable-laying. Further to this, new structures emerge in ocean space as a result of diverse forms of energy production, interrupting the horizon and producing a new seascape image. Technology is also employed to demarcate ocean space, and since the ocean is deep and flowing, this demarcation remains in an abstract, electronic form without being visually evident. Ecological systems have critical spatial dimensions which, while understood by specialists, are slow to be mapped in a way comparable to other "uses" of ocean space. Because of seasonal dynamics, fish populations, for example, often remain spatially undocumented. Technology provides for human access to the ocean, therefore it pervades every aspect of our large-scale interactions.

It is for these reasons that the above four topics have been chosen to structure the review above other potential thematic approaches to ocean space. They contain inherent contradictions of presence and absence which demand closer investigation and interrogation. Furthermore, these four topics emerged from the preliminary research in different combinations, leading to the following questions and observations:

– Is there a chronological sequence of "development" in the ocean such as Lefebvre's observation; "in short, the rural, industrial and urban succeed one another?[2] An exploration of this idea of progression would begin with traditional primary production such as fishing the *seascape.* Through the application of *technology,* intensification of all maritime sectors including fishing, has taken place, resulting in an unevenly industrialized ocean. Have these steps prepared the ground for the urban, and if so what kind of urbanity can develop on such a foundation? At the same time, although the "natural" space of the ocean has been almost completely dissolved, *ecology* reappears in ocean space as a marriage of the oceanic ecosystems and human intervention, again mediated through technology.

1 Stopford, *Maritime Economics.*
2 Lefebvre, *The Urban Revolution*. p 78

– The physical force, materiality and multiple dimensions of inherent ocean space are unique. In a discussion on urbanization, how can they be represented? Ecology and Seascape are two topics which could take on this role. Within the complete thesis framework, the inherent qualities of ocean space represented by these two poles, are confronted with the urbanizing forces of technology and networks. Viewed from this perspective, it is expected that the resulting interactions between the four topics will determine the specificities of urbanization in ocean space.

– In practice, I argue that the most frequent ocean activities lie within these four topical domains:

Networks: cables, pipelines, shipping.

Seascape: Fishing, aquaculture, wind energy, oil production, gas production, dredging and sediment extraction, dumping.

Technology: military practice, research, oil and gas exploration.

Ecology: conservation, cultural heritage (shipwrecks, archaeology). Hence, the pertinence of these topics is validated by their reappearance under different examination criteria; the spatial contradictions between presence and absence, a progression of development, opposing poles of inherent ocean and urbanizing forces and the four main categories of current ocean use.

The review must achieve a further task in this thesis. Literature on each of the four topics is prolific, however, literature related directly to ocean space is rare. Therefore the review must build a conceptual link to the ocean as an urban phenomenon, which is rooted in and inspired and structured by, the chosen works/ it becomes "a bridge to ocean space". Each topic brings specific questions to the discussion on ocean space as an urbanized realm, which are integrated into the four parts.

PRIMARY SOURCES

The primary theoretical sources of this thesis, Lefebvre and Brenner and Schmid, have been presented in the introduction. I argue that the world's oceans are implicated in the process of planetary urbanization, that the inherent space of the ocean interacts with this process as an active agent and that particular typologies of extended urbanization are produced as a result. The state of the art of urban theory – a "*theory without an outside*" – enables the oceans, which had previously received scant attention within urban debates, to be examined from a new perspective. Previous knowledge of historical interactions with ocean space can therefore be revisited. This makes a certain work relevant to the discussion, for example Phillip Steinberg, who does exactly this in his book *The Social Construction of the Ocean*, Fernand Braudel and Manuel de Landa.

The ocean emerges from this retrospective as a context where forces have been played out and where radical forms of urbanization emerge. Deleuze and Guattari's ideas on nomad space and also specifically on the ocean in relation to this are an important reference in different sections of the thesis. Bruno Latour's Actor-Network – Theory is useful in linking animate and inanimate objects and events which can be seen to make up the dynamic environment of the ocean. The mobile, trans-national aspect of ocean space is discussed through the work of Appadurai. The four topics are artificially separated in the review in order to establish a conceptual terrain within which each field can each be considered in its own right including particular links to history, philosophy and practice. In this way, the literature review aims to construct a landscape of thought as a basis for the subsequent detailed analysis of ocean space under urbanization processes in the Barents and the Baltic Seas.

2.1 NETWORKS

INTRODUCTION

Urban history is to a great extent a history of transactions, exchanges and connections, and therefore tightly interwoven with the concept of networks [1]. These dynamics interact with mechanisms of control and enclosure which have aimed to establish regulations, to fix urban borders and which have left lasting physical legacies. Network activity, on the other hand, while exerting great influence on urban relations, may be difficult to grasp and represent. Swyngedouw argues that both networks and bounded space are subject to globalization mechanisms whcih infiltrate all scales, but which result in particular tensions:

> "The current process of transformation will be considered from the vantage point of the reorganisation of the geographical scales of economic and political life. In particular, the tensions between the rhizomatic rescaling of the economic networks and flows on the one hand and the territorial rescaling of scales of governance on the other."[3]

Ocean space has also been etched with borders, but it has maintained a special status aligned to flows and trade and has privileged transport and communication networks which channel these flows. Ocean networks have been paramount in the construction of radical urban systems formed by multiple, heterogeneous and autonomous entities. In order to understand the effects of such dynamics, the consequences of a topographical/topological merger and the challenge of reconciling spaces of flows with geographical *place*, this review presents state-of-the art positions which focus on networks in their spatio-cultural dimensions.

Firstly, the fundamentals of abstract networks are presented.

Secondly, networks of cultural exchange are discussed. I argue that the cultural aspect of networks and the role played by the oceans forms an important basis for understanding extended urbanization in a historical context. This exchange is then linked to urban networks mediated by the ocean and the "great void idealization" is introduced – a conceptual construction which is aligned to the scale-less, topological property of ocean space.

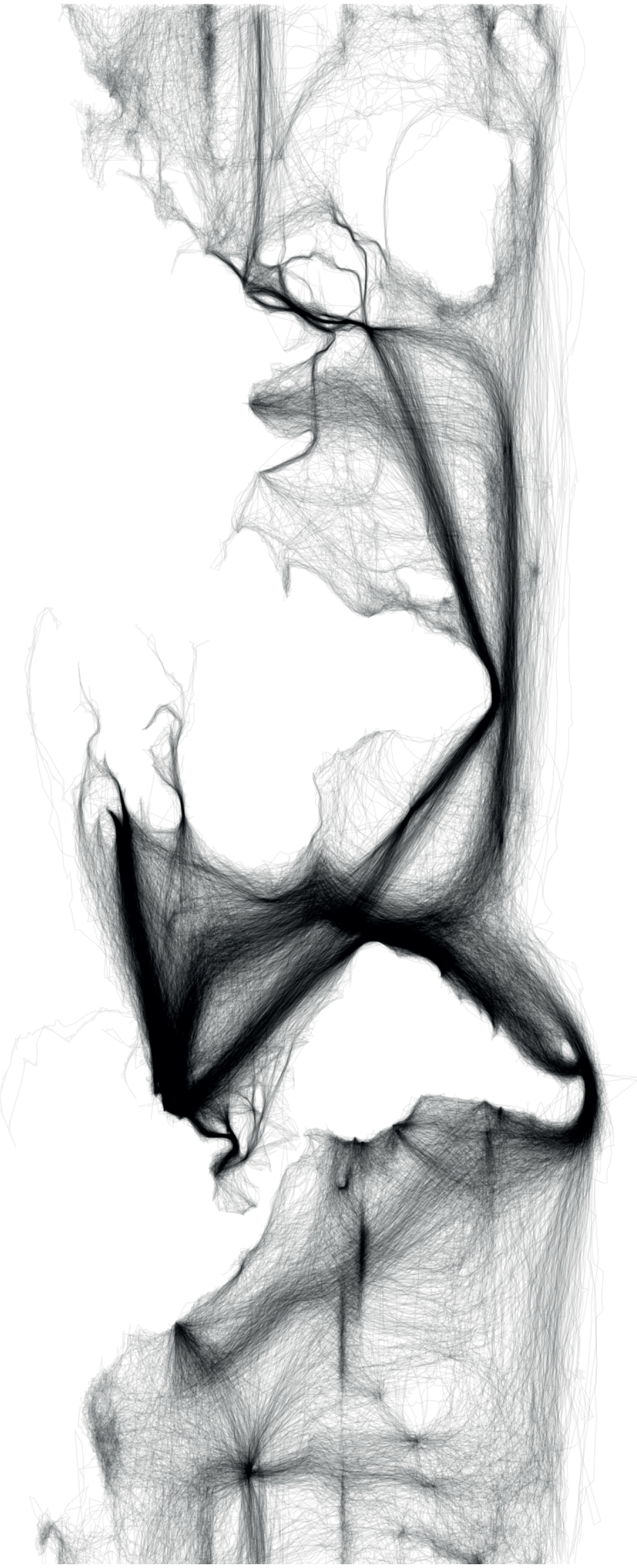
The third section revisits Lefebvre's stance on networks as an integrated component of urbanization processes, which is further developed by Brenner and Schmid through their three-dimensional concept of space under planetary urbanization. Studio Basel's study then offers a concrete insight into the workings of networks in differentiated urban contexts within a fully urbanized Switzerland.

Three further positions make important contributions to the discussion on network space and how they overlay urban systems. Gabriel Dupuy advocates a new type of *network urbanism*, Nick Dunn sees networks contributing to *multi-layered urban landscapes* of both digital and physical networks and Jacques Lévy argues that there is no contradiction between *material and immaterial* forms of human interaction.

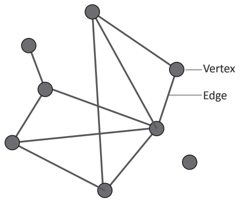
2.1.1 ABSTRACT NETWORKS : EULER, MORENO, CASTELLS

Networks are by definition non-spatial. The study of networks emerged as a means of analyzing complex relational data in different disci-

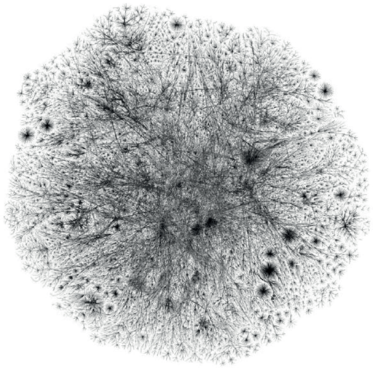
3 Swyngedouw, *Globalisation or "Glocalisation"?*



[1] 200 years of ocean journeys 1800 – 2000



[2] A small network composed of 8 vertices and 10 edges.



[3] Representation of the internet.

plines, combining ideas from mathematics, physics, biology, computer science, the social sciences and many other areas. This makes it an interdisciplinary field which seemingly brings order to complex structures and enables them to be represented as a diagram. Network studies focus on the abstract, systematic aspects of a network as opposed to its physical properties:

> "A Network is a simplified representation that reduces a system to an abstract structure capturing only the basics of connection patterns and little else."[4]

The origins lie in the first examples of graph theory proposed by the Swiss mathematician Euler who presented the solution to the famous "seven bridges of Königsberg" problem using what would subsequently be called the *Eulerian circuit* theory in 1735.[5] The diagrammatic abstraction of relationships was developed independently by Austrian psychiatrist Jacob Moreno who is accredited with being one of the founders of social network analysis and who published some of the first graphical representations of social relations in 1934.[6]

Within this study, spatial aspects of network behavior are largely irrelevant to the system, which is based on two elments, the *vertex* and the *edge* – a path connecting vertices [2].[7] Notions of distance, density and connectivity are mathematically defined according to the characteristics of these two elements and, although borrowing terminology from spatial discourse, spatial relevance is minimal.

Research on the behavior of network systems has led to discoveries such as the "small-world effect" occurring in all types of networks, whereby the "geodesic distance"[8] between two vertices is short. Empirical research carried out on social networks by psychologist Stanley Milgram in the 1960s resulted in what is known as "the six degrees of separation". This principle states that in social networks, any person can reach any other person through six intermediate social connections.[9] Paths taken over the internet to a required endpoint have also been found to be short – between 10 to 20 hops. These experiments demonstrate the high levels of connectivity achieved in the respective networks.

Depending on particular factors, "natural" patterns tend to emerge in networks. One example is the tree-like structure formed by paths from any single source to a set of destinations, or vice-versa. River systems produce this pattern, some road networks and also the internet system itself [3]. Networks can potentially operate over vast scales, but are equally relevant and display the same essential properties at a small scale. Therefore, networks are characterised by the dominance of the topological over the topographical. Topology derives from the Greek "*topos*" – place and "*logos*" – study, and can be defined as the mathematical study of shapes and spaces concerned with continuity and connectivity. Topography derives from *topos* and "*grapho*"- write, and is understood as the study of surface shape and features, in particular the three dimensional qualities.

4 Newman, *Networks*. p 2
5 The problem was to ascertain the possibility of crossing each bridge only once in order to complete a full circuit of all 7 bridges – Euler proved that it was not possible because not every vertice had an even degree.
6 Moreno, *Who Shall Survive?*
7 The names of these elements change according to the discipline, for example in physics vertices=sites, edges= bonds; in sociology vertice = actors, edges = ties; in computer science vertice = node, edges = links.
8 The shortest route (in edges) from one vertex to another is the *geodesic distance*.
9 Easley, *Networks, Crowds, and Markets*.

Networks such as transport systems will, however, have not only properties solely associated with the network itself, but will also have local, geographically-rooted aspects. It is at this intersection of the topographical and the topological that networks become interesting from a spatial perspective; contradictions between fixity and flows, between stability and permanence and between control and emergence, are brought into relief.

The emergence of a new global economy closely linked to the informational economy was the subject of sociologist Manuel Castells' influential work *The Rise of the Network Society*[10], within which the abstract, scale-less properties of networks were contrasted to the traditional modes of spatial conceptualization. This is linked to the contradiction between society's historical modes of production and organization and *informationalism* – the mode of development which has shaped and continues to shape society since the end of the 20th century:

> "There is a split between abstract instrumentalism and historically-rooted, particular identities… a structural schizophrenia between function and meaning".[11]

Castells argues for the predominance of flows in the organizing "architecture" of this system, which is based on asymmetric, independent powers which are not geographically related and which use the technological infrastructure of the informational economy. The three main "spaces of flows" within this system bear a strong relation to network theory, comprising, firstly, the *circuit* – the fundamental spatial configuration of the communication network, secondly, *nodes and hubs*- developed through locally-based activities, serving a key function in the network and taking over the role of exchange and co-ordination and, thirdly, the *spaces of the managerial elite*- a secluded community whose identity is derived from managerial membership and not from a cultural group. The latter describe "personal micro-networks within functional macro-networks".

According to Castells, places do not disappear, but their logic and meaning are absorbed in the network. The technological infrastructure defines a new type of space, just as railway regions defined economic regions in the industrial economy and "links up specific places with well-defined social, cultural, physical and functional characteristics".[12] However Castells also confirms that, despite the ubiquity of flows and the potential emergence of a new spatial order based around this abstract materiality, an unresolved chasm exists between the ahistorical space of flows and "place-based" space.

2.1.2 CULTURAL NETWORKS : CLIFFORD, APPADURAI

The work of historian James Clifford is concerned with challenging the myth of historical continuity regarding discussions of culture. He considers this a biased perspective which represses "the impure, unruly processes of collective invention and survival".[13] His argument is based on the idea of heterogeneity and displacement as an essential factor in the nourishment and development of culture, and he challenges the common assumption that "roots always precede routes".[14] Historically, Clifford main-

10 Castells, *The Rise of the Network Society*.
11 Ibid. p 3
12 Ibid. p 413
13 Clifford, *Routes*.
14 Ibid. p 3

tains that political forces such those embodied in the idea of a nation, seek to control what are inherently natural forces of movement and "contamination". Such an "imagined community" and its borders then requires constant and often violent maintenance.

While cultural "crossings" are a permanent feature throughout history, according to Clifford, a new combination of three factors has resulted in emerging concepts of a trans-local culture; the continuing legacies of empire, the effects of unprecedented world wars and the global consequences of industrial capitalism's disruptive restructuring activity. In this sense Clifford argues that Networks both pre-suppose and exceed cultures and nations. Clifford makes reference to socio-cultural anthropologist Arjun Appadurai who examines the condition of modernity and its post-national political order through the interconnected phenomena of mass media and mass migration, which have established what he calls "relations of disjuncture".[15] While networks have always been a vehicle of cultural transport, Appadurai argues that certain characteristics of the contemporary condition intensify the levels of migration related to refugees, labour and education and in combination with mass-media, may result long-term in a cultural freedom and sustainable justice outside the nation state which "could be the most exciting dividend of living in modernity at large".[16] Appadurai's well-known "scapes" describe five types of global cultural flows which are formed by specific, fluid and irregular connections; *ethnoscapes*, *mediascapes*, *technoscapes*, *financescapes* and *ideoscapes.*[17] A constant tension exists between the moving and the stable within which everybody is engaged. In the case of Mumbai, for example, this tension refers to networks extending well beyond the city combined with the wish to produce a legible local stability.

This perspective outlines the complexity, instability, global range and specificity of parallel interacting networks operating in a post-national space.

2.1.3 URBAN OCEAN NETWORKS : BRAUDEL, DE LANDA, STEINBERG

The social and cultural aspects of networks described above are firmly embedded in history. I argue that parts of this history are closely linked to the ocean as an agent of connection and that radical forms of urbanity resulted from trading networks exploiting the ocean before the rise of the nation state. The Hanseatic League operating in the Baltic Sea and beyond from the 13th to 16th centuries with a network of 200 free trading towns and the Venetian Empire from the 11th to 17th centuries are examples of this type of urbanization.[18] Braudel's well-known example of the Venetian postal system, undisputed in its efficiency and reliability, in particular between Constantinople and Venice in the 16th century, demonstrates the extent and sophistication of communication networks during this period.[19] Through a combination of overland and sea travel, letters are estimated to have taken between 25 to 30 days to reach Venice from Constantinople. A further example is the Euro-

15 Appadurai, *Illusion of Permanence*.
16 Appadurai, *Modernity at Large*.
17 Ibid.
18 See 3.2.2 HISTORICAL BACKGROUND, BALTIC SEA.
19 Braudel, *The Mediterranean and the Mediterranean World in the Age of Philip II*.

pean expansion and colonization which took place between 1450 and 1800 and established an empire based on oceanic rather than terrestrial dominance. Researchers argue that this expansion reconfigured international relations towards a global rather than regional system.[20]

In a similar vein to Clifford, Manuel de Landa contradicts classical versions of history which have promoted a linear model leading to the singular outcome of equilibrium. Instead he presents human progress from 1000 to 2000 AD as a non-linear process and traces the emergence of Europe as a dominating cultural and technological force due to non-linear dynamics:

> "Dynamical systems operating far from equilibrium, that is, traversed by more or less intense flows of matter-energy that provoke their unique metamorphoses."[21]

Markets and exchange facilitated these flows. Within this context, de Landa distinguishes the network type of urban system from the *central place* system. In the network system, groups of cities form a meshwork-like assemblage within which they are functionally complimentary and where the "key systematic property is nodality rather than centrality."[22] By contrast, in the central place system the city may be a political capital such as Paris, Prague or Milan, which is geographically connected to the regional area.

Meshworks featured *gateway cities* which were maritime ports connected by the Mediterranean, Baltic and North Seas. These cities traded in luxury items over long distances. They were not interested in accumulating territory and "exhibited the kind of weightlessness or lack of inertia that we associate with transnational corporations today."[23] Their ties to one another and to overseas settlements were stronger than those to settlements in their geographical proximity. Core cities in the network, such as Venice, Genova, Antwerp, Amsterdam and London, had different degrees of stability and could also replace each other. De Landa argues that uncertainty and friction in a meshwork system generate self-organization and the levels of complexity which enabled the "industrial take-off" of the economy in Europe at around 1000 AD. The relationship between *meshworks* and central places, however, was also dynamic. Centralized forms of control were set in place when volumes of trade became extreme, resulting in an "anti-market" effect and in the emergence of further meshwork entities elsewhere. De Landa borrows the "anti-market" idea from Braudel who used this term to describe the exploitive business practice of trading companies in the 18th century which he argues represented the essence of capitalism.[24] Through De Landa's work, the ocean emerges as an essential element in the formation of meshworks during this period of history. He also vividly describes how networks persist parallel to, and in interaction with, political restrictions such as borders and centralities. Yet networks are by definition working towards speed and directness, therefore operating in direct competition to other systems of order.

The "common" status of the ocean generally agreed by maritime nations according to the *mare liberum* principle (as described in 1.6.2), suited their expansionist and trading ambitions. The ocean represents a

20 Mancke, *Early Modern Expansion and the Politicization of Oceanic Space*.
21 De Landa, *A Thousand Years of Nonlinear History*. p 28
22 Ibid. p 39
23 Ibid. p 128
24 Braudel, *Civilization and Capitalism*. Braudel argues that the beginnings of capitalism were in the Italian city states of the 13th century.

neutral domain compared to the territory of nation states and, therefore, network activity at sea is less impeded by political borders. This concept is still ingrained in the UNCLOS regulations regarding activities at sea, where shipping activity is given priority and merchant ships are afforded the right of peaceful passage by law.[25] Built on this history, the ocean as a site of flux and movement potentially provided a continuous space for network functions largely unencumbered by other spatial claims.

Geographer Phillip Steinberg has pioneered research into *ocean-space*; that is, the ocean as a spatial entity distinct from *land-space*, yet also as a site shaped by important physical and social processes.[26] One convenient and therefore, persistent spatial model of the ocean for the western world, is described by Steinberg as the "great void idealization", where the ocean is conceived as a surface for movement to be kept "free" at all costs. This implies an "unmanaged" space to be used by all and an exploitation of the topological potential of ocean space. Steinberg argues that during the period of mercantilism beginning in the late Middle Ages when sea power was established as the means to political and economic power, the sea was the surface across which the "channelled circulation" of trade transpired. From the mid 18th century and the beginning of industrial capitalism, the sea began to be more intensely used for deep-sea fishing and the laying of submarine communication cables. Coastal waters also became accepted as a developable territory. However, the predominant idea of the ocean void to serve the maritime transport network existed alongside these parallel models. Therefore, according to Steinberg, the double desires to both territorialize the sea and to maintain a "free" zone for trade, characterize the essential and contradictory properties of capitalist spatiality.

2.1.4 INTEGRATED AND EXTENDED NETWORKS: LEFEBVRE, STUDIO BASEL, BRENNER AND SCHMID

The concept of networks is fundamental to Lefebvre's "search for a unitary theory" in that it relates to the dynamics of *implosion-explosion* and the systems which serve this mechansim. For Lefebvre, *implosion-explosion* is a simultaneous process of the concentration of people, wealth, instruments, and thought in places of centrality and the "projection of numerous, distinct fragments… peripheries, suburbs, satellite towns… into space."[27] This model adds new dimensions to urban relations, which are then expressed through the multiplication of exchanges.

Lefebvre describes how the many different, intertwined social spaces are made real by the networks of relationships and how historical markets are overlaid with contemporary markets, each of which has its own network. The circulation of capital and the exchange of commodities or labour are examples of this. For Lefebvre, networks are inseparable from the materials and locations with which they interact, since it is these social interactions which *produce* space itself:

> "Social space contains a great diversity of objects, both natural and social, including the networks and pathways which facilitate the exchange of material things and information".[28]

25 UN, *UNCLOS 198*2.
26 Steinberg, *Navigating to Multiple Horizons*.
27 Lefebvre, *The Urban Revolution*. p 14
28 Lefebvre, *The Production of Space*. p 77

Hence networks serve and accelerate the interactions associated with the extension of the urban as a result of *implosion-explosion.*

Using Lefebvre's ideas as a conceptual backdrop, the three concepts of Networks, Borders and Differences are used by Studio Basel to guide their comprehensive investigation of the specific urban character of Switzerland. Networks are defined here as "systems of exchange, either of concrete or immaterial nature".[29] Social processes are integrated into both these types of exchange which, however, are also based on physical infrastructure and real space with physical dimensions. The authors see the city as being the form of network with the greatest density. The study examines three particular network features within the Swiss context; intensity of interaction, network extension/range and heterogeneity/complexity.

> "The city acquires its particular physiognomy through the interplay of these three properties".[30]

According to the study, a metropolitan region will typically display the most intense interactions, will have developed networks both in the regional and global range and the overlapping of these networks will produce complex patterns which provide a resource for social innovation and hence high heterogeneity.

The Swiss urban typology Network of Cities is, however, less dynamic than the metropolitan regions due to a type of resilience aligned to the scale and administrative restrictions inherent to the system itself. Here, networks are most influenced by the concept of borders:

> "The material space of interaction and networks is discontinuous, limited and structured. Urban regions are crisscrossed by many borders that cut territories off from the continual flow of network interaction."[31]

This study identifies the competing interactions between networks orientated towards continuous connections and the possibilities of expansion, and the restrictive tendencies of administrative borders based on the concrete example of the Swiss territory.

Building on Lefebvre's three-dimensional dialectic of space, Brenner and Schmid identify three interacting "moments" of urbanization in the force-field of modern capitalism's urban fabric which go beyond the two poles of implosion-explosion, "extended urbanization, concentrated urbanization and differential urbanization."[32] Within each of these moments, Lefebvre's dimensions of perceived, conceived and lived space can be recognized. In the model proposed by Brenner and Schmid, these dimensions have been called spatial practices, territorial regulation and everyday life, respectively. Thus a concrete epistemological framework for the multi-scalar processes of urbanization is proposed. Networks are implicated in the process of extended urbanization, not only as forms of exchange and social routines which span the potentially trans-national scale of relations, but also as physical infrastructure which lays out concrete trajectories and determines the baseline for territorial transformations. The resulting "operational landscapes" may be characterized by restricted access, by disconnection from established settlements and services and by specific functions such as re-

29 Diener et al., *Switzerland – an Urban Portrait*. p 42
30 Ibid. p 42
31 Ibid. p 171
32 Brenner and Schmid, *Towards a New Epistemology of the Urban?*

source extraction or energy production. Brenner and Schmid argue that such landscapes do not exist in isolation, rather they are part of the system of capitalist industrial development and are inextricably linked to the related processes of accumulation in concentrated agglomerations.

While being fully integrated into urban relations, the nature of networks equips them as agents of extreme expansion capable of covering vast distances and resulting in discontinuous development. The networks of urban infrastructure such as transport corridors, communication systems and water and energy pipelines provide the equipment to effect predetermined tasks in any location and to connect any geographic site back to differentiated "origins" or nodes. Here, the topological dimension of networks is activated. At the same time, the topographic result is an uneven, *disjunctive,* differentiated yet expansive "thickening and stretching of an urban fabric"[33] across the planet.

Collier and Kemoklidze point out the inevitable materiality of "capitally intensive and spatially fixed" infrastructures, which belie the supposed flexibility and fluidity of networks. The authors argue that the repeated cases of impeded pipeline-projects, in particular concerning Russian gas, are due to the "stubborn facts of geography, the intransigent materiality of infrastructure, and the weight of recent history."[34]

2.1.5 NETWORK OVERLAYS: DUPUY, DUNN, LÉVY

The urban planner and theorist Gabriel Dupuy pursued a critical interest in the role of technology in urbanism, in particular the possibilities he saw in the network-based conception of space to revitalize urban planning:

> "Geographical scales are dilating to the edge of infinity; technology is developing at ever-faster speeds and with the liberalization of the network utilities, monopolies are giving way to almost uncontrollable competition."[35]

For Dupuy, the rise in importance of the *relational* as opposed to static, object-focused urban thinking meant that new network-based concepts of urban space emerge which overlay the traditional idea of geographically-located place. He defined Networks as being essentially *topological*, *kinetic* and *adaptive* and combined concepts derived from relational network behavior with urban analysis in an attempt to bridge the gap between social and physical spatial systems. One example is the concept of *adhesion*, which refers to the amount of interaction between a network element such as a street, and the local context. Dupuy argues that such concepts are important because they place the user in a pro-active rather than a passive role. The user's projects, aims and intentions are on the one hand limited by those controlling the networks, but on the other hand are capable of modifying the network itself by forming new nodes. Such nodes are then more than mere geometrical abstractions – they also contain social and geographic substance and are "points of reference or power."[36] Dupuy acknowledges the existence of historic systems of urban organization, but is convinced that these will change dramatically. Influenced by the Swiss geographer Claude Raffestin, Dupuy saw the democratizing and emancipatory potential of net-

33 Ibid. p 171
34 Collier and Kemoklidze, *Pipes & Wires*.
35 Dupuy, *Networks and Urban Planning: The Evolution of a Two-Way Relationship*.
36 Gabriel Dupuy, *Urban Networks-Network Urbanism*. p 41

works and urged planners to embrace the changes of scale, technology and forms of control implicated in network systems.[37]

This aspect of networks has also been critically examined by Ash Amin and Nick Dunn who see the potential of networks to describe a more democratic, user-orientated urban arena with multiple choices. The network mode overlays the physical layout of the urban environment and contributes to another layer of richness. Nick Dunn argues that the relationship between digital and physical landscapes has reached the complexity of naturally evolved systems and can be called an *ecological mutuality*.[38] He sees networks as multi-scalar devices that can be useful in supporting a dialogue "to, across, and within urban landscapes".[39] In a similar vein, geographer Ash Amin proposes new and more fruitful means of political organization, not based on the power structures of territorial boundaries, but based on exactly the cross-national, "heterotopic sense of place"[40] which is a characteristic of contemporary urbanity. The "politics of propinquity" would then embrace all such disjunctions present within a geographical "node".

For Jacques Lévy, the network is one type of preferential space available to an individual, alongside the options "territory" and "place". The network is the type of space which most accurately represents the "real" world. The network develops as a space within the history of spatial separation which characterizes the history of humanity. In the current historical phase, Lévy sees the distinction between material and immaterial as being of less relevance than in previous phases. Lévy's 3-space model includes the ways of managing distance; co-presence, telecommunication and mobility, which he argues are all increasing in "co-opetition."[41]

SUMMARY : OCEAN NETWORKS

The above selected positions within the broad domain of *network* literature, are able to shed light on particular aspects of ocean space. Cultural exchanges through the ocean and the development of *meshwork* systems as described by de Landa can be specifically located in the histories of both the Barents and the Baltic Seas. In both contexts I argue that the surface properties of the sea-space enable and reinforce network interaction. At the same time it is through this interaction that the common referential space of these seas is formed.[42] In terms of Lefebvre's dimensions, this space is both a space of representation and a lived space.

Networks extend land or sea-side connections according to spatial and temporal requirements. However, the sea pre-exists as a geographical reality and, therefore, also interacts with networks in material ways and hosts physical infrastructure. I argue for the position held by by Brenner and Schmid that the laying of infrastructure in ocean space is a method to secure particular new connections and to open new territories to the multi-scalar process of extended urbanization. In the Barents and the Baltic Seas, specific infrastructural interventions are linked to offshore energy projects, or in the case of the Nord Stream pipeline, to traversing a neutral, uninhabited space

37 Dupuy, *Networks and Urban Planning: The Evolution of a Two-Way Relationship*.
38 Dunn, *Infrastructural Urbanism: Ecologies and Technologies of Multi-Layered Landscapes*.
39 Brook and Dunn, *Urban Maps*.
40 Amin, *Regions Unbound*.
41 Jacques Lévy, lecture *What is Space*, 26/10/11, course *Architecture et sciences sociales: rencontres théoriques et methodologiques,* EDAR, EPF.L
42 See 3.5 SUMMARY

free of political conflicts. The development of long-term sites of production in the Baltic and Barents Sea bears witness to the diminishing "void" of navigable ocean surface as described by Steinberg and the increase of bounded, topographical space. Management of surface networks such as shipping routes, is also increasingly contained within predetermined spaces in order to accommodate the increase in urbanizing activities.

At the same time the ocean is a space of flows. Electronic communication, physical shipping lanes, cables and pipelines connect nodes which partly redraw geographical relationships. Nodes either correspond to existing socio-historical centres, therefore having a strong influence in the direction of their development, or bypass such well-defined *places* altogether and are located according to network logics corresponding to Appadurai's *scapes*. Since the physical ocean is itself kinetic, it supports multi-directional and non-subscribed paths of flow. The link between inherent ocean flows and shipping routes is the most clear in the example of early exploration, where ocean crossings utilized the predominant currents and winds. Since modern shipping does not depend on the ocean's energy, these networks in the ocean are largely free of infrastructural constraints – they are not defined by predetermined "edges". This network condition is particular to the ocean and the air and therefore will be the subject of more detailed examination as a potential spatial typology.

2.2 SEASCAPE

INTRODUCTION

The concept of *seascape* as a body of thought, literature or theory either as an independent stream, or in parallel to *land*scape is only in its fledgling stages of development and is discussed almost wholly outside the realms of architecture or urbanism. The embedded fluidity and dynamism of recent conceptualizations of *seascape,* have linked it to globalization and post-modernity:

> "The recognition of the fluidity, porosity and mutability of spaces and places opens up room for embracing the sea in ways hitherto on the edges of academic analysis".[43]

Anthropologist Jake Phelan recognises the limits of western land-based approaches in his examination of seascapes:

> "Anthropological theory, rooted in the land, has often been constrained by a sedentary bias."[44]

However, the *scaping* and *shaping* of the sea implicated by the term seascape has not been a focus of these reflections from the social sciences. This aspect demands attention from an urban perspective and supports my argument that while the growing importance of the oceans as a productive field, an infrastructural artery and a specialist area of planning is acknowledged, *seascape* aspects of ocean space represent a research gap in urban discourse.

The seascape literature review firstly covers theoretical reflections on landscape. Secondly, these reflections are tested on the sea. As a result, parallels are drawn and differences are extracted which form a preliminary definition of *seascape.*

43 Brown, *Seascapes*.
44 Phelan, "Seascapes: Tides of Thought and Being in Western Perceptions of the Sea."

[4] Nysted Windpark, Baltic Sea.

Landscape discourse offers a rich and broad basis from which to launch this discussion, offering a three-fold understanding of *landscape*; the productive landscape, the essentially visual landscape and the all-encompassing, amorphous hybrid of architecture and nature defined by Koolhaas as simply "scape".[45] In all three of the above, landscape exists by definition only in relation to urbanization.

The fundamental landscape characteristics of the seas are highly significant since they hold the key to economic potential in the form of natural resources. Land and seascape is topographical rather than topological, therefore seascapes have physical properties and are geographically rooted. These properties distinguish seascapes from networks. In the Barents Sea the major resources are fish and fossil fuels. In the Baltic Sea fishing is still an important industry and the wind energy sector is expanding. Further economic potential is seen in the tourism, aquaculture and research sectors, all of which depend on an environmentally sound seascape.

2.2.1 LANDSCAPE DEFINITIONS : LANDSCAPE ONE

The origins and meanings of *Landscape* have been well researched and documented. I argue that these meanings can be related to the sea in order to assist in defining *Seascape*. Landscape theorists discuss three accepted and distinct understandings and uses of the term landscape. The important American landscape researcher J.B. Jackson, called these "landscapes one, two and three."[46]

LANDSCAPE ONE
IS A PRODUCTIVE UNIT OF ORGANISATION

According to its origin in Old German, *Landschaft* referred to a group of inhabitants firmly connected to a certain area through patterns of activity, occupation and space. This pattern included agricultural fields surrounding a cluster of houses from where people would walk out to the fields on a daily basis. Stilgoe utilizes Jackson's three landscape types and describes how landscape one also implied the inhabitants' obligation to the land and to one another.[47] *Landschaft* represented the dominant form of domestic organisation in the medieval period and can still be found in some traditional communities today. Olwig uses the example of the *landschaften* of Dithmarshen located on Germany's north-western marshy coast to illustrate the integral political essence of landscape:

> "Landschaft as place was thus defined not physically, but socially, as the place of a polity. The physical manifestation of that place was a reflection of the common laws that defined the polity as a political landscape."[48]

Until 1864, Dithmarshen managed to maintain its "landschaften" as a means of community organization alternative to the centralized, urban modes of control advancing in the adjacent regions of Schleswig-Holstein.

Also in Dutch, *landschap* referred to "a collection of farms or fenced fields, sometimes a small domain or administrative unit".[49]

45 Chuihua Judy Chung et all, *Great Leap Forward*, *Project on the City, 1.*
46 Jackson, J. B. *Discovering the Vernacular Landscape*
47 Stilgoe, *Common Landscape of America, 1580 to 1845*.
48 Olwig, K. R. *Landscape, Nature, and the Body Politic.*
49 Yi-Fu Tuan, *Topophilia.*

This pattern displays what Stilgoe calls “a fragile equilibrium between natural and human force; terrain and vegetation are moulded, not dominated”.[50] When the balance tips towards structure and built form, it becomes a related but distinct variety of scape-*cityscape*. Prior to this, Cicero had already recognised how human knowledge and skill had transformed the natural world at around 45 BC “by means of our hands we endeavour to create in nature a kind of second nature.”[51] Without such shaping and ordering, there are landforms such as mountains, forest or prairies which according to Stilgoe are “only wilderness, the chaos from which landscapes are created by men intent on ordering and shaping space for their own ends.”[52] Wilderness is then the antithesis of this landscape; unknown, unordered and beyond human control.

2.2.2 LANDSCAPE TWO IS AN IMAGE

Again referring to Stilgoe, the word landscape is believed to have entered the English language as *landskip* at the end of the 16th century. It was imported from the Dutch *landshap* meaning at first only Dutch landscape paintings. The meaning of the word quickly developed to mean large-scale, aesthetically pleasing rural vistas and was the beginning of the inextricable association of landscape with image. This landscape/image relationship has been extensively discussed by landscape architects and theorists, among them James Corner:

> “Landscape and image are inseparable. Without image there is no such thing as landscape, only unmediated environment.”[53]

This period corresponded with the beginning of technological innovation and urbanization, and most of the great 16th and 17th century painters travelled and observed the landscape – the space shaped for agriculture – with an aesthetic interest in its picturesque and compositional qualities. Joachim Ritter went so far as to say:

> “Nature becomes Landscape only when there is no practical objective and it has become an aesthetic object.”[54]

Although a romantic vision originating in a specific historical period, this understanding of landscape is still widespread. Studies as recent as 1978 revealed that the majority of interpretations of *landschaft* among the German subjects interviewed were associated with beauty, tranquillity, harmony, aesthetics and the rural.[55]

2.2.3 LANDSCAPE THREE IS EVERYWHERE

Jackson observed that what he saw in the contemporary American landscape matched neither of his own definitions of landscapes one or two. He defined landscape three as:

> “A system of man-made spaces on the surface of the earth... it is never simply a natural space, a feature of the natural environment; it is always artificial, always synthetic, always subject to sudden or

50 Stilgoe. p 3
51 Marci Tulli Ciceronis, *De Natura Deorum (On the Nature of the Gods)*
52 Stilgoe. p 3
53 Corner, J. *Recovering Landscape*.
54 Ritter, J. *Landschaft: zur Funktion des Aesthetischen in der modernen Gesellschaft.*
55 Prominski, *M. Landschaft.*

> unpredictable change. We create them and need them because every landscape is the place where we establish our own human organization of space and time… A landscape is where we speed up or retard or divert the cosmic program and impose our own."[56]

Jackson's observations greatly influenced the contemporary landscape discourse. Landscape urbanism was subsequently seen as a way to unleash the potential of landscape as a flexible surface structuring device which could incorporate infrastructure, different grades of open space, as well as all manner of built programmes at the urban and territorial scale. By viewing the increasingly incoherent urban environment through this lens, principles of ecology could also be incorporated. Charles Waldheim, initiator of the original landscape urbanism conference and exhibition in Chicago in 1997, sees its particular contributions as follows:

> "Landscape urbanism describes a disciplinary realignment currently underway in which landscape replaces architecture as the basic building block of contemporary urbanism. For many, across a range of disciplines, landscape has become both the lens through which the contemporary city is represented and the medium through which it is constructed."[57]

In Great Leap Forward, Koolhaas and team call the diffuse, amorphous urban conglomerations rapidly transforming the Pearl River Delta simply SCAPES:

> "The arena for a terminal confrontation between architecture and landscape."[58]

Referring to this definition, Klingmann and Angélil describe such a condition in their own terms:

"Moving from closed to open structures, the city as an urban landscape increasingly evolves as a dynamic process… The boundaries between architecture, infrastructure and landscape dissolve."[59]

2.2.4 UNMEDIATED ENVIRONMENT

As opposed to landscape, the natural world has been described as *wilderness* by Stilgoe and *the unmediated environment* by Corner. Does this exclude seascapes from urban discourse? I argue that there are two main reasons why visibly "natural" seascapes are also fundamentally synthetic, having been manipulated for human purposes.

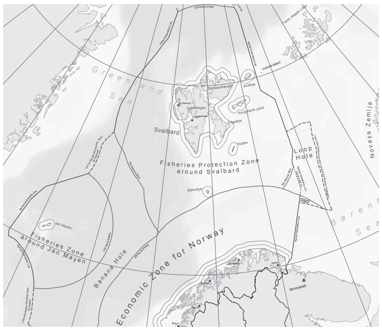
The first reason is that seascape surfaces may not necessarily reveal traces of perpetual and structured human activities. Offshore fishing activities are spatially located by abstract co-ordinates and determined by landmark nuances only visible to the experienced seaman. One example is the migration of Barents Sea capelin as they return to their coastal breeding grounds, attracting predatory cod en route:

> "It is largely this annual event that makes the coast of Finnmark one of the world's richest fishing grounds."[60]

Traffic separation schemes are becoming more frequent in order to control heavy marine traffic to protect vulnerable environmental sites and to opti-

56 Jackson, J. B *Discovering the Vernacular Landscape*. p 156
57 Waldheim, C. *The Landscape Urbanism Reader*. p 11
58 Chung et al., *Great Leap Forward*. p 393
59 Angélil and Klingman, M. and A. *Hybrid Morphologies: Infrastructure, Architecture, Landscape*. p 24.
60 Hønneland, G. *Making Fishery Agreements Work: Post-agreement Bargaining in the Barents Sea*. p 37

[5] Medieval herring fishing 1555.



[6] Norwegian maritime boundaries and fishing zones.

mize frequent ferry routes such as Tallin/Helsinki or Rostock/Gedser in the Baltic Sea. Numerous other less densely-frequented ocean routes are visible only for a limited span of time through water displacement, flocks of birds or vessel discharge. The ocean is composed of complex, shifting layers. Human structuring devices such as cables and pipelines are located on the ocean floor. Traces of past military activity also lie on the seafloor in the form of mines, nuclear submarines and dumped waste.[61] Evidence of human activities can, therefore, be suspended or submerged in different ocean spaces, meaning that infrastructural networks or residual warzones can be simultaneously overlaid with the visual appearance or mental conception of wilderness.
The second reason refers to Lefebvre's writings on the production of urbanized space on a global scale and the subsequent disappearance of nature:

> "Nature is now seen as the raw material out of which the productive forces of a variety of social systems have forged their particular spaces."[62]

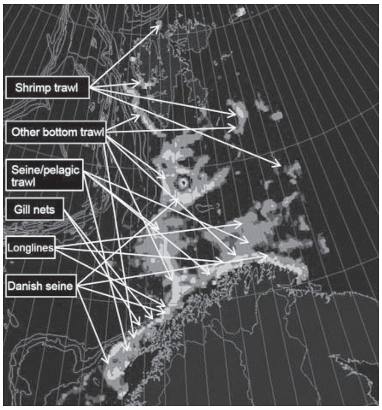
Subsequent to this phenomenon, Lefebvre raises the question if protected natural spaces such as national parks are essentially natural or rendered artificial through the act of enclosure within an otherwise predominantly urbanized environment. Lefebvre discusses the illegibility of certain forms of urbanization and their related social relations, which although visibly dominating, are becoming harder and harder to analyse and decipher.[63]

The ocean is an interconnected global system which does not adhere to boundary divisions. While isolated parts may come close to a natural state of *wilderness,* human impact has penetrated most of the ocean. Long-range pollution is an increasing problem in the otherwise largely intact marine environment of the Barents Sea. Highly migratory species such as the bluefin tuna have been over-fished in international waters and ocean space in areas rumoured to contain valuable resources such as the Arctic Ocean is avidly claimed by all rim countries.[64] In the two case-studies examined by this thesis, the traces of *unmediated environment* are subject to planning in order to formalize their protection. Planning is beginning to give visual form to the way we *scape* the ocean.

2.2.5 SEASCAPE ONE

The traditional practice of fishing for a livelihood can be directly compared to agricultural practices on land and therefore contributes to *scaping* the sea in the sense of landscape one. Rather than making a visual mark on the territory, I argue that the daily relationship with the physical environment qualifies fishing practice as a modification of the seascape in a similar way as the organisation of a social group, their land and buildings defines the original concept of *landschaft* [5]. Fishing has traditionally provided the basis for settlement along the shores of the Barents Sea and for most of the Norwegian coastline. In central Norway, for example, two main settlement systems prevailed until the end of the 19th century; the fisher-farmer holding and the proprietary-owned fishing settlements.[65] The

61 *Nord Stream Espoo Report: Key Issue Paper. Munitions: Conventional and Chemical.*
62 Lefebvre, H. *The Production of Space*. p 31
63 Ibid. p 83
64 Gugger, Couling, and Blanchard, *Barents Lessons. Teaching and Research in Architecture*.
65 Jones, M. *Land-Tenure and Landscape Change in Fishing Communities on the Outer Coast of Central Norway, c. 1880 to the Present: Methodological Approaches and Modes of Explanation*.



[7] Fishing activity in the barents Sea, 2011.


[8] Hiroshi Sugimoto, Sea of Japan, 1997.


[9] Hiroshi Sugimoto, Seascape Baltic Sea Rügen 1996.

fisher-farmer holding combined the complimentary activities of fishing for both trade and subsistence with a small farm providing hay and potatoes and supporting a few animals at the subsistence level only.

Mediation of the landscape through fishing, although marked by ports, fish-processing facilities, piers, buoys, nets, lines and cages is ephemeral in relation to the scale of fishing grounds themselves. In the case of the Barents Sea, since the special Svalbard zone extends further north, fishing grounds comprise an even larger area than the 1,405,000 km^2 of the sea itself [6]. Fishing activities are controlled by quotas, licenses, restricted zones and the monitoring of fishing vessels. All vessels over 15 m in length operating in Norwegian waters are required to carry a tracking device that automatically submits data to the fishing authorities. The electronic monitoring system records location and catch in each of the three fishing zones; the Norwegian EEZ, the Russian EEZ, or the special Svalbard Fishery Protection Zone [7].

These invisible systems represent the *human organisation of space and time* in the ocean. The physical scale of the seascape is so much vaster than familiar landscapes or zones of aquaculture. “Wild” fishing has not been accompanied by the physical marking off of territory, so the visual recognition of occupation and modification of territory becomes evident only through the compilation of this data in the form of maps.

2.2.6 SEASCAPE TWO

The common usage of the word seascape corresponds closely to the concept of landscape as a pictorial view. Capturing the sea through paintings followed the genre of landscape painting, although at a later date. 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.”[66]

For this reason the development of seascape two as an image is also discussed by Steinberg in *The Social Construction of the Ocean.*[67] The rising importance of maritime trade and naval power in the 16th century, in particular in the Dutch Republic, provided new artistic subject material. The sea then also became a subject in its own right through the interest in ocean voyages and navigation. During the 18th century, seascapes revealed the fascination with ocean creatures and the ocean as a chaotic, mysterious wilderness.[68]

Seascapes paralleled other landscape genres during the period of Romanticism at the end of the the 18th century. According to Steinberg, artists like Turner portrayed “a sublime environment of nature, beyond history, against which man could test his physical strength and moral courage, far from the corrupting influence of land-based society.”[69] In addition, Turner’s paintings included references to Britain’s transformation into an industrialized society through steam power at sea. Gugger and Costa describe his painting “Rain, Sea and Mist” as “an impressionistic hazy landscape of industrial mist” which illustrates the forced co-existence of two antagonistic conditions – the urban and nature.[70]

66 Brown, *Seascapes*.
67 Steinberg, *The Social Construction of the Ocean*.
68 Stilgoe, *Common Landscape of America, 1580 to 1845*.
69 Steinberg, *The Social Construction of the Ocean*. p 119
70 Gugger and Costa, *Urban-Nature: The Ecology of Planetary Artifice*.

[10] Gerhard Richter, Meerlandschaften, Atlas 1970.

[11] Gerhard Richter, Meerlandschaften, Atlas 1970.

The seascape image, however, differs from the landscape image. I propose that the artistic "view" of the sea is not related to a possible ordered, scaped quality. Seascape artists instead portrayed the sea in its unpredictability and strength, utilising its surface qualities and potentially infinite depth to experiment with light and atmosphere.

The abstract, minimalistic potential of a seascape – a "view of the sea" – has been exploited by the photographer Hiroshi Sugimoto in his on-going series of black and white seascapes which he began in 1980. His images are devoid of human presence or objects other than sea, sky and horizon [8 – 9]. The representation of the two essential elements – water and air – mean that seascapes can be both "nothing" and "everything" at the same time. Sugimoto himself describes how these elements evoke for him a personal journey back in time:

> "Water and air. So very commonplace are these substances, they hardly attract attention – and yet they vouchsafe our very existence. Every time I view the sea, I feel a calming sense of security, as if visiting my ancestral home; I embark on a voyage of seeing."[71]

While realistic in the sense of the photographic medium, Sugimoto's seascapes are distorted through long exposure times, weather and lighting conditions sometimes making the central ordering element of the horizon illegible.

Gerhard Richter also produced a series of seascapes called Seestücke which are paintings based on photographic studies and collages, investigating the same two elements of water and air [10 – 11]. Richter has spoken of the deliberate reference he makes to romanticism and Carl David Friedrich, whose work he admires for its lasting aesthetic quality independent of the artistic influences of the time. He himself, however, aims to paint without composing subject matter and characterizes his own work as a "principal avoidance of the subject"[72]. For Richter, the technique of using photographs as a basis for painting was a means to this end and acted as a springboard to abstraction:

> "Photography keeps you from stylising, from seeing 'falsely', from giving an overly personal interpretation to the subject… we are encumbered with the sentiments of the artists who have gone before us. Photography can unburden us of previous imaginations."[73]

However, the photographic collages on which the seascapes are based are also manipulated. Richter cut and reassembled his images along the horizon line, creating new combinations where sea and sky are mismatched, or where subtle irritation is caused by the sea taking the place of the sky. Sugimoto openly describes his interest in capturing timelessness in his work, whereas Richter's interest is in taking an impersonal, almost banal view and yet transforming this into a painting that could be compared to romanticism:

> "It was my wish to be neutral… it was the opposite of ideology. The paintings have the advantage that I can still add a little something- because the notion of neutrality and objectivity is an illusion, of course."[74]

71 Hiroshi.
72 Buchloh, *Photography and Painting in the Work of Gerhard Richter*. p 63
73 Ibid. p 135
74 Storr, R. *Gerhard Richter: Doubt and Belief in Painting* (New York: Museum of Modern Art, 2003). p 173

The seascapes of both artists are unconcerned with scapes as representations of aesthetic, ordered nature within which time and human endeavour is inscribed. Nor is untouched nature in the form of wilderness the artists' interest, since although arousing mild irritation, the visual effect is essentially calm. The works refer instead to elements outside time, yet represent time and space through the horizon. What is the real "subject" of these seascapes? Do the elements portrayed evoke a collective memory? Richter's seascape photographs are part of an ongoing collection called "Atlas" where images are arranged in a systematic, yet open-ended, contingent manner. Some images have become paintings, others not; "In my picture atlas… I can only get a handle on the flood of pictures by creating order since there are no individual pictures at all anymore."[75]

Artist and filmmaker Chris Marker's project "Immemory"[76] explores the idea of an infinite, collective memory. He collected images with the idea that fragments of memory could be considered in terms of geography and that through the familiar codes of the images, each reader/visitor would be able to recognise their own types of memories within the image. Philosopher Jean-Luc Nancy uses this term when discussing Christian painting and defines it as:

> "What is absent from all remembrance but toward which an infinite memory endlessly rises, a hypermemory or rather, an immemory."[77]

Seascapes described here occupy a singular position in the world of visual representation. They exploit the abstract potential of the fundamental elements water, air and horizon to evoke a universal memory which can be described as the *immemory*. Precisely the absence of visual markers of civilization, markers of space, scale and distance enable this associative process. However, a viewpoint from within the framework of human civilization is also implied. This type of "nature" is so abstract as to be almost devoid of interpretive meaning. In terms of landscape as an image and in reference to landscape two, I argue that the seascape depicting the open sea – a vast, abstract surface with minimal spatial information and no sign of human intervention – enables urban society to access a universal memory.

A further important contribution to the discussion of landscape image is made by James Corner who believes the dominating idea of the image has paralysed the landscape architecture profession. He uses the word "*eidetic*" to describe landscape imagery not only associated with the visual:

> "A mental conception that may be picturable, but may equally be acoustic, tactile, cognitive or intuitive."[78]

Through this mode of perception, he calls for a re-evaluation of the image in landscape architecture and an imagery which can release the full force of landscape creativity and processes in order to "realign the landscape architectural project toward the productive and participatory phenomena of the everyday, working landscape."[79] Corner is, in effect, aiming for forms of imagery and representation that steer landscape back to its origins in land-

75 Gerhard Richter, quoted by Lynne Cook in the introduction to the *Atlas* exhibition, Dia Art Foundation New York,1995, http://www.diaart.org/exhibitions/introduction/54 accessed. 30/05/15
76 Marker, *Immemory*.
77 Nancy, *The Ground of the Image*. p 108
78 Corner. p 153
79 Corner. p 159

scape one. His idea of a landscape image being mental rather than visual supports the argument that the ocean is abundant in seascapes.

This idea will be briefly examined in relation to ocean pathways. The Baltic has been a trading artery throughout history. Viking trade-routes originating in Scandinavia penetrated as far as Constantinople in the south-east and via the Volga River to the Caspian Sea and Persia to the Far East during the height of the Viking period from ca. 800 to 1100.[80] Can these activities be seen to have physically shaped the ocean? Vikings, or the Norse, navigated over great distances but never made maps. Instead, information was passed down through word of mouth and subsequently recorded in the Norse Sagas in Iceland in the Middle Ages.[81]

Roadways are a primal structuring element of landscapes fulfilling vital political, economic and military functions.[82] The scale of Viking movement and operations can be compared to the Roman Empire through examining arterial pathways of land and sea; the longest Roman road is reputed to be the Via Augusta from Norbonne in the Pyranees to Cadiz in the south of Spain, a distance of 1500 km. It was an extension of Via Dometia from Rome and acted as the main Roman artery for the province of Spain. A folded line through the Baltic Sea from the Kattegat to St. Petersburg also measures around 1500 km; an ocean "roadway" of equal distance and arguably of equal historical importance. Historians believe the Vikings navigated with a combination of visual indicators such as the position of the sun, moon and stars as well as landmarks and locations of bird and fish populations. With an intricate knowledge of the water and guided by stories, it is feasible that the Vikings sailed along similar routes to any vessel in the Baltic today. Used by a variety of vessels, the Baltic can be read as one broad highway offering a series of alternate crossings and parallel routes. While navigational aids were also based on elements in continuous flux, traces of the trading routes are stored in language as mental "images". The intrinsic association with "image" which characterizes landscape two takes on a distinct meaning when translated to a seascape. This is due firstly to the power of the seascape image to refer to a collective *immemory* and secondly, to the fluidity and temporality of habitual ocean activities which means the seascape has traditionally relied on eidetic imagery as its mode of representation.

2.2.7 SEASCAPE THREE

In oceanic zones of intense activity seascape three can be readily recognized. Both the Baltic and Barents Sea contain areas where human organization has been visibly imposed and where programmes of seascape protection and production spatially compete. Since 1980 petroleum exploration activities structure the space and determine future action in the Barents Sea:

> "The Government will maintain oil and gas exploration activities, and will give the oil industry access to areas of potential interest within an environmentally sound framework. We will generate more knowledge of the northeastern part of the Norwegian Sea, carry out an environmental impact assessment for the southern part of the Barents Sea, and pave the way for petroleum produc-

80 Ulla Ehrensvärd, Pellervo Kokkonen and Juha Nurminen, *Die Ostsee: 2000 Jahre Seefahrt, Handel und Kultur.*
81 A posthumous map was made according to these stories.
82 Stilgoe, *Common Landscape of America, 1580 to 1845*.

tion in the areas that have been opened."[83]

In the Baltic Sea, the need for co-ordinated planning is urgent due to the sea's poor environmental condition, the limited space within which the nine coastal countries have to manoeuvre and the growing importance of ocean production in areas such as wind energy.

> "The North Sea and the Baltic Sea today lead a conflicting, dual existence as an arena for economic activity and an ecologically valuable natural environment."[84]

These seascapes can readily be compared to the landscapes of energy addressed by researchers in "New Geographies"[85] and "Landscape Research."[86] While New Geographies editor Rania Ghosn warns against the tendency of spaces of energy to be "externalized" to the periphery and out of sight, Landscape Research editors Nadai and van der Horst see the new landscapes of renewable energies as the re-composition of socio-technical links between landscape and energy.

The characteristics of seascape articulated in the "Nature Conservation Objectives and Principles" of the spatial plan for the German EEZ, describe the EEZ as a "natural landscape unit… characterised by large-scale openness and freedom from barriers, particularly in the water column and above the water."[87] The desire to preserve the seascape are also motivated by visual criteria:

> "Spatial planning also safeguards open spaces in the sense of largely unspoiled and undisturbed habitats and landscapes as a prerequisite for ecological regulation as well as for 'landscape experience' and for basic research."[88]

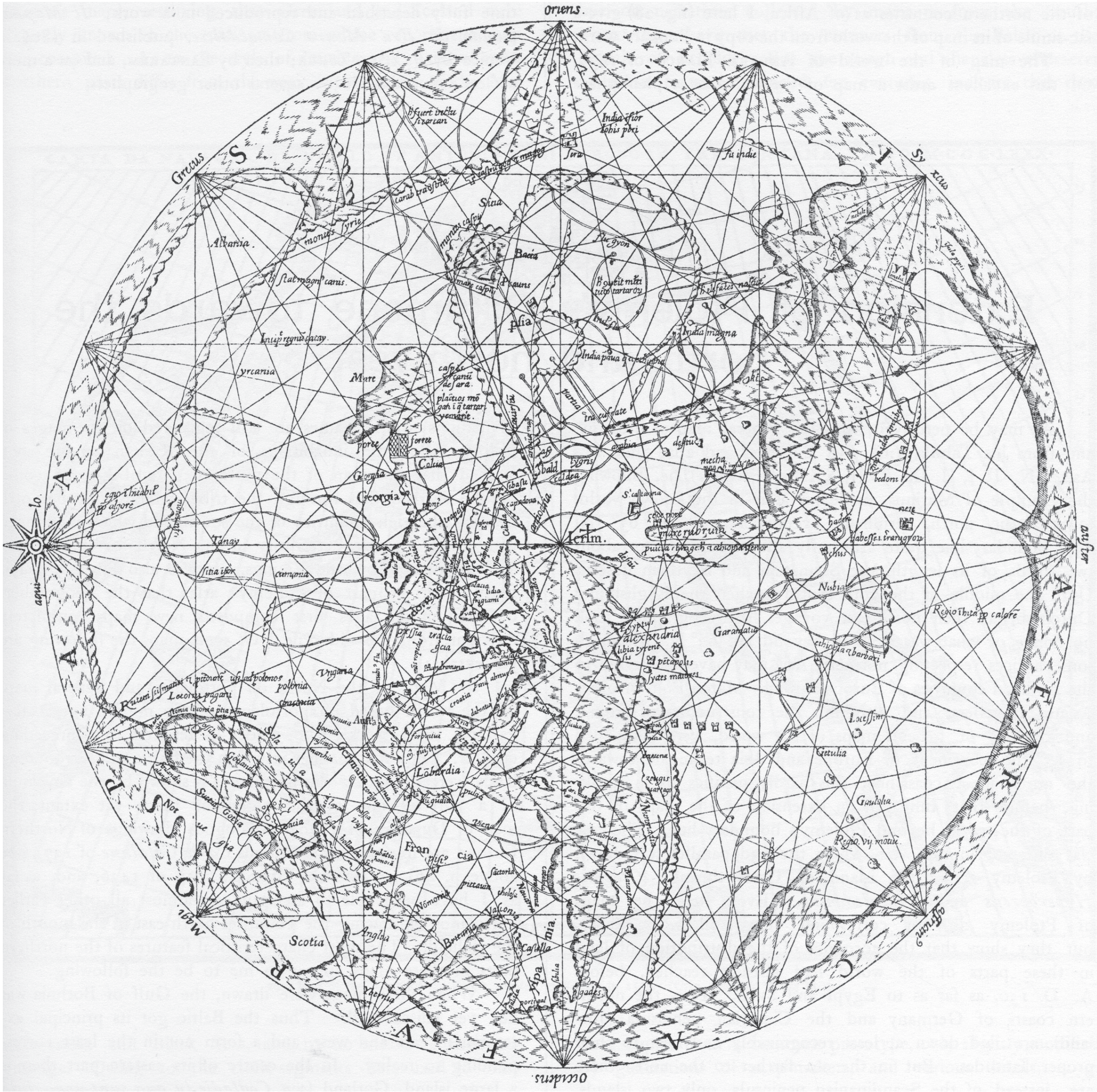
These statements confirm Lefebvre's predictions that nature itself is not only on the decline, but due to the processes of urbanization, becomes the subject of planning.

2.2.8 SUMMARY SEASCAPE

This review has revealed that the ocean provides distinct seascapes pertaining to all three of Jackson's proposed landscapes *one*, *two* and *three*. However, the understanding of the term *seascape* in documents relating to the Barents and Baltic Seas is currently one-dimensional, referring to the visual dimension alone.[89 – 90]

A seascape in the active sense is created by human activities over time, although this space may exist primarily as an abstract, mental map

83 Royal Norwegian Ministry of the Environment, *Meld. St. 10. Report to the Storting (white paper) First Update of the Integrated Management Plan for the Marine Environment of the Barents Sea – Lofoten Area*.p 41
84 Federal Agency for Nature Conservation, *Germany, Human Activities and Nature Conservation in the North Sea and the Baltic Sea – Uses and Threats*.
85 Ghosn, *Landscapes of Energy*.
86 Nadaï and van der Horst, *Introduction*.
87 German Federal Agency for nature Conservation (BfN), *Spatial Planning in the German Exclusive Economic Zone of the North and the Baltic Seas – Nature Conservation Objectives and Principles*, 2006. p 5
88 German Federal Agency for nature Conservation (BfN). p 10
89 Royal Norwegian Ministry of the Environment, *Meld. St. 10. Report to the Storting (white paper) First Update of the Integrated Management Plan for the Marine Environment of the Barents Sea – Lofoten Area*. Seascape appears in relation to windparks*; among the possible impacts are… the visual impact on the seascape.* p 78
90 BSH: Federal Maritime and Hydrographic Agency, *Marine Spatial Plan for the Exclusive Economic Zone of the Baltic Sea*. Seascape appears under Natural Scenery: *Up to now, the seascape in the priority areas for wind energy has been characterised by the fact that… no structures rise above the water column.* p 63



[12] Map of the world, Marino Sanudo, beginning of 14th century.

since permanent physical traces of traditional activities in the ocean may drift with the ocean itself, or remain unseen in suspended ocean layers. A seascape, however, should be understood as a *cultivated* space, where interactions occur between natural cycles and human interventions, where history has taken place and where the impacts of actions will be apparent in subsequent cycles.

The visual seascape can be seen as a collective cultural medium, whether experienced in person or through artistic representation. Its level of abstraction enables the suspension of time and space. In comparison to similar land-based activities, physical modification of ocean space is becoming more frequent as technology meets the increased demands of an urbanized society for energy and resources. Such physical modification takes on a vast scale to match the dimensions and natural forces inherent to the ocean itself, producing new types of technological seascapes. The articulation of seascapes as environments manipulated by man presents a challenge and an opportunity to spatial design. Because the ocean is a fluid, interconnected system, it cannot be fully controlled and all interaction must take a series of constant variables into consideration. The ocean is a complex ecosystem, determining the planet's climatic cycles and providing habitat to a wide range of species. All *scaping* activities are confronted with these forces.

2.3 TECHNOLOGY

INTRODUCTION

The review of technology literature aims to shed light on the role of technology in the urbanization of the sea. Technologies accompanying the marking, defining, occupying, controlling and *producing* of space in the ocean are embedded in our cultural, political and social relations with the maritime world [12]. The review should place them in historical context and reveal in which way these specific relations are distinct from land. Human interaction with the sea occurs through technological mediation – perhaps one of the most influential relationships after the advent of agriculture. Braudel names ocean navigation among the three great technological revolutions of the 15th – 18th century alongside artillery and the printing press.[91] However, in the 20th century, huge investments were made in space technology, leaving exploration of the oceans behind.[92] In this century, technology is being called on to mediate our maritime relationships in another way – to monitor, control and "manage" the oceans.

Many scholars agree that the significance of technology in human affairs distinguishes our time from everything that has gone before. This has to do with the marriage of science and technology, the accelerated pace of technological development and the infiltration and merger of technology with almost every field of activity.[93] The oceans prove to be no exception.

Technology cannot be discussed without mentioning the military. In Science in Action, Bruno Latour concluded that "technoscience is a military affair", having presented statistics stating that defense takes up about 70% of Research and Development spending.[94] The oceans are a favoured realm of military tests, reconnaissance exercises, offshore demonstrations of

91 Braudel, *Civilization and Capitalism*.
92 See quote from oceanographer Robert Ballard later in this section.
93 Kranzberg and Pursell, *Technology in Western Civilization*.
94 Latour, *Science in Action*. p 171

military strength and outright war. I argue this has to do with the ocean's specific spatial properties: its deep, wide and concealed zones, and the freedom of access which allows latent occupation.[95] The grip of military technology over global space, including the oceans, is sobering, however some of these technologies, such as GPS data[96], have spilled over to civilian life and Global Positioning Systems have further revolutionized maritime navigation.[97] However, this review focuses on the urbanizing effects of technology in a civilian context, and therefore will not directly include military technologies.

The literature chosen firstly presents the theoretical and philosophical aspects of technology and society. The second part concerns the relationship between technology and urbanity and the third section deals with literature and reports on the specialist ocean technologies which contribute to urbanization processes themselves.

2.3.1 THEORETICAL BACKGROUND

The prominent technological historian Melvin Kranzberg defined technology as:

> "Man's efforts to cope with his physical environment… (both natural & man-made) and his attempts to subdue or control that environment by means of his imagination and ingenuity in the use of available resources."[98]

Man's relationship with technology is as long as human history itself – "man the thinker" was simultaneously "man the maker" and therefore has always been inseparable from technology:

> "Man made tools, but tools made man as well."[99]

A second essential characteristic of technology iterated by Kranzberg, is its relationship to society.

> "Technology may be ambivalent, but it does not exist in the abstract; it exists in society, and it exists to meet human & social goals.W[100]

Technology alone will achieve nothing unless supported, driven, financed, undertaken, managed researched by particular members of society:

> "The construction of facts and machines in technoscience is a collective process."[101]

History is full of examples of innovative technologies that were not recognised or applied due to politics or competing knowledge systems. The hard-fought acceptance of the latitude chronometer for navigation at sea[102] and the difficulty of establishing windfarms in contexts dominated by pronuclear energy politics[103], are but two examples related to ocean space. Conversely, technology can then be used to implement political and social practices of which a negative example is its application for military purposes.

95 For a more detailed discussion on the military sea, see presentation online: http://architectureofwar.artun.ee/ documentation
Friday 05, Nancy Couling *The military space of the ocean*.

96 Public access to GPS data was enabled by the US military in 1995.

97 The US Military *Unified Command Plan 2011* divides the globe into geometric blocks of command responsibility, including 800 military bases in 63 countries. Source: US National Geo – Spatial Intelligence Agency.

98 Kranzberg and Pursell, *Technology in Western Civilization*. p 4

99 Ibid. p 8

100 Ibid. p 706

101 Latour, *Science in Action*. p 29

102 Sobel, *Longitude*.

103 Reichsteiner, *Wind Power in Context- A Clean Revolution in the Energy Sector*.

Philosopher Andrew Feenberg has published widely on what he calls a critical theory of technology, where he criticizes both the stance of technological determinism, which advocates a technology-led theory of social change and the stance of technological essentialism, which maintains that technology is socially constructed, depending on specific individuals, groups and cultural values. For Feenberg, technology is the essential issue of our time, and is closely linked to power structures, hence requires a rigorous critique in order to realise a restructuring to suit human needs[104]:

> "The central issue today is the prevalence of technocratic administration and the threat it poses to the exercise of human agency. This leads me to emphasize the essentially hierarchical nature of technical action, the asymmetrical relation between actor and object which, when it overtakes large swaths of human relations, tends to create a dystopian system."[105]

Feenberg calls for a democratic transformation of technological systems within which the inclusion of previously excluded social values can be realised.

The widely-published entrepreneur Peter Drucker brings forward a further dimension of contemporary technology which originates from the systems approach and refers to the emergence of the concept of systematic "management". Drucker argues that 19th century technology was more or less unmanaged "invention", but in the 20th century innovation has become something strategic:

> "The purposeful and deliberate attempt to bring about, through technological means, a distinct change in the way man lives and in his environment – the economy, the society, the community."[106]

According to Drucker, this hugely increases the impact of technology and is the measure of a "newly-found technological capacity". Drucker also saw huge opportunities in the exploration and development of the world's oceans, which he saw as essentially a "systems task" accompanied by new sub-sea technologies. The level of our interaction with the ocean, he argued, was at that of a hunter and a nomad, rather than a "cultivator". He predicted that the 21st century would bring about a much more sophisticated understanding of ocean systems, so that man could interact in a meaningful, productive way.

Undoubtedly the most penetrating and transformative technologies of our time are the information and communication technologies (ICT), but researchers at the London School of Economics draw attention to the philosophical deficiencies in the field:

> "There is no long-standing philosophical depth or roots in a philosophy of information or of technology… major philosophical and ethical questions on technology receive all too little in-depth treatment."[107]

But an important contribution to the philosophy of ICT comes from philosopher Luciano Floridi, who concerns himself with the conceptual analysis of what he believes is the dawn of a new "Weltanschauung."[108] Floridi coined the expression "Infosphere", which, borrowing from biosphere, constitutes the

104 Feenberg, *Questioning Technology*.
105 Feenberg, *A Critical Theory of Technology*.
106 Drucker, *Technological Trends in the 20th Century*.
107 Willcocks and Whitley, *Developing the Information and Knowledge Agenda in Information Systems*.
108 Floridi, *A Look into the Future Impact of ICT on Our Lives*.

whole informational environment, analog as well as digital. The Infosphere is progressively absorbing any other space. For Floridi this is a fundamental transformation of the intrinsic nature of our world, hence an ontological shift. He argues that the outcome of this shift is already with us, and that it is far from bleak science-fiction but rather evolutionary and hybrid. Objects can easily obtain interactive, responsive electronic "ITentities" with today's technology. Comparing this revolution to the agricultural and industrial revolutions, Floridi goes as far as to say that we are in fact constructing a new environment for future generations, and should be "working on an ecology of the infosphere if we wish to avoid problems such as the tragedy of the digital commons."[109]

2.3.2 TECHNOLOGY AND URBANITY
CITIES, ZONES, SCAPES AND PRODUCTS

The direct link between technology and the city has been well-studied. Kranzberg argues that settlement itself was first enabled through the technological innovation of agriculture.[110] Closely associated are water technologies first serving irrigation as early as 10,000 BC in Mesopotamia. Irrigation and water supply developed in parallel to important urban centres such as Jerusalem in 1000 BC, which boasted the oldest and most extensive waterworks in any ancient city.[111] Researchers in the history of urban technology therefore claim that cities are sites of technology density; they rely on transport and communication networks to maintain dominance and control over their hinterlands, and to manage the flows of people, ideas and goods. Urban technology is embedded in social, political and geographical contexts, which in turn, have moulded the development of technology itself, resulting in a "co-construction" of technological structures and urban life:

> "Human-made materialities we understand today as "technology" have largely been urban creations designed with the needs of the urban population and urban commerce in mind."[112]

In Europe, technologies facilitating integration, trade and communication, such as river-based transport systems and the subsequent railway systems, are old and so well-integrated into the urban fabric as to have become invisible as technology, but rather a kind of "second nature" – "an artificial structure that appears entirely natural."[113] The "naturalization" of some technologies has meant its physical disappearance into the underground or to the periphery, where it is no longer the content of important public buildings or landmarks, as water-towers were at the beginning of the 19th century.[114]

The geographical influence of the urban, however, ranges far beyond the form understood as city. Brenner and Schmid describe the current urban as "an unevenly developed yet worldwide condition and process of sociospatial transformation."[115] This condition produces agglomerations which relate dialectically to their "operational landscapes" – landscapes whose role is primarily to support the agglomerations in providing essentials such as food, energy, waste disposal, entertainment and leisure. Network technologies enable this connection.

109 Greco and Floridi, *The Tragedy of the Digital Commons*.
110 Kranzberg and Pursell, *Technology in Western Civilization*.
111 Hill, *A History of Engineering in Classical and Medieval Times*.
112 Hård, *Urban Machinery*. p 6
113 Ibid. p 8
114 Kaika and Swyngedouw, *Fetishizing the Modern City*. Gas, electricity, information etc.
115 Brenner, *Implosions/Explosions*.

The appearance of unfamiliar types of urbanity at locations distended from established towns, cities or agglomerations, demands a closer examination of the relationship between technology and urban processes. Territories characterized by their technological component are of particular research interest to human geographer Andrew Barry, a specialist in science and technology studies. He describes what he calls *technological zones*:

> "A space within which differences between technical practices, procedures and forms have been reduced, or common standards have been established."[116]

Such zones are abstract, largely immaterial and interact in uneasy, unstable interrelationships. According to Barry, technological zones cannot be mapped, but, using the example of the oil industry "correspond to the shifting sphere of operations of particular companies", including those involving finance and economics. These alliances respond to the dynamics of the industry. Although technological zones such as those established by the oil industry are manifest in diverse geographical locations which are subsequently physically modified for industrial purposes, Barry argues that place is essentially unimportant and even interchangeable within the larger system or framework. His idea of technoscapes echoes strongly with the restless, assymmetric ethnoscapes, mediascapes, technoscapes, financescapes and ideoscapes which unfold across national divisions as described by Appadurai.[117] Technoscapes embrace both high and low technologies, and mechanical and informational formats which all move at high speeds across previously impervious boundaries. Their odd distribution is driven by the complex relationships between money flows, politics, skilled and unskilled labour.

Kellar Easterling has identified other "critical materializations of digital capitalism" which she calls simply *spatial products*, which lie outside of embedded territorial logic, outside of architectural consideration and which are formed through digital conveniences, such as sunshine hours, flight distances or labour costs.[118] Easterling argues that these products also characteristically occupy loopholes of jurisdiction, but which are at the same time politically convenient:

> "The space of naturally occurring loopholes or errors is political territory".[119]

The sea is rife with such contradictory possibilities. Through the traditions of piracy, maritime empires and naval wars to the contested boundaries of today's oceans, Easterling recognises the disguised appearance of capital in the form of organizations claiming territory in grey "slushy" zones, only partly sanctioned by the state:

> "The sea is often used to imagine the dissolving of national, familial or other territorial boundaries. These waters model a space of impossible elegance which moves through an archipelagic network of power, decoding hierarchies."[120]

116 Barry, *Technological Zones*.
117 Appadurai, *Modernity at Large*.
See also 2.1.2 CULTURAL NETWORKS
118 Easterling, *Enduring Innocence*.
119 Ibid. p 10
120 Ibid. p 66

EXTENDED OIL URBANITIES

The above authors define technological, scapes and spatial products as independent of geography. Can a technological zone be mapped? Barry uses the oil industry as a reference. In this context connections through communication, infrastructural and financial networks are complex and continuously renegotiated, however material densities are also physically manifest for significant periods of time. Offshore wind-parks and oil and gas production platforms are examples of technological *nodes*[121] or *concrete material knots*[122], which generate a specialised spatial condition. These nodes exist within legal frameworks which are set out geographically in large-scale blocks or sectors.

Within the context of oil, technology also builds the foundation for an unspoken contract enabling the public and private sectors to overcome distances of communication, access and apparent control. The 2010 BP Deepwater Horizon oil spill was the subject of an edition of the journal "Imaginations" entitled "Sighting Oil." Contributions examined the nature of two kinds of technological distance; the physical remoteness and the (dis) connection to tangible policy, both of which operate in paradoxical parallel to the material ubiquity of oil itself.

Oil is extracted by an alliance of technology and capital that, while it benefits from government sanctions on which it depends for its operational permissions, it operates day-to-day with instruments and methods which political entities have extraordinary difficulty monitoring and managing.[123] Such independence was then problematic as technology failed at Deepwatre Horizon, since governments and other bodies were helpless in the face of the disaster. The cutting-edge technology implemented is developed and essentially understood only by the private group of specialists engaged in its extraction. Physical remoteness, the specialized nature of the area and the local risks meant that during the spill it was extremely difficult for journalists to approach and it was only BP submarine robots that could survey the damage. The giant oil industry has a determinate pervasive presence, and yet is surrounded in corporate secrecy and concealment, making it extremely difficult to *site* as well as *sight*.[124]

2.3.3 OCEAN TECHNOLOGIES

Our productive relationship with the sea has always exploited technology. In western society it is technology which enables access to ocean knowledge and at the same time distributes this knowledge within a seamless and far-reaching system- for example the Norwegian fishery's electronic reporting scheme.[125] The range and seamlessness of this doistribution is characteristic of electronic technology itself as described by Kwinter:

> "What is occurring under the guise of 'rational' historical process is the systematic formation of a new subjectivity- a new type of 'man'… whose matter/intelligence variables are being reengineered and finely calibrated to fit those of a new machinic workplace-society into which he/she is to be seamlessly integrated."[126]

121 Latour, *Science in Action*.
122 Wilson and Pendakis, *Sight, Site, Cite. Oil in the Field of Vision*.
123 Duerfahrd, *A Scale That Exceeds Us*.
124 Wilson and Pendakis, "*Sight, Site, Cite. Oil in the Field of Vision*."
125 See 2.2.5 SEASCAPE ONE
126 Kwinter, *Far from Equilibrium*. p 5

The application of technology has incrementally transformed traditional ocean sectors such as fishing and maritime transport. In addition, technological adaptations to land-based industries have enabled their move offshore. Developing an ocean "knowledge-base" is a primary objective when dealing with challenges facing the management of ocean resources. Hence technology is also applied to research, monitoring and protection of ocean species. This knowledge-base is perceived as fundamental to risk-assessment at sea, in particular for the oil and gas industries.

2.3.4 FISHING TECHNOLOGIES

The fishing industry is a traditional productive practice which has used technology throughout history to optimise the catch. Callum Roberts traces this history in "The Unnatural History of the Sea" and points to evidence suggesting that fishing as a specialised occupation began in Mesopotamia and Egypt several thousand years ago and that commercial fishing was already occurring at around 1000 BC in Cadiz, one of the first Phoenician colonies on the Andalusian coast of Spain.[127]

Fishing technology in Europe gradually developed with beam-trawling appearing at the beginning of the 14th century as well as wellboats, a "reinvention of classical Greek technology"[128] which held a tank for fresh fish and so could deliver fish to Hamburg and London from the central North Sea. Medieval technologies of sail, oar, hook, trap and net still prevailed the 18th and middle of the 19th centuries until the advent of the steam engine in the 1880s. Engine power expanded vessel size, enabling fishing further offshore and in deeper waters. Diesel replaced steam in the early 20th century, with further increases in size and power as well as advancements in net material from hemp and cotton to monofilament.

The next technological revolution in fishing was marked by the introduction of echo sounders in the 1950s:

> "Echo sounders revealed the presence of fish beyond the dreams of the most skilled captains from prior generations."[129]

Parallel to these developments, the Food and Agriculture Organization of the United Nations record falling capture fishery numbers in Europe.[130] Aquaculture, on the other hand has been increasing at an average of 6.2% per annum in the same period. Over the last half century, all statistics point to a decline in marine capture fisheries. Roberts' descriptions of the previous abundance and subsequent collapse of fish stocks and catches leave no doubt as to the reason why. At a global level, small motorized boats less than 12 m in length, still dominate in numbers (ca 79%), particularly in Africa, Latin America, the Caribbean and the near East. But the comparatively small number of large industrial fishing boats are disproportionately responsible for large catches.[131]

Within this context, fishing has become a highly managed industry through the implementation of technology. Although a direct relationship between the depletion of global fish stocks and the improvement of fishing technology is apparent, the Barents Sea is an example of the application of

127 Roberts, *The Unnatural History of the Sea*.
128 Ibid. p 40
129 Ibid. p 41
130 FAO, *FAO Statistical Yearbook 2014. Europe and Central Asia Food and Agriculture*. p 60. Avg decline of -1.3 % per 2000 – 2011 but a 3% decline 2011.
131 Ibid.

technology to stabilize and monitor fish stocks and catches and to produce a knowledge-base regarding the changes in the ecosystem as a whole. Fishing in the Barents Sea is managed by both sophisticated electronic systems, which are virtually unrestricted in their area of penetration, and localised tracking and control systems. The Barents Sea lies within the regulatory area of the North East Atlantic Fisheries Commission (NEAFC), made up of the five contracting parties; Denmark, European Union, Iceland, Norway and the Russian Confederation. Information on fishing activities of all fishing vessels are required to be notified to the NEAFC. This is reinforced by Coast guards at sea who inspect fishing vessels and check the catch against log-books and fishing licenses.

2.3.5 OFFSHORE OIL TECHNOLOGIES

Offshore industries utilize similar bore/pump/distribution technologies to their land-based counterparts. This includes the energy-producing industries of oil, gas and wind as well as the required distribution infrastructure. The ocean then poses additional technological challenges due to achieving stability under harsh wind and wave conditions, structural protection in a corrosive environment, and in extreme climates such as the arctic, to stress caused by ice and lack of daylight.[132] These technologies have been reviewed through descriptive, historic accounts as well as sectorial reports.

"Offshore Pioneers" tells the story of the offshore oil industry as an inventive hands-on, practical process of adjusting existing (onshore) technology, testing new ideas and improvising on site until technology caught up with what was required.[133] The move offshore was incremental, originally associated with shallow fields of 3 – 7 m straddling the shoreline which was well within the limits of existing land-based technology. Access was originally provided through the construction of piers, such as the 375 m-long Treadwell Pier, also a conventional construction system for the time, which then gave way to the first platforms constructed with wooden piles as new wells further offshore were developed.[134]

At the end of the 1950s, maximum depths were around 60 m, increasing to 122 m in the 1970s in the North Sea. The idea of "deep water" was a variable parameter, gradually increasing with the age and progress of the offshore industry. Research into wave, wind and hurricane behaviour, as well as soil conditions for foundations, was challenged to meet the needs of offshore contexts. Accompanying the move to deeper water was the pressure on technology to provide ways of reducing increased costs associated with greater depths and distances from land. At the same time, the development incentive for the industry was a function of fluctuating oil prices. Currently "deep water" refers to between 400 and 1500 m and "ultradeep" to depths greater than 1500 m.[135] Rising oil prices in the late 1990s initiated a boom in deep-water oil and gas, making such projects economically feasible for the first time. According to analysts, the move to deeper and colder water is not only motivated by a depletion of more readily accessible reserves, but also by the efforts of private companies to secure reserves outside the control of national oil companies.[136] NOCs currently control 87% of known

132 Palmer and Croasdale, *Arctic Offshore Engineering*.
133 Pratt, Priest, and Castaneda, *Offshore Pioneers Brown & Root and the History of Offshore Oil and Gas*.
134 The Creole field, developed in 1937, was 1.6 km offshore in the Gulf of Mexico.
135 Martin, *Deeper and Colder*.
136 Ibid.

available reserves and potentially restrict access, or require particular agreements, such as partnerships and technology transfer requirements. Of the potential remaining oil to be produced worldwide, the IEA estimates that 6 – 12% lie in deep-water locations and that by 2035, nine million barrels a day will be produced from deep water resources.[137] This report also predicts that offshore production will rise to around 33% of total oil production by 2035, then levelling off as onshore production in the Middle East plays an increasingly important role.

Technology associated with the offshore oil and gas industry can therefore be seen to have "grown up" over time to become a specialised branch boasting its own research and operational equipment. Along with the military, oil and gas industries have acquired vast amounts of knowledge about the ocean and its local properties – a valuable resource for all users of the sea and an enterprise highly dependent on technological systems to scan the ocean floor and deeper geological levels. Technology alone, however, was not the driving force behind offshore oil and gas development. In bursts and starts similar to the influence of oil prices, advances in technology were demanded and implemented by the industry in response to fluctuating development pressure and further/deeper waters.

2.3.6 OFFSHORE WIND TECHNOLOGIES

The establishment of an offshore industry in wind power can be seen as an ultimate step within the long tradition of modification and improvement of land-based windmills. This has been a slow and convoluted path, the first record of windmills in western Europe being 1180.[138] The technology itself has only been one factor in a process determined by interactions between politics, economics and diverse social and environmental pressures. According to experts, in terms of the time taken to arrive at a "commercialization" period, the 120 years of wind power development represents roughly 4 times the required time for other technological innovations such as the telephone or the automobile.[139] It is estimated that wind power technology will first reach maturity at around 2100. However despite this long incubation period, the potential of wind power to capture 20% of the world electricity market by the late 21st century, could still make it a breakthrough innovation. The idea of a "breakthrough" or "radical" innovation has become a specialist field in itself- based on the findings of the US National Science Foundation that 50% of economic growth derives from technical innovation, and that the 21st century displays a phenomenon called "balkanisation", which prevents innovation breaking through to rapid and affordable application:

> "Two opposing trends characterize the dilemma for radical innovation in the 21st century: the continued explosion of the science and technology base, and the necessarily short-term, profit- driven outlook of the technology sector."[140]

From a science and technology point of view, the multidisciplinary knowledge needed for successful wind energy electrical systems spanned a num-

137 *World Energy Outlook 2010*. Compared to 5 million barrels in 2009
138 Hill, *A History of Engineering in Classical and Medieval Times*.
139 Dismukes, Miller, and Bers, *The Industrial Life Cycle of Wind Energy Electrical Power Generation*.
140 Dismukes and Bers, *Principles and Practice of Accelerated Radical Innovation*.

ber of fields that only came into being progressively during the entire 20th Century. These include fundamental aerodynamics of converting wind power to electrical power, power electronics, electrical control systems, development and manufacture of large, cost effective composite wind turbine designs, computing, communication and information technology, and reliable and cost effective linking to the electric utility grid.[141]

The technology was most popular in the 1700 and 1800s, when the number of windmills in Western Europe was estimated to peak at around 200,000.[142] Offshore windpark installations first began in sandy-bottomed sites in shallower waters close to grid connections. These conditions were partly the reason why the first offshore wind experiments took place in England and Denmark. It was in Denmark that one of the earliest examples of an electrical-energy producing windmill was developed by Poul la Cour in the 1890s.

Fluctuating fortunes in the industry were due to the introduction of cast-iron gearwork in 1755 which coincided with the use of steam power, the wide adoption superior AC technology,[143] and the cheap price of fossil fuels after World War II. The 1970s oil crisis and the Chernobyl nuclear accident renewed interest in wind and European nations took the lead in wind power technology and market structure in the 1990s. According to the Energy Watch Group, nuclear power never received the same difficulties in terms of permission and finance as wind power during its development phases.[144] Wind turbines first went into serial production in Denmark in 1979. While turbines have increased in size and capacity since this model[145], the basic structure has not essentially changed, but continual technical refinements are being made in areas such as the aerodynamic qualities of blades, advanced concrete-steel hybrid towers that can mitigate higher steel prices and the turbines themselves.

Technological refinements have enabled the positioning of installations in deeper water, corresponding to the release of larger, more efficient turbines. While offshore installation costs are higher than those on shore, the increased production capacity of larger turbines can be exploited offshore, where more space is available and turbines cause less visual obstruction. In turn, larger, more powerful turbines make the development of offshore sites economically feasible since increases in scale are exponentially rewarded with higher output.

2.3.7 OFFSHORE PIPELINE TECHNOLOGIES

Offshore energy systems require network infrastructure. Technical challenges in pipeline construction do not relate to the pipe itself, rather are linked to demands in complex routing systems in order to meet political preferences, regardless of terrain. Since the main function of a pipeline is to connect two or more endpoints, the segments and contexts in-between are, in network terms, merely a technological exercise in adjustments and refinements. However, pipeline construction is often a giant exercise involv-

141 Reichsteiner, *Wind Power in Context- A Clean Revolution in the Energy Sector*. p 183
142 De Decker, *Wind Powered Factories: History (and Future) of Industrial Windmills*. The Netherlands utilized 9000 windmills in 1850, compared to 1974 in 2009, and Germany used 18,242 in 1895, compared with 18,000 in 2009.
143 Dismukes, Miller, and Bers, *The Industrial Life Cycle of Wind Energy Electrical Power Generation*.
144 Reichsteiner, *Wind Power in Context- A Clean Revolution in the Energy Sector*.
145 See 3.6 INTERPENETRATION, [2]

ing many specialists, workers, politicians and secondary actors over large geographic areas.

The twin Nord Stream 1220 km-long gas pipelines installed along the Baltic Sea floor between Russia and Germany were completed in 2012 after two years of construction work. Despite the technological challenges involved in producing, coating, laying and testing the line, Nord Stream conclude that in the Baltic Sea, where the average water depth is only 53 m, the main challenge was logistical rather than technological. Consultations involving all rim countries were carried out, and environmental reports for each of the 5 national EEZs compiled. Referring to Peter Drucker's comments at the beginning of this section, logistics are a form of strategic and technical management, and Nord Stream claim to have developed an innovative plan, distributing section storage sites around the Baltic and having three laying barges operating simultaneously. This complex logistic effort was rewarded with the German Logistics Prize for Nord Stream in 2010. The logistical exercise continues for Nord Stream, who operate the pipeline long-distance from the control room in Zug (CH).

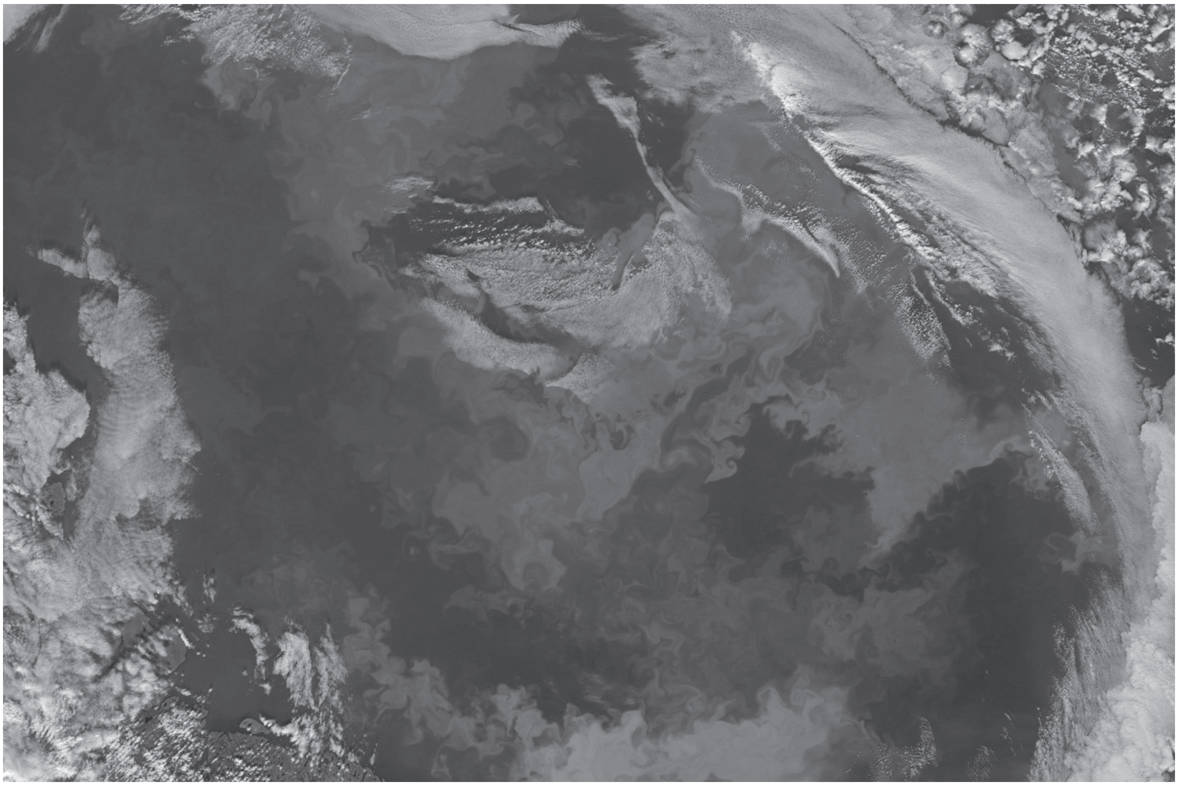
The contradictory scale of the Nord Stream pipeline is examined in greater detail in the Typology section of this thesis.[146] Video artist Ursula Biemann addresses a similar question in her project on the Baku-Tblissi-Ceyhan oil pipeline "Black Sea Files," which aims to "visually map these procedures in the most diverse way possible, challenging the monological narration based on technological pioneering."[147] She describes her Black Sea work as loose cartography of those who come into contact with the pipeline; migrants, peasants, fishermen, prostitutes, oil workers. This serves on the one hand to reveal the economic discrepancies between the oil business and marginalized communities on the local level, and on the other to record narratives generated by the pipeline, which after completion will effectively be buried and silent. The linear, simplified nature of the official narrative, is mirrored in the linear nature of the pipeline itself and therefore the real scale of the project is deceiving.

2.3.8 SUMMARY TECHNOLOGY

The literature in this review reveals that ocean technologies are largely adaptations of systems developed on land, hence while the move into the ocean implies specific challenges, I argue that the fundamental systems have not changed in a radical or innovative way. Examples explored expose the intricate weaving of technological solutions into the complex fabric of social, political, economic and scientific life and verify Kranzberg's claims that technology alone is not responsible for change and that at the same time all human activities are linked to technology. While it is recognized that technology has radically changed every sphere of life, in particular the information and communication technologies, a lack of theory and philosophical thought accompanying this shift is evident.

Of the types of technologies in use in the Barents and the Baltic seas, the most sophisticated are the information and communication technologies which gather and distribute fishing information and control pipelines or gas-fields long-distance and eliminate the need for regular on-site

146 See 3.7 CONTRACTION
147 Biemann and Pendakis, *This Is Not a Pipeline. Thoughts on the Politico-Aesthetics of Oil*.



[13]. Phytoplankton bloom, Barents Sea 31/08/10.

manpower. They operate within the *Infosphere.*[148] Management of the Barents Sea environment in the Norwegian EEZ also relies on the information and communication technologies to monitor, scan, collate and redistribute data, on which the survival of a healthy marine environment, alongside petroleum activities, will depend. To quote Drucker, this use of technology could elevate us from the level of *nomad* to that of ocean *cultivator* and cement enviro-technical relationships which relate to the ocean in an intelligent, non-intrusive way. To cultivate is to observe the application of technologies *within* global limits.

However, the complexity and efficiency of the ocean's vital functions are far superior to even the most sophisticated technology; "no computer on earth can match the processing power of even the simplest natural system, be it of water molecules on a warm rock, a rudimentary enzyme system or the movement of leaves in the wind".[149] Ocean forces and complex interactions will outsmart our technological abilities for many years to come and technology as yet has not managed to resolve the ocean's pressing environmental concerns. For these reasons collaboration is a preferable strategy to techno-scientific control.

2.4 ECOLOGY

INTRODUCTION

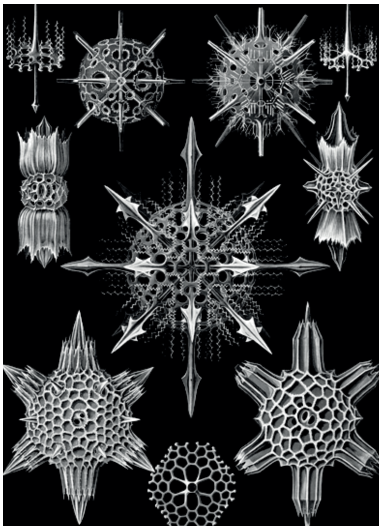
One of the most widely-accepted definitions of ecology comes from Arne Næss, a Norwegian philosopher:

> "The interdisciplinary scientific study of the living conditions of organisms in interaction with each other and with the surroundings, organic as well as inorganic."[150]

As one of the four topics of this review, ecology has the potential to capture the cyclic, kinetic aspect of the ocean and the vast range of life and habitats it contains. Ecology is not only connected to biology and earth science, rather it is also derived from philosophy, in particular ethics and politics; "ecological thought articulates worldviews and defends ethical codes expressed (in part) in political and economic practice."[151] Although the ancient Greeks were well aware of the planetary inter-relations we would today call ecology, this review covers the historical period since the word *ecology* was first used.

The concept of ecology relies on knowledge of the interrelations between organisms and their environment. This field developed along with other realms of scientific thought, emerging in association with inductive, empirical research in the Renaissance which departed from medieval deduction.[152] The rising importance of science through the 17th and 18th centuries led to biological sciences being increasingly recognized. Important figures include Charles Darwin's grandfather, Erasmus Darwin (1731 – 1802), who had suggested the idea of evolution and Alexander von Humboldt (1767 – 1835), who is accredited with being one of the first modern scientists to see the connection between geography and species distribution, which would later become the field of biogeography. He believed that the

148 Floridi, *A Look into the Future Impact of ICT on Our Lives*.
149 Kwinter, *Far from Equilibrium*.
150 Næss and Rothenberg, *Ecology, Community and Lifestyle*.
151 Laferrière and Stoett, *International Relations Theory and Ecological Thought*. p. 25
152 Maleuvre, *The horizon*.



[14] One of the more than 4000 species of Radiolaria collected by Haeckel on the Challenger Expedition 1873 – 1876.

"unity of nature" meant the interrelation of all physical sciences and meticulously documented his observations of phenomena during his many travels.[153] His complete scientific work Kosmos, which he saw as a "compendium of the world's environment"[154] was published in four volumes before his death and one volume posthumously.[155]

It was within this context that *ecology* was first articulated. The review is ordered chronologically in order to demonstrate the parallel progression of the philosophy of ecology to urbanization processes. Extended urbanization across the oceans provided the first impetus and mechanisms with which to study the marine environment, hence growing knowledge of this realm accompanied resource exploration and infrastructural operations. From a base of environmental knowledge, ecological practice and thought has developed from the concept of protection to immersion within the context of planetary urbanization, a progression directed by the changing concepts of *nature* and *culture*.

2.4.1 19TH CENTURY PIONEERS: HAECKEL, DARWIN

Ernst Haekel, a German zoologist and philosopher, first used the term "ecology" in 1866:

> "By ecology, we meant the whole science of the relations of the organism to the environment including, in the broad sense, all the "conditions of existence". These are partly organic, partly inorganic in nature; both, as we have shown, are of the greatest significance for the form of organisms, for they force them to become adapted."[156]

He referred to the Greek origins of ecology – oikos – household or housekeeping, living relations. This was however, not the main thrust of his "Morphology" publication and although he was the first to use the term, he was neither an advocate of ecology as such, nor did he advance this idea through his work. Instead he was an ardent follower of Darwin, who had published "On the Origin of the Species by means of natural selection" in 1859. While Darwin's theory of evolution was not a theory of ecology, it was an important watershed in understanding of the dynamics of the natural world and man's place in it. The ideas about ecology published by Haeckel were all to be found in Darwin's work, if not by this name. It was during Darwin's five-year voyage from England across the Atlantic to South America and back across the Pacific and Indian Oceans on the HMS Beagle from December 1831 to October 1836, that the primary observations for his theory had been made. He studied and recorded many forms of life on land and at sea and realized through the exposed shell-bearing cliffs he saw in South America, that the land including the Andes Mountains must have been uplifting out of the sea. The idea of a planet in a constant state of flux was revolutionary at the time and also against the view of a perfect, unchanging creation according to official religious beliefs.

Like Darwin, Haekel and many other botanists and zoologists embarked on ocean voyages; Haekel was selected to work on the Challenger

153 One example is the Jurassic period named after rocks Humboldt observed in the Jura, Switzerland, on his scientific trip in 1795.
154 Walls, *Introducing Humboldt's Cosmos*.
155 Alexander von Humboldt, *Alexander von Humboldts Kosmos*.
156 Stauffer, *Haeckel, Darwin, and Ecology*.

Expedition (1873 – 1876), the first non-commercial exploration of the deep-sea environment by the British Admiralty,[157] explorers such as Captain James Cook had botanists and naturalists on board,[158] and operations such as the preparatory soundings for the first trans-Atlantic cable (1856 – 1866) also took sediment samples from the sea-floor which revealed previously unknown life-forms.[159] The Challenger Expedition is considered the founding event in establishing the discipline of oceanography- its mission was to investigate the physical conditions of the deep sea, the chemical composition of all levels, chemical composition of ocean water, deep sea deposits and organic life through all levels and on the seafloor. It was equipped with laboratories for natural history and chemistry for the group of scientists and at the termination of its voyage, a full report was published of all findings including over 4000 new species [14].[160]

It was within this scientific context that the concept of ecology as the relationships between living things and their environment, emerged. The oceans expanded this scientific context geographically and typologically, and therefore the same routes and "stations" which had been established for the purposes of trade and colonization, became sites and circuits of scientific research. Darwin's descriptions of the trunk-fills of specimens he shipped back to England,[161] provide a vivid image of what Latour describes as going somewhere and bringing knowledge back to the "centres of calculation" where this knowledge was accumulated.[162]

The ocean's ecological systems are by no means fully understood, and much knowledge has only been established relatively recently. While making soundings for the Atlantic telegraph cable in the 1850s, a depth of 5,700 fathoms[163] was recorded with simple line-and sinker equipment. Even if the sounding was not accurate, the fact that the sea could be deeper than land was high and the discovery of the deep ocean as a new dimension of the earth's space, was an astounding revelation.[164 – 165] At the same time, the word urbanization was first introduced by Ildefons Cerdà in his 1867 book *Teoria general de l'urbanizacion* to describe the boundless dynamic of people, places and interests which could longer contained within a finite formation such as a city.[166]

2.4.2 20TH CENTURY: SAUER, LEOPOLD, NÆSS, BALLARD, ODUM, FULLER

Influential 20th century ecologists include Carl Sauer, a geographer who took a chair at the Berkeley School in 1923 and from this position, developed ideas of geography which ran against environmental determinism and emphasized the changes humans interactions make on the environ-

157 The Challenger travelled the Atlantic, the Pacific and the Antarctic Oceans and is considered the voyage which established the field of oceanography.
158 Famous Botonist Sir Joseph Banks accompanied Cook on his first South Pacific voyage 1768 – 1771, along with two naturalists, Daniel Solander & Herman Spöring.
159 Rozwadowski, *Technology and Ocean-scape*.
160 *Report on the Scientific Results of the Voyage of H.M.S. Challenger during the years 1873 – 1876*
161 Charles Darwin and Keynes, *Charles Darwin's Beagle Diary*.
162 Latour, *Science in Action*.
163 Ca. 10,431 m.
164 Rozwadowski, *Technology and Ocean-scape*.
165 Height of Mt Everest: 8,849 m, depth of the Challenger Deep, Mariana Trench (Pacific Ocean): 11,003 m.
166 Aureli, *The Possibility of an Absolute Architecture*.

ment. This approach came to be known as the "Berkeley School" of geographic thought. Sauer claimed geography was interconnected with culture, landscapes and history, ideas articulated in his famous 1925 article, "The Morphology of Landscape." At this time the notion of culture reflected in the landscape was a new approach:

> "A cultural landscape is fashioned from a natural landscape by a culture group. Culture is the agent, the natural area is the medium. The cultural landscape the result."[167]

Aldo Leopold (1887 – 1948) was originally a forester who became one of America's most influential wildlife conservationists and redefined the role of wilderness in conservation terms. He was widely recognized for his advanced thinking in this area, which highly influenced the environmental movement. His most well-known essay "Thinking like a mountain" describes the relationship between wolves and deer on a mountain, and the importance of both in maintaining a long-term balance.[168] None of man's efforts in controlling wolves, deer, cattle or vegetation are as effective as the wilderness in the time-frame of a mountain:

> "The cowman who cleans his range of wolves does not realize that he is taking over the wolf's job of trimming the herd to fit the range. He has not learned to think like a mountain. Hence we have dustbowls, and rivers washing the future into the sea."[169]

Leopold observed the advancing urbanization and its effect of steadily reducing the "blank" spots on the map, which to Leopold represented the valuable wilderness areas. This motivated him to not only initiate his own ecological restoration project, but also to extensively document and publish his work examining humanity's relationship to the natural world.

Arne Næss spoke out against what he saw as the superficiality of ecologically responsible policies, which became concerned only with pollution and resource depletion. Næss argued that there are deeper ecological concerns which touch upon principles of diversity, complexity, autonomy, decentralization, symbiosis, egalitarianism, and classlessness. He invented the term *deep ecology* to make this differentiation, first using it in an article in 1973.[170] Deep ecology resonates with the ideas put forward by Leopold. The ecology movement is for Næss a world-view which called for a radical rethinking of man's position in the world. It is an *egalitarian and holistic* environmental philosophy which denies differential valuation of organisms, and therefore also human-beings over other life-forms.[171] In contrast, a shallow worldview as subscribed to by most mainstream environmentalists in Europe and North America, is anthropocentric- preservation of nature and biodiversity is motivated primarily by maintaining *human* welfare. Although influencing environmental philosophy, deep ecology did not last as a field of inquiry in its own right.

Oceanographer Robert Ballard has taken part in many groundbreaking deep ocean explorations including the discovery of the Titanic wreck in 1985 at a depth of 3800 m. But his contribution to ocean ecology stems from his drive to communicate the critical importance of the oceans since the planet's entire water-supply cycles through them. Ballard

167 Sauer and Leighly, *Land and Life*.
168 Aldo Leopold, *A Sand County Almanac, and Sketches Here and There*.
169 Ibid.
170 Naess, *The Shallow and the Deep, Long-range Ecology Movement. A Summary*.
171 Callicott, *Encyclopedia of Environmental Ethics and Philosophy*.

describes the oceans as a central “clearinghouse” for nutrients and minerals essential to life and the deep ocean as “the ultimate reservoir from which life everywhere draws sustenance.”[172] This scientific conviction is faced with general lack of research and knowledge:

> “We know more about impact craters on the far side of the moon than about the longest and largest mountain range on earth.”[173]

The deep oceans explored by Ballard revealed seafloor spreading, where the earth’s crust was pulling apart, volcanic vents of hot water and new forms of life which did not rely on photosynthesis. Through these discoveries in the 1960s and 70s, theories of the continual new formation of the earth’s crust and the possibility of the deep ocean being the place where life began, gained ground. Not only to the oceans represent a complex, unitary ecological system, but they are also interconnected to every other life-sustaining system on the planet.

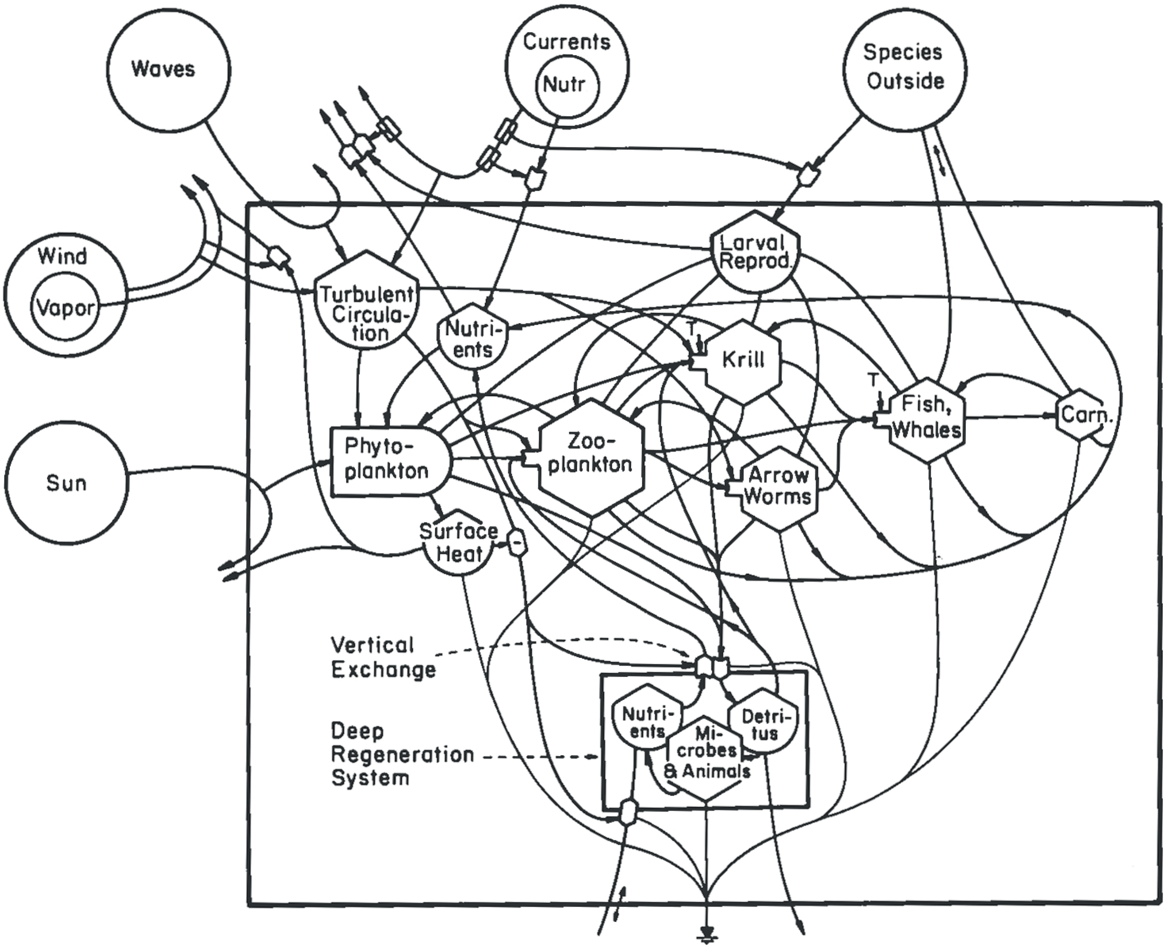
In the the 1960s and 70s, some theorists became interested in the systems approach to relations. Howard Odum connected the systems approach to ecology. Pierre Bélanger compares Odum’s open systems approach to closed-system advocates, in particular the engineer J. W. Forrester who developed and applied the theories of systems dynamics with apparent success in the 1960s and 70s in a corporate context which was itself a “closed system”. Forrester’s 1961 publication “Industrial Dynamics” led to the expansion of his thinking to the urban and then global scale, the latter on invitation from the Club of Rome.[174 – 175] Bélanger argues that Forrester’s ideas landed on fertile ground in the municipal administration, which were also a form of corporation entrenched in Fordist industrial thinking. However, they remained on a theoretical level and unforeseen developments in America’s urban landscape with the decline of the great industrial cities, made it clear that such models did not reflect the real character of urban dynamics.

Bélanger sees much potential in Odum’s open-systems thinking and its application to urban contexts:

> “His modelling of complex systems through flows helped position the urban as a landscape of processes and patterns, extents and intensities, economies and ecologies.”[176]

Odum pioneered the understanding of natural systems through flows of exchange and energy, beginning with the mapping of estuaries. He developed a “systems language” based on circuit energy language which was useful to “generalise and compare systems of nature and humans.” Based on this language, Odum generated diagrams of all types of systems both including and excluding human factors. The biosphere is the largest of the planet’s ecosystems, which, fuelled by the flow of sunlight, then drives the cycles of the atmosphere, the oceans, most of the geologic systems and therefore the fabric of life. He describes the ocean as as an “open, steady state,” through which cycles of elements pass in their flow from sediment or air back through the main rivers to the sea again. The marine ecosystem [15] includes the role of waves, currents, winds as well as the species, since vertical eddy diffusion is important in accessing nutrients for many species. Also

172 Ballard, *The Eternal Darkness*. p 5
173 Ibid. p 3. The Mid-ocean ridge is a subsea volcanic mountain range 68,600 km in length and sometimes rising to a height of 4572 m.
174 Jay W. Forrester, *Industrial Dynamics*.
175 Jay W. Forrester, *World Dynamics*.
176 Bélanger, *Sprawl: A Stratregy? From Closed System Dynamics to Open Systems Ecologies*.



[15] Systems diagram: Upper 1000 m of open sea, Howard Odum 1983.

within his analysis of cities or regions, the energies of the natural environment are always an integral part of the system, even when translated into economic value. However a feedback mechanism from the urban economy is necessary to maintain a healthy environmental subsystem, which in turn is essential to provide a good symbiotic input to the economy. Odum comments that this link is "weakly developed in many modern patterns."[177]

Sanford Kwinter believes Buckminster Fuller was highly underrated by architects and describes him as possibly the first designer to think of ecology in its current sense:

> "The interplay and mutual determination of organism and environment".[178]

Fuller was interested in the capacity of design to channel and utilize energy and information more efficiently. This led to proposed solutions to energy- and resource management on a global scale. Nikos Katsikis compares the two contributions of Doxiadis and Fuller to the problems and challenges of increasingly globalized urbanization. Both were members of Doxiadis' World Society of Ekistics which was conceived as an alternative to the Congrès Internationale d'Architecture Moderne (CIAM). Katsikis points out the problematic technoscientific determinism of Fuller's vision, but also the fact that his contribution lay in the reconceptualizing of world resources and their distribution.[179] For Fuller this began directly with a new world map – the Dymaxion, which portrayed each continent as its true size without the distorting effects of reducing the globe to a flat plane. Fuller's globe was a series of unfolded triangles, which together formed an icosahedron, and where the view from the North Pole highlighted the interconnectivity of all continents. The map was a tool to show and reorganize global flows as a design project on a world scale. Fuller's intentions were to democratize and equalize systems regardless of political or physical barriers.

The systems approach is interested in flows. Although organic and inorganic matter represent different individual input/output pathways, in terms of their relation to the system they are handled the same manner. This idea has contributed to an evolution in the understanding of ecology itself to include the *unnatural* environment and has opened the way for a new generation of ecological thinking for the incoming *Anthropocene*.

2.4.3 21ST CENTURY- THE ANTHROPOCENE : ECOLOGY WITHOUT NATURE

A thin layer of carbon on the earth's crust marks a new era and the first time in history that man has influenced geological time. Defined by the Oxford dictionary as; "Relating to or denoting the current geological age viewed as the period during which human activity has been the dominant influence on climate and the environment,"[180] the Anthropocene is currently being reviewed by scientists for formal acceptance into the geological timescale. The date of the beginning of this era is still widely debated. The recognition of the Anthropocene as a new geological era was proposed by the Nobel Prize-winner and atmospheric chemist Paul Crutzen, and ecologist Eugene Stoermer in an article of the same name in 2000:

177 Howard T. Odum, *Systems Ecology*. p 534
178 Kwinter, *Far from Equilibrium*.
179 Katsikis, *Two Approaches to "World Management": C. A. Doxiadis and R.B. Fuller.*
180 Oxford online dictionary, accessed, 22/05/15.

> "Considering these and many other major and still growing impacts of human activities on earth and atmosphere, and at all, including global, scales, it seems to us more than appropriate to emphasize the central role of mankind in geology and ecology by proposing to use the term 'anthropocene' for the current geological epoch."[181]

Crutzen and Stoermer propose the industrial revolution as the beginning of this era.[182] The discussion in ecology can therefore no longer be conceptually based on the *natural* vs the unnatural or the *cultural*. The current state of ecological thinking has progressed beyond this divide and a reassessment of what has previously been widely accepted as nature has taken place. In a world where urbanization processes were observed to be penetrating the most remote and "natural" places, Lefebvre already noted that "spaces with predominantly natural traits are on the decline."[183] For Lefebvre, spaces with natural traits are those which enter less into the social relations of production. But he also comments that natural spaces have been engulfed and enclosed by the spaces of production, for example in the case of a regional park, where they have become subordinate.

Brenner and Schmid's statement 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", has been referred to in 2.2 SEASCAPES.[184] For Brenner, these transformations highlight the need for an *urban theory without an outside*- a theory beyond the urban/nature or city/rural divide which has remained a paradigm in urban studies long after it ceased to exist in reality.[185]

Timothy Morton vividly describes this loss of the outside as "a flattened world without ontological U-bends. A world in which there is no away."[186] He argues from the Object-Orientated-Ontology (OOO) viewpoint, where instead of being occupied by Culture and Nature, the world is made up of a host of irreducible and unique beings with which we share all space.[187] His critique of ecology derives from this very fact that it has been based on the idea of a nature which sustains civilization, but which exists outside of it. Instead Morton proposes abandoning these notions of inside and outside and deconstructing the artificial limits between them:

> "If we let go of limits, we let go of the vague aperion of infinity and embrace finitude: not as scarcity or as a limit, but as coexistence in the disquieting flux of time."[188]

As a logical consequence, Morton's dark ecology would deliberately include human interaction with all the unpleasant by-products of our existence:

> "But there is no away after the end of the world. It would make more sense to design in a dark ecological way, admitting our coexistence with toxic substances we have created and exploited."[189]

Subscribers to the idea of dark ecology include artists and thinkers, one group of which have initiated a three year art and research project in the

181 Crutzen and Stoermer, "The Anthropocene."
182 The exact date proposed in the article is 1784, the year James Watt invented the steam engine.
183 Lefebvre, *The Production of Space*. p 83
184 Brenner and Schmid, "Planetary Urbanization."
185 Brenner, *Introduction: Urban Theory without an Outside*.
186 Morton, *PEAK NATURE. Capitalism Has No Soul*. (U-bends refers to flushing the toilet).
187 OOO is pioneered by Graham Harman, philosopher of metaphysics.
188 Morton, *Everything We Need: Scarcity, Scale, Hyperobjects*.
189 Morton, *Architecture without Nature*.

Barents Region. The organizers argue that precisely here, in a pristine sub-arctic environment, the link between human civilization and industrial pollution can be keenly sensed in every way. Ironically it is global warming which contributes to economic growth in the region, as petroleum exploration and the northern-sea route prepare to reap the rewards of the receding ice front. These activities, in turn, assist in accelerating climate change.[190]

Bruno Latour also argues for an "Ecology without Nature,"[191] in his discussion on political ecology, which is distinguished by "its equal concern for non-humans and humans."[192] This discussion is anchored within Latour's "longterm project to develop an alternative to the notion of modernity." An important part of this project explored in the essay, is the political origin of the notion of nature. Latour discusses the impossibility of the marriage of the two concepts politics and ecology as they are generally understood. A much simplified version of his argument can be described as follows; if ecology is about nature, then the politics of this entity must be so large as to include everything, hence would be out of range of understanding of ordinary citizens, and also due to its complexity, would be entrusted to a range of specialists. Instead, Latour claims that "ecology has nothing to do with taking account of nature, its own interests or goals, but that it is rather another way of considering everything."[193] The way of "considering everything" for Latour is based on Actor Network Theory, in that entities we are involved with in the world, such as rivers, for example, should be considered in their unpredictable, uncertain course rather than considered as objects to be managed.[194] Through this perspective, nature and social both emerge as outmoded, constructed assemblages which have failed to take the vast majority of entities into consideration.[195] Actor Network Theory (ANT) considers these entities as quasi-objects, networked socio-natural assemblages or nature-culture hybrids.

Practicing ecology in this way, would according to Latour, bring about a marked transformation and generate new political life, in contrast to a hierarchized system under modernization:

> "Ecologising a question, an object or datum, does not mean putting it back into context and giving it an ecosystem. It means setting it in opposition, term for term, to another activity, pursued for three centuries and which is known, for want of a better term, as modernisation."[196]

Latour calls for a radical political change- one that the current politics of ecology embodied in green parties have not been able to effect, precisely because of the contradiction between politics and ecology.

From the perspective of ecological economics, a field which emerged in the 1980s to focus on the connections between ecological and economical processes, the oceans are a prime example of the failure of neoclassical economics to incorporate biophysical processes in their models.

190 http://www.darkecology.net/dark-ecology-project accessed, 24/05/15.
191 The title of a book by Timothy Norton, Harvard University Press, 2007
192 Latour, *To Modernize or Ecologise? That Is the Question*.
193 Ibid.
194 A river, therefore should be treated not only as a *means*, but also understood as an *end,* in the same way that a human subject demands the autonomy never to be treated as a means, but as an end to itself. Latour refers to Kant's definition of human morality in Kant, I (1956), *Critique of Practical Reason*, trans. L.W. Beck, The Liberal Arts Press.
195 Latour, *Reassembling the Social*.
196 Latour, *To Modernize or to Ecologize? That Is the Question*.

Environmental factors have been externalized from the equation in neoclassical economics and complex marine ecosystems have been reduced to a single category; "natural capital."[197] Ecological economics also calls for a complex systems approach to marine ecology, which according to some critics, has been dominated by "linear mathematical Newtonian mechanistic views of organization and behavior."[198]

Eric Swyngedouw is also highly critical of the way in which sustainability and ecology have been successfully integrated into what he calls "post-political" techno-managerial planning, which in effect conforms to the profit principle and guarantees that there is no significant change in the existing socio-ecological order. Borrowing from the philosopher Alain Badiou, he uses the expression "Ecology is the opium for the masses" to drive this position home.[199] Swyngedouw also claims that nature is an empty signifier in that it represents everything and nothing. However we are still unable to rearrange and build alternatives to our everyday socio-ecological relationships which revolve around these beliefs and the structures which uphold them. For a closer analysis of the manifold meanings we attach to nature, Swyngedouw refers to Tim Morton's, "Ecology without Nature."[200] Morton lists three meanings of nature; nature as a metonymic reference – a substitution for another name, where the content of nature is expressed through a range of diverse terms, nature as a solid foundation with normative laws and nature as an external terrain and an object of fantasies and desires.

Political theorist Aijaz Ahmad highlights a further aspect of the relationship between nature and culture. He argues that after the enlightenment, a split between two types of nature became evident; raw, dangerous nature could be an immense source of wealth if tamed through science and technology. This left human nature, which was also then to be tamed, shaped and improved through culture:

> "Culture was to human nature what technology was to external nature".[201]

All points of view describe the dissolution of *nature*. These authors are among those who call for an ontological shift in the understanding of ecology – a discipline "in need of a theory."[202] The San Rocco issue entitled Ecology discusses the possible contribution of architecture to the ecology project:

> "The planning we are proposing would not really be Planning… it would just be kind of planning… planning would be listening, observing, learning and only then correcting, while always accepting the logical priority of the existent over the new… What would be the territorial consequences of the decline of the nation state be? First, territories need to be recognized not according to existing administrative borders, but according to ecosystems and the organization of production".[203]

197 Sunde, *The Open Horizon: Exploring Spiritual and Cultural Values of the Oceans and Coasts*.
198 Gibbs and Anthony, *Oceans and Coasts as Complex Adaptive Systems*.
199 Feltham, *Alain Badiou.* Badiou makes reference to Marx's statement "religion is the opium of the people" which was published in 1844 in his *Deutsch-Französische Jahrbücher*.
200 Morton, *Ecology without Nature*.
201 Ahmad, *The Politics of Intercultural Learning*.
202 Ghidoni, *Editorial*.
203 Ibid.

2.4.4 SUMMARY ECOLOGY

Ecological thought has developed both in parallel to other scientific areas and in relation to urbanization. It was within the climate of enquiry and exploration of the 19th century that the first oceanographic expeditions took place and that the term, was first used. Until this point, little was known about the ecology of the oceans in the western world. Projects of connecting the continents with physical links, such as the laying of the first Atlantic telegraph cable, presented opportunities to gain knowledge about the physical environment of the ocean and it's life-forms at the same time as solving the technical challenge.

However it is only recenty that the global ecological significance of the oceans has been understood. Theories of ecology based on the influence of the *cultural* on the *natural* world, were developed by pioneers observing landscapes and wilderness areas. These ideas were enriched by the systems approach, which demonstrated the interconnectedness of human and natural systems.

The concept of ecology has advanced in a spatial sense to include not only wilderness areas but to be understood as the convergence and overlapping of the domains that were previously understood as *nature* and *culture*, and the expansion of urbanization processes into all forms of territory. An understanding of territory based on ecosystems as suggested by Ghidoni above, corresponds to the proposition in the introduction to this thesis. Through an as yet undefined type of *planning,*[204] or architectural contribution, the ocean can be embraced not as something *natural*, rather as a kinetic, contingent, productive territory, full of non-human life, animate and inanimate objects and manifold relations both between objects and to topographical territory.

CONCLUSION LITERATURE REVIEW

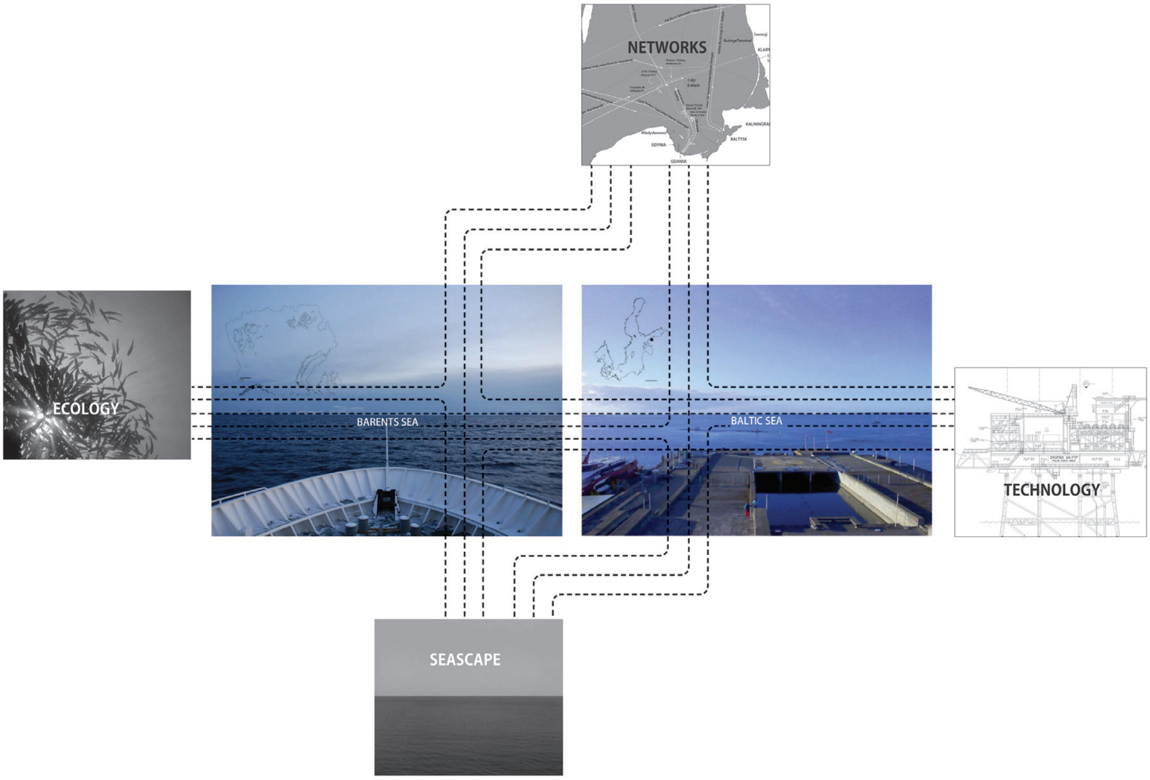
The literature review aims to use four topics to construct a landscape of thought for ocean space and a conceptual bridge to the urbanization of this space. It serves as a basis for the subsequent analysis of the Barents and Baltic Seas. The theoretical and historical study of these individual topics, combined with empirical research, therefore contributes to a preliminary theory of ocean space.

The following conclusions have been drawn from the four topics:

– Shipping networks have been a dominant feature of the ocean surface throughout history, activating specific connections and nodes which may be geographically far removed. This has led to radical forms of urbanization which use the ocean as a connecting agent. Its status as a site of heightened network activity is still ingrained within the laws of the sea, which prioritizes shipping movement, cable- and pipe-laying, each of which play an important role in extending urban systems across, through and into the sea. Although the dominance of the surface-view of the sea led to the "great void idealization," thick network activity creates regional ties and makes the seas a common referential space.

– Seascape describes the physical modification of the ocean which has, until recently, largely remained below surface. Dredging, trawling and the dumping of munitions are examples of activities within this category. In the ocean, the traditional productive activity of fishing moved with

204 See 4.4 THE OCEAN PROJECT



[16] Framework for the interrelations of ocean urbanization in the Barents and Baltic Seas

the body of water and its prey, meaning that constructed fixtures were minimal and the modifications to this fluid space escaped untrained perception. The social and spatial organization of fishing communities can be compared to the agricultural communities of J.B. Jackson's "landscape one." However, our scaping of the sea is intensifying, taking on new forms, becoming longer-term and extending to the above-surface realm. This produces new visual realities which are in contrast to the reduced, abstract, infinite horizons of the seascapes we share as a universal *immemory*.

– Construction technologies utilized in the offshore oil, pipeline and wind-energy industries are not highly advanced, but have been gradual adaptations of systems used on land. Therefore technology alone is not responsible for the type of offshore urbanization created by these industries. The most sophisticated technological advances are in the area of ICT – information and communication technologies, which are able to overcome distance and which enable levels of cohesion comparable to urban formats. Through these systems, knowledge-bases about the sea are established, monitoring and control is carried out and abstract "territories" are created for the extraction and capture of natural resources.

– The meaning of ecology has always been the relationship between living organisms and their environment, both organic and inorganic. But until recently, ecology was still firmly attached to the concept of nature – something outside of culture. Current ecological thought calls for the abandonment of this association with nature, which no longer exists in the form we imagine. Ecology has been "naturalized" – that is it has become a concept integrated into a fully urbanized world. For the critics of a "politically correct" form of ecology, such as Eric Swyngedouw and Bruno Latour, this could potentially mean a major shift in the existing order – a call for the non-distinction between natural and cultural beings or objects.

Further to these conclusions derived from the separate topics, particular interrelations can be identified. Seascapes are created by ecological systems, the network interaction of shipping routes or pipelines and by the technologies associated with energy-production. The comparison to landscapes enables the reading of seascapes in their full dimensions, in particular their properties below-surface. When infrastructural networks link to physical seascapes, the topological, scale-less properties of networks meet the physical, topographical reality of the seafloor. This is an inherent contradiction which merits closer analysis. On the other hand, shipping networks continuously modify the spatial relationships on the sea surface and therefore the highly abstract seascape itself.

The realization that the underwater seascape plays an important role in maintaining the ecological balance of ocean systems has led to more intense research into its properties. In the case of the Baltic Sea this is in order to restore its deteriorating environmental condition and in the case of the Barents Sea it is to maintain the balance alongside oil and gas activities. Still much less is known about seascapes than landscapes. The equipment required to access these biotopes and to carry out the research is provided by technology, hence ecology and technology are inextricably linked. Western society has passed the point of maintaining an ecological balance through sustainable practice, therefore technology is employed to address this issue.

Offshore, "industrialization" of the seascape through technology and management systems has created abstract specialist zones, but has not led to further, diversified urbanization as it has on land according to Lefebvre's statement that the "rural, the industrial and the urban succeed one another." The review has also demonstrated that a possible opposition between Ecology and Seascape as poles of inherent ocean space, and Technology and Networks, as poles more clearly linked to urbanization processes, does not exist, rather relationships and interdependencies create a meshwork linking all four topics.

It is through this meshwork, that a preliminary framework for a theory of ocean urbanization has been constructed. Contradictions and unusual links revealed through this review sharpen the following spatial analysis and steer the selection of typological conditions.

3 SPATIAL ANALYSIS

INTRODUCTION

Having established a theoretical context for ocean space through the themes of Networks Seascape, Technology, and Ecology, this part tests the relevance of these positions through spatial analysis on two levels: a comparative study on the Barents Sea and the Baltic Sea, and the proposition of five spatial typologies found within these seas.

The general introduction to the comparative study locates the two seas geographically and historically. The two seas are then presented through their territorial traits of physical oceanography, life-forms and urbanization processes. Mapping is used as a method to articulate these forces and to describe their spatial dimensions and properties and profiles summarized [31-32].The relationships between Networks, Seascape, Technology and Ecology within these seas and their relative influence on urbanization processes, emerges through the analysis. I argue that situations of intensity, collision or contradiction in the two seas are a result of particular interrelations between these four factors. The proposed five typologies represent a preliminary, non-exhaustive selection of such situations which describe generalized conditions of urbanization in the Barents and Baltic Seas.

3.1 TWO SEAS

The Barents Sea as an urbanized realm was the subject of a research and design investigation at the EPFL laboratoire bâle (laba) in 2011 – 12. This sea is vast, remote, pristine, rich in resources and yet its geographical location on the edge of the Arctic, the effects of climate change and the discovery of significant offshore fossil fuel reserves, have swiftly made the Barents Sea the focus of international attention. Urbanization processes have accelerated. The establishment of a Northern Sea Route from Europe to Asia across the northern Russian coastline has only recently become feasible due to the receding ice-front and has been launched as a business venture which should save shipping companies almost 30% in time and transport costs compared to the route through the Suez Canal.[38] It is estimated that the Barents Sea holds 30% and 25% of the world's untapped gas and oil reserves respectively. Since 2010, when the Barents Treaty resolved the Norwegian/Russian ocean boundary dispute and the moratorium on oil exploitation lifted, exploration activities have intensified. At the same time the WWF describe the Barents Sea as "one of Europe's last large, clean and relatively undisturbed marine ecosystems," one of the most productive in the world and among the most biologically diverse in the Arctic.[39] These interests steer the development of the Barents Region – a geographic entity, an ecosystem and a political-economic construct created as recently as 1993 to "mark the end of the cold war and the beginning of something new."[40]

38 In September 2010 the first international commercial transit sailing took place across the Northern Sea Route from Kirkenes to Lian yungang in China. The Centre for High North Logistics (CHNL) was formally established in 2009, to coordinate and promote research and business relating to maritime logistics in the Arctic region, in particular the Northern Sea Route.

39 *The Barents Sea Ecoregion*.

40 Strøksnes, *The Inner Space of Barents*. p 58

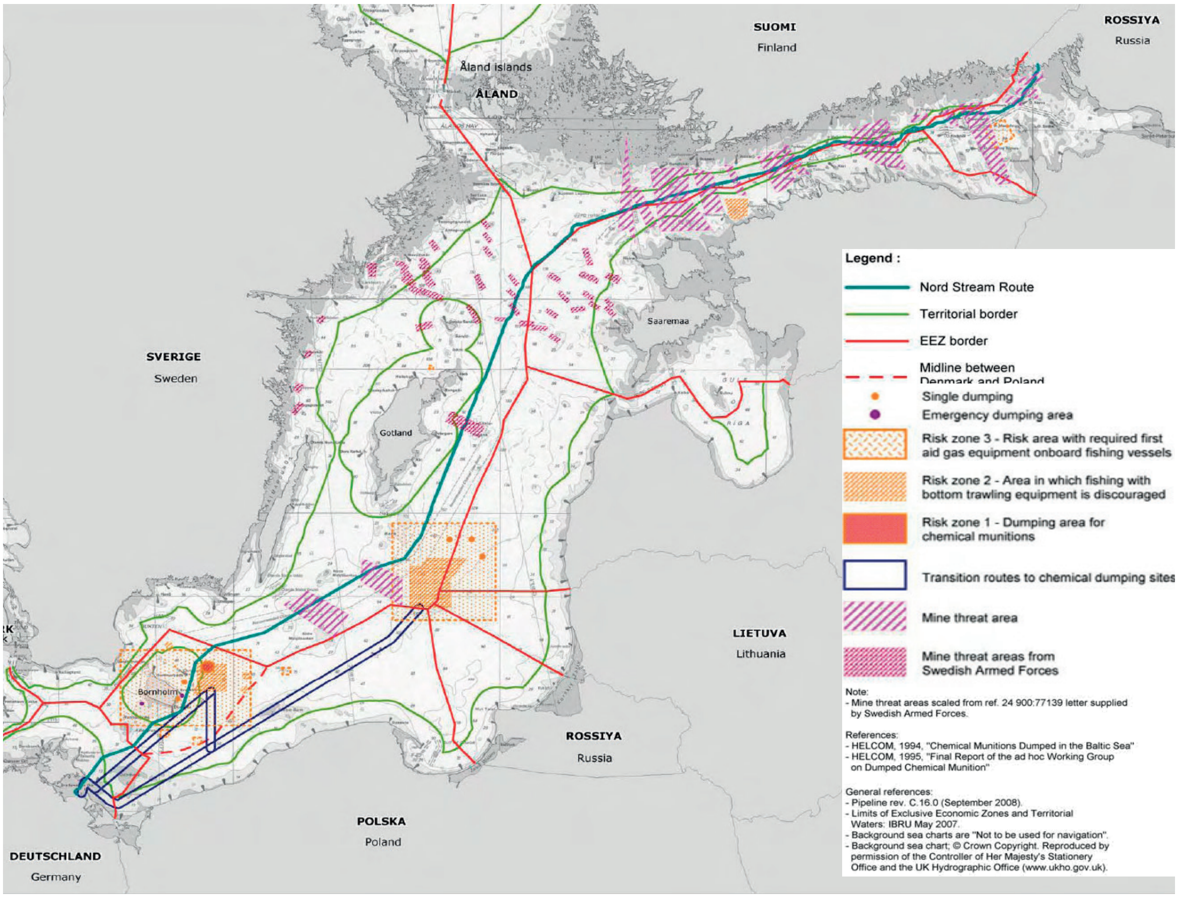
[1] Location Barents and Baltic Seas.

The Baltic Sea has been chosen as the second case study because of its marked spatial, cultural and geographical differences to the Barents Sea. Important epochs of Northern European history are inscribed in the sea through the exploits of the Vikings and the formation of the Hanseatic League several centuries later. This prosperous period of Baltic trade has left a particular legacy of urban centres with exemplary levels of cultural achievement. Compared to the remoteness of the Barents Sea, the Baltic Sea is centrally located in Europe and accessible to a large population. Despite its compact size, the Baltic Sea also straddles geographic, cultural and political boundaries in both an east-west and a north-south direction. Some of the world's busiest maritime transport routes cross the Baltic Sea and favourable wind conditions mean that the sea is becoming increasingly important for the renewable energy sector in the perimeter countries. These development pressures are indicators of the Baltic Sea's level of urbanization. For the Baltic Sea, the combination of a sensitive oceanographic predisposition and the intense coastal exchange, means it is approaching a tipping point where the sea as a resource in the broadest sense is endangered. As the focus of its nine surrounding countries, vast amounts of knowledge exist about the Baltic Sea and recently many efforts have been mobilised, in particular from the EU, to economically unite and strengthen this realm, while addressing the sea's pressing environmental issues. Hence the Baltic Sea is also a strategic political project.

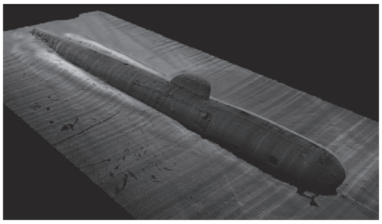
The preliminary research undertaken at laba included a comparative study of the Barents Sea with the Eastern Mediterranean, the North Sea, the Persian Gulf, the Caribbean Sea and the South China Sea under the five aspects of resources, energy, governance, infrastructure and economy. This cross-section of diverse seas resulted in an understanding of the ocean as a geographical arena where forces are played out and where the sea engages in a reciprocal exchange of influence with its bordering lands. The potentials of each sea are met by a range of problems, which, depending on the consensus of power, may or may not be overcome. Each sea was found to have a unique profile created by a combination of climatic, ecological, resource, industrial, cultural and political conditions; volatile geomorphic conditions in the South China Sea and the Caribbean are matched by volatile political landscapes, the North Sea is highly managed as an energy resource by the industrialized, heavily populated and culturally unified rim countries, the Persian Gulf is dominated by oil and the Eastern Mediterranean is frozen in an uneasy deadlock despite its rich history and economic potential. Based on this experience, the comparative study of the Barents and the Baltic Seas also seeks to define a territorial profile for each sea.

The two seas are separated by only 450 kms of land between Haparanda (Sweden)/Tornio (Finland) on the northern Baltic shores and Alta (Norway) on the southern Barents shore [1]. Through this proximity, historical trading routes, climatic features such as the ice front, ethnic language groups and the geological presence of iron, copper and nickel ore with their associated mining infrastructure, are common to both the Northern Baltic and the Southern Barents regions. Russian territorial waters exert a strong influence on both seas.

Apart from the ocean connection through the North and Norwegian Seas, the Barents and Baltic Seas are also connected inland through the White Sea-Baltic Sea canal, build by forced labour under Stalin between 1931 and 1933. The 227 km-long waterway links 48 km of man-made canals to rivers and large lakes lying between the White Sea and Lake Onega. From the southern end of this lake, the Svir River, Lake Lagoda and the Neva River then connect to St Petersburg and the Baltic Sea. The construction



[3] Mines & chemical munitions, Baltic Sea.



[2] B-159 Russian nuclear submarine, sunk 2003, Barents Sea, depth 234 m.

of the canal was an important strategic project to link the two seas, enabling the connection of Russian military bases and the transportation of fuel and equipment. This exemplifies the role of oceans as a military forcefield and the importance of ports as the channels through which this force is directed. Both the Barents and the Baltic Seas have been arenas of war with a legacy of sunken military waste to testify. The Iron curtain fell across both seas – they were therefore vitally important strategic locations for both Russian and Allied forces. The most powerful nuclear weapon ever detonated, the Tsar Bomba, was released during Russian nuclear testing on Novaya Zemlya in 1961. After 1990 and until recently, Russian nuclear submarines were sunk off the Barents coast [2]. Similarly in the Baltic Sea, an estimated 100 – 150,000 mines were laid during the First and Second World Wars, of which 35 – 50,000 have since been removed [3].[41] Dumping of worthless conventional and chemical munitions was then common practice after both wars.

3.2 HISTORICAL BACKGROUND

3.2.1 BARENTS SEA

The history of the Barents region is the history of the sea. Vikings explored and established small ports along the Norwegian coast in the 11th century, at the same time as Russians from Novgorod arrived to settle the Russian coastline, but evidence points to this region already being continuously inhabited by indigenous groups since at least 10,000 BC.[42] The indigenous Sami people inhabit an area encompassing northern Norway, Finland, Sweden and the Kola Peninsula. Their traditions are closely linked to the seasonal changes and the resources in this environment, in particular fishing and semi-nomadic reindeer herding. Traditionally the sea has been more important than the land for providing the livelihood for much of Norway's population and hence fishing has been the basis for settlement along the shores of the Barents Sea and for most of the Norwegian coastline.[43] After the last ice age, the Norwegian coast was habitable before the frozen inland areas due to the positive temperature effect of the warm Gulf Stream. Fish was also in plentiful supply. Ocean trade routes connected coastal towns to each other and to centres much further afield.

The attempt by the Norwegian Kings to maintain control over a *mare clausum* in the 11 – 13th centuries has been described in the Thesis Introduction.[44] By 1360 Bergen had become an outer trading post of the Hanseatic League, called a Kontor, and controlled maritime trade. The control of the League practically extended to the whole Norwegian economy in this period, since the Norwegian royalty were carrying a large debt to them. Bergen was granted monopoly from King Haakon on the fishing trade from northern Norway. This mainly comprised of dried fish and was the reason Bergen became one of Northern Europe's largest centres of trade at the time. The Kontor in Bergen remained after the dissolution of the Hanseatic League in 1630, but ended its operations in 1754, shortly before Bergen's trade monopoly on northern Norway was lifted in 1789.

41 Nord Stream. Espoo Report: Key Issue Paper. Munitions: Conventional and Chemical.
42 Derry, *A History of Scandinavia*.
43 Jones, *Land-Tenure and Landscape Change in Fishing Communities on the Outer Coast of Central Norway, C. 1880 to the Present*.
44 See 1.6 OCEAN PLANNING

[4] Dutch whalers near Spitzbergen, Abraham Storck, 1690

Russian deep-sea fishing history also began in the Barents Sea when the Pomors came from Novgorod to the Kola Penninsula in the 11th century.[45] They established a trading network with people along coast of northern Norway from Arkangelsk to Tromsø, which peaked from 1740 to 1917 when it was terminated by the Russian Revolution.[46] English merchants were active in the Barents area from the 16th century, and in addition to Norwegian and Russian whaling expeditions, the Svalbard waters had been discovered as rich whaling grounds by English, Dutch, Danish and French whalers in the early 17th century [4]. At the end of the 1800s, coal deposits had been discovered on Svalbard and mining began by Norwegian, Russian, British and American companies. Longyearbyen, the largest settlement of just over 2000 inhabitants, was founded by the Norwegian coal-mining company Store Norsk as a mining town and it is only recently that the economy has diversified into research and tourism. Mining was also the basis for the establishment of Kiruna in Sweden in 1900, of Nikel, Zapolyarny and Monchegorsk on the Kola Peninsula during the Soviet era and of Kirkenes with the opening of the iron-ore mine in 1906.

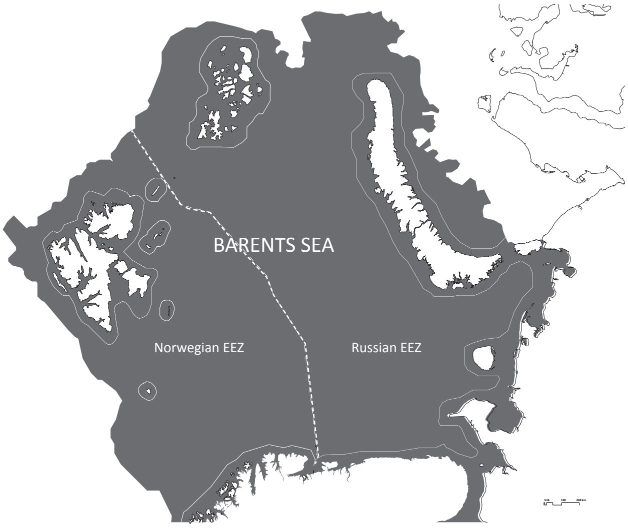
Before the discovery of oil in the late 1960s[47] fishing was the primary earner for the Norwegian economy. In 2012, seafood products were still the second most important Norwegian export item, amounting to 6% after oil and gas which amounted to 70% of exports.[48] The oil economy has placed Norway consistently high on World Bank rankings of income per capita, where it was placed 4th in 2012.[49] However, a large regional disparity exists between Russia and Norway; despite Russia being the second world exporter of oil behind Saudi Arabia in 2012,[50] the 2013 GDP (gross domestic product) per capita in Russia was ranked at 77th place, compared to Norway in 9th position.[51] In Norway, the sea continues to provide the resources which sustain the nation's wealth.

3.2.2 BALTIC SEA

The Baltic coastline is densely populated compared to the Barents Sea, with 85 million living in the watershed area. The sea's form and shoreline are diverse, but the coastal zones play an important role since the 8000 km coastline is relatively large compared to the entire area of the sea. These littoral zones are where intensive water and material exchange takes place between sea and land. Baltic history demonstrates extensive use of this exchange zone through fluid of trade interactions, which was ultimately transformed into the region's cultural richness. However, in this thesis, attention is focused on the offshore areas beyond territorial waters.

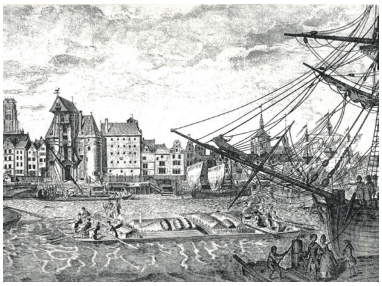
Already in the Stone Age ships were used in the Baltic Sea and their depictions from the Northern Bronze Age demonstrate their importance for warfare, trade and fishing during this period.[52] During the height

45 Pomors means "seasiders" in Russian.
46 Røyseland and Oystein, *Northern Experiments. The Barents Urban Survey 2009*.
47 In 1969 a major offshore oil discovery in commercial quantities was made in the Norwegian Sea after the drilling of 200 exploratory wells throughout the 1960s. This discovery was developed into the Ekofisk field and six further fields nearby (source: Off shore Pioneers. 1997. Pratt et all).
48 FAO, *Fishery & Aquaculture Country Profiles: The Kingdom of Norway*.
49 Greenfield, *The World's Richest Countries*.
50 IEA, *Key World Energy Statistics*.
51 CIA, *The World Factbook 2013 – 14*.
52 Ulla Ehrensvärd, Pellervo Kokkonen, and Juha Nurminen, *Die Ostsee*.

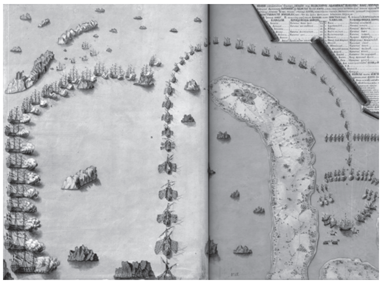


[7] Barents Sea boundaries.

[8] Barents Sea bathymetry.



[5] Danzig port at the height of its importance in the C18th – goods averaging 200,000 tons/year were handled here.



[6] Depiction of a sea battle between Russian & Swedish fleets in 1714. Sweden is shown blocking the Gulf of Finland near Hanko, while Russian vessels manage a manoeuvre of evasion.

of the Viking period from ca. 800 – 1100, Viking trade-routes originating in Scandinavia penetrated as far as Constantinople in the south-east and via the Volga River to the Caspian Sea and Persia to the Far East.[53] The highly successful trading networks of the Hanseatic League – a business confederation of 200 ports and inland cities throughout the Baltic united as free trading cities in the interests of commerce between the 13th and 16th centuries – exemplify the persistence of these flows, in particular before the rise of nation states [5]. The aim of the League was to protect the interests of commerce and keep trade moving – they were not interested in politics and did not employ warships – instead they commissioned armed private ships, called peace ships to protect convoys if necessary. Disputes were generally resolved through embargoes or port closure.[54]

After the fall of the Hanseatic League in 1534, a split in the development of urban centres on the Baltic became evident; southern Baltic countries such as Poland, Germany, and Lithuania were oriented inland and developed their capitals in the river cities of Berlin, Warsaw and Vilnius, whereas the northern Baltic cities directly on the coast developed into metropolitan centres- Copenhagen, Stockholm, Tallinn and later Helsinki and St Petersburg, founded in 1651 and 1703 respectively.[55]

Allegiances, collaborations and lines of military force frequently crossed the Baltic, creating oscillating political territories such as the Kingdom of Denmark which included Schleswig and Holstein in Northern Germany (1460 – 1866), the period of Swedish rule over Finland (late 1100s – 1809) [6] and the incorporation of Estonia/Latvia/Lithuania and Poland into the USSR after the Second World War. Many Baltic countries are in the process of regaining their national identities and economies since the fall of the Iron Curtain and reinforcing traditional ties across the Baltic to the established democracies and post-industrial societies of Finland, Sweden, Germany and Denmark. The sea is the common territory which accommodates and reinforces this development.

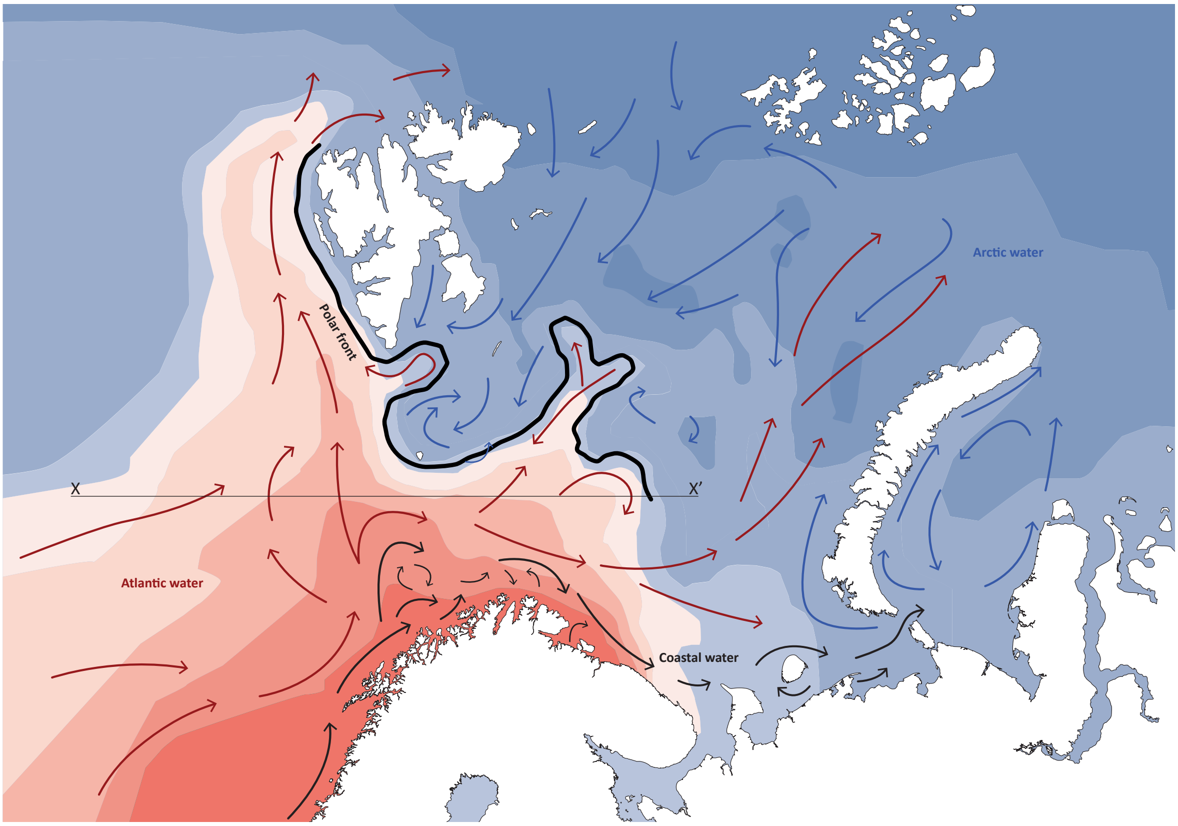
3.3 BARENTS SEA: SPATIAL CHARACTERISTICS

3.3.1 OCEANOGRAPHY

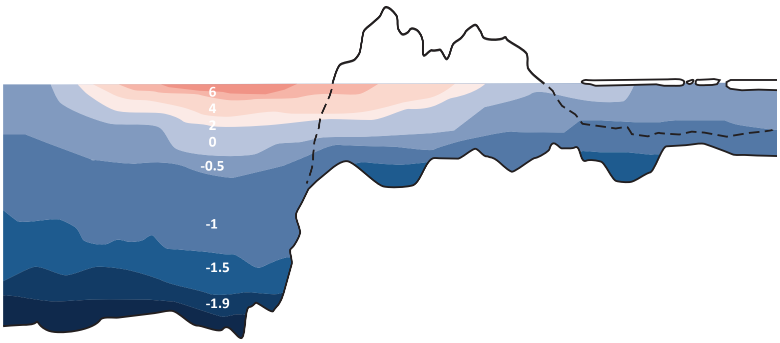
The Barents Sea is geographically located to the north of Norway, between northern coasts of Russia and Norway (ca. 70°N) to Svalbard and Franz Joseph Land in the north (80°N) and Novaya Zemlya (R) to the East. It has an area of 1,405,000 km2, equal to almost four times the size of Norway, The Barents Sea Treaty (2010) saw the division of the previously disputed oceanic border zone into roughly equal parts between the Russian and Norwegian Exclusive Economic Zones [7].

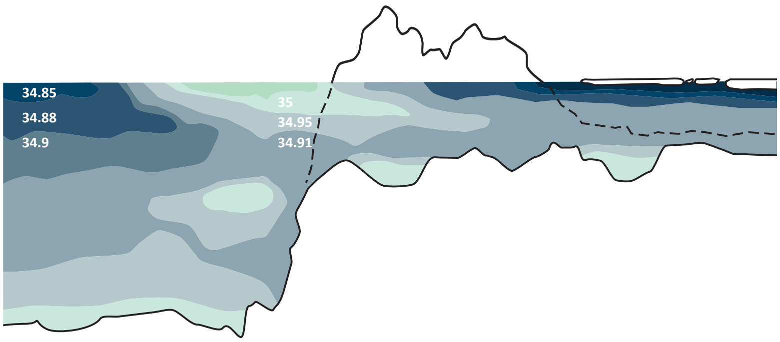
With an average depth of 230m, it is a relatively shallow shelf and its western boundary is defined by the edge of the continental shelf to the Norwegian Sea where a marked change in depth occurs [8]. The Norwegian Sea is part of the North Atlantic Ocean and has an average depth of 2000 metres. The northern boundary is also determined by a drop in depth to the Arctic Ocean, which has an average depth of just over 1000 m. The maximum depth of ca. 500 m occurs on the western side of Bear Island Trench. Sev-

53 Ibid.
54 Palmer, *Northern Shores*.
55 Görmar and Leupolt, *Übersicht Zu Raumstrukturellen Entwicklungen in Der Ostseeregion Aus Historischer Perspektive (ergänzende Information)*.

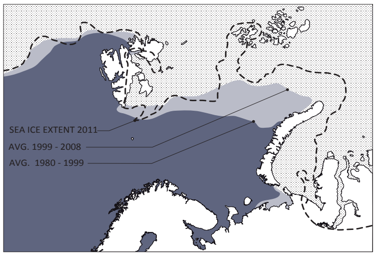


[9] Barents Sea currents and water-masses.





[10] Barents Sea temperature (above) and salinity sections at western edge, Section XX'



[11] Sea-ice extent, Barents Sea in June 1980 – 2011.

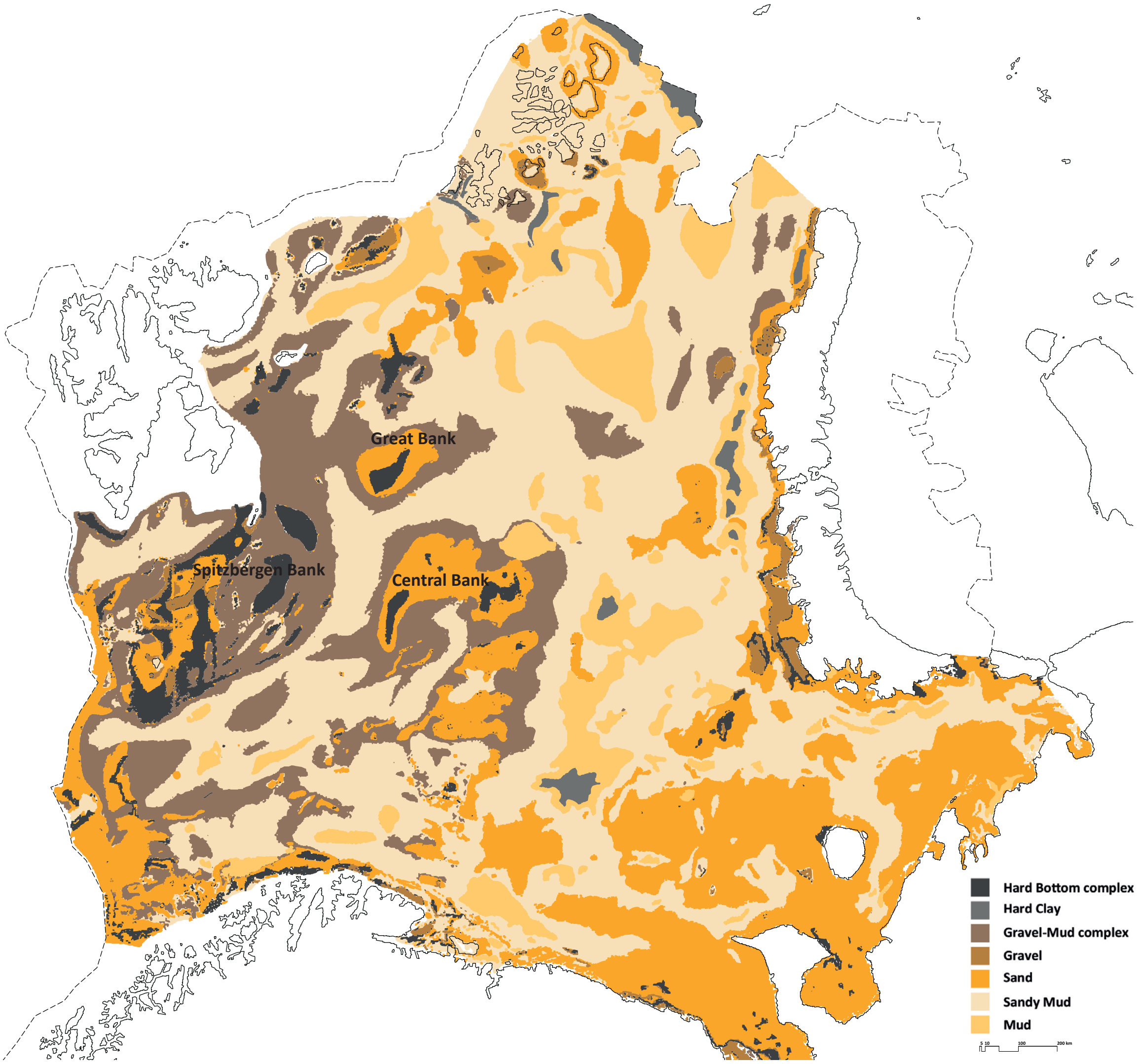
eral shallower banks occur in the Barents Sea; the Spitzbergen Bank between Bear Island and Hopen with most depths less than 50 m, the Great Bank and the Central Bank, both with depths of less than 200 m. The slope of the Spitzbergen bank, located on the oceanic polar front, is the site of complex, local eddies and strong mixing between the different water masses.

The Barents Sea marks the meeting point of the North Atlantic Ocean and the Arctic Ocean, which both have very different water compositions. The dynamics between these two neighbouring seas determine many of the Barents Sea's internal spatial characteristics. Warm (3,5 – 6,5°C), salty (above 35%) Atlantic water is carried northwards with the North Atlantic currents, meeting the cold Arctic water (below 0°C) which is carried southwards. The particular location of the meeting of these waters is the Polar Front zone – a meandering convergence system across the Barents Sea [9]. In addition, coastal water with a lower salinity (< 34,7) is formed and transported with coastal currents along the Norwegian and Russian coasts. These water masses are seasonally stratified, for example the heavier Atlantic water entering the Barents from the south-west is submerged below the lighter Arctic water [10]. In winter the Arctic water occupies the uppermost 150 m of the water column, but during the summer this is topped by 5 – 20 m of ice-melt water with a lower salinity (31 – 34%) and a temperature above zero due to atmospheric heating. In autumn & winter a vertical mixing of the water masses occurs, bringing deep sea nutrients to the surface layers. At the ice-edge, this nutrient-rich layer is exposed to sunlight as the ice retreats, causing a spring Phytoplankton bloom, which in turns supports zooplankton growth and the arrival of migrations of plankton-eating fish such as capelin [13].

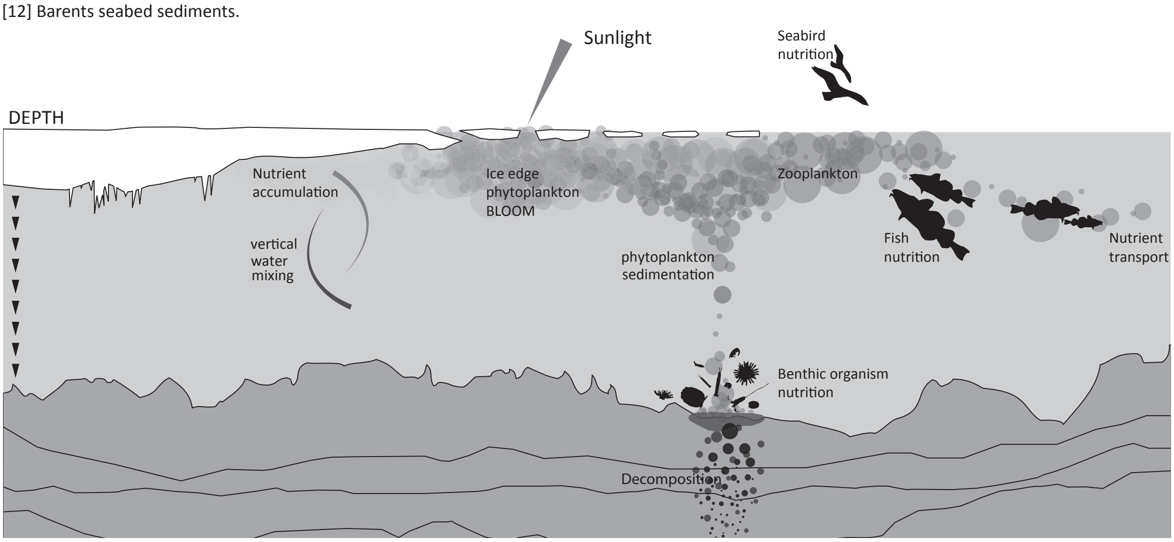
The ice edge is the limit of the Arctic ice at this location. When the sea ice begins to form as the water freezes in late autumn, the ice-edge moves rapidly southwards, usually reaching its maximum extent in late December or early January. When the air temperature is above the freezing point of the ice – usually around May – melting begins and the ice edge moves slowly northwards. This movement accelerates through the summer, reaching its peak in late July and August. The average winter ice extent from 1980 – 2010 covered between 60 – 70% of the Barents Sea. The southern part of the Barents Sea remains ice-free all year-round due to the warm Atlantic drift, but the marginal ice zone has been retreating further north in both winter and summer over the last 25 years. The sea ice extent in June 2011 is compared with two 19-year averages beginning in 1980 [11]. Thin, first-year ice also now makes up a much larger proportion of the Arctic sea ice. Some models predict an ice-free Arctic Ocean in summer in less than 30 years- much faster than earlier predictions.[56] This effect of global warming has direct repercussions for the exploitation of the region. Due to the reduction in permanent ice-cover, which is defined as ice more than one-year old, nuclear-powered Russian ice-breakers can easily cut through the thin, young ice along the northern Russian coastline, and so offer an escort service through the Northern Sea Route for commercial vessels.

The annual spring phytoplankton bloom in the Barents Sea also provides nutrition for benthic organisms inhabiting the sea bottom, through the process of downward export (sinking) and sedimentation at the sea

56 Royal Norwegian Ministry of the Environment, *Meld. St. 10. Report to the Storting (white paper) First Update of the Integrated Management Plan for the Marine Environment of the Barents Sea-Lofoten Area*.



[12] Barents seabed sediments.



[13] Ice-edge primary production.

floor. Here micro-organisms slowly degrade the particles and it is this process that enables the oceans to absorb large quantities of carbon, originally sequestered by photosynthesis in the upper ocean layers. Benthic organisms are an important food source for some fish species such as haddock and Greenland halibut, seabirds and marine mammals.

The sediment composition of the Barents seafloor is determined by depth and local current patterns, therefore in shallow areas with a strong current, such as the Spitzbergen Bank, little sedimentation occurs and the sea bottom has a high content of stones and gravel [12]. Below 200 m depth, mud dominates the seabed, whereas at depths above -200 m, the sediments consist of sand and sandy mud. In the central and northern Barents Sea, the border between Atlantic Water and Arctic Water is situated at this 200 m depth. The rocky shores of northern Norway and Svalbard consist of exclusively hard-bottom sea-bed (shown white [12]), which is unusual for Europe and which provide a high number of important habitats for a variety of species. The Barents seafloor is further characterised by diverse benthic flora and fauna, including kelp forests, sponge communities and rare cold-water corals. These have been recognised as priority areas by the Ministry for the Environment.

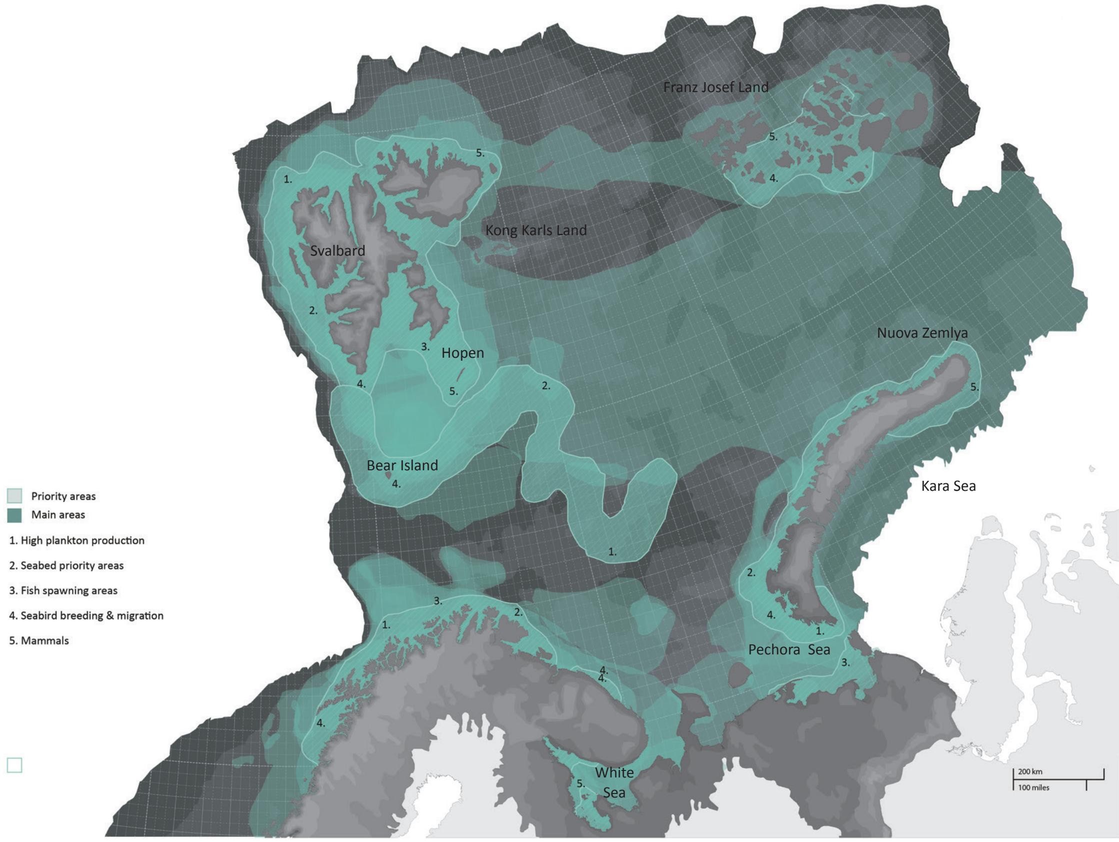
3.3.2 LIFE-FORMS

The high levels of primary production in the Barents Sea support large populations of fish, birds and marine mammals. The two main commercial fish species are capelin and cod, and the stocks of these species in the Barents Sea are likely to be the largest in the world.[57] The capelin and polar cod are true arctic species and spend their whole lives in the Barents Sea, spawning on the north Norwegian and Russian coasts. Capelin winter along the polar front, and move northwards to their main feeding grounds in the central and northern Barents Sea in the summer. Other species, such as (Northeast Arctic) cod, haddock, saithe, herring, Greenland halibut and redfish are boreal species which occupy the Atlantic parts of the Barents Sea, and spawn along the Norwegian coast south of 69°N.

The Northeast Arctic cod lives mainly in the southern part of the Barents Sea, around Bear Island and Svalbard and begins migrating to the spawning areas on the north-western Norwegian coast around January. Immature cod migrate to the northern coast to feed off spawning capelin. From the cod spawning areas, the fry are transported by the Atlantic currents into the Barents Sea. Larger cod feed mainly on capelin and herring, and in winter the cod and capelin overlap over large areas of the Barents Sea.

These large fish stocks, the quantity of zooplankton and communities of ice-plankton in turn attract large populations of both migrating and permanent resident birds. It is currently estimated that around 20 million individuals are present in the summer in the Barents region, the most numerous being the kittiwake, Brünnich's guillemot, little auk and the puffin.[58] In winter and spring, most seabirds forage close to the highly productive ice-edge zone, which also attracts migrating birds in spring and summer. Important breeding colonies in the Barents Sea are found on Bear Island, Hopen, SE Svalbard, north and north-west Norway, Novaya Zemlya, Franz Joseph Land and the Murman coast.

57 Sakshaug, Johnsen, and Kovacs, *Ecosystem Barents Sea*.
58 *The Barents Sea Ecoregion*.



[14] Priority areas, Barents Sea.

Twelve whale and five dolphin species have been recorded in the Barents Sea, but these are mostly long-distance migrants and only three species- the white whale (beluga), narwhal and bowhead whale are permanent high Arctic residents. Whale-hunting during the "golden age" has depleted all stocks except the minke whale, which was considered too small. Before hunting, the bowhead whale for example was estimated to number almost 25,000 around Svalbard, which is equal to half of the world population. Currently the population has been reduced to between 50 and 100 scattered individuals near the ice-edge.[59] The white whale breeds in the White Sea, southern Svalbard, Franz Joseph Land and the eastern Kara Sea and its distribution follows a large zone connecting these areas. The minke whale is attracted to herring, capelin, krill and cod, which brings it to the Barents Sea in summer in numbers between 40,000 – 85,000.[60] Seven species of walrus and seal (pinnipeds) are found in the Barents Sea. The walrus was also hunted almost to extinction, but now an estimated 2500 individuals live there. Most species can be found in the Pechora Sea, the western coast of Novaya Zemlya, the Svalbard Bank, Svalbard Coast, Central Barents Sea and the Kara Sea. Both shores and pack-ice are used as haul-out sites. The ringed seal – with an estimated population of around 2,5 million – and the harbour seal are also found in the White Sea. These two seals, plus the bearded seal and the grey seal, are still legally hunted by licensed sportsmen in some areas.

The mammal at the head of the food-chain, the polar bear, spends most of his time on the sea ice and his main prey is the ringed seal. An estimated 3 – 5000 polar bears live in the Barents ecoregion according to WWF.[61] Their dens are located on Svalbard, Franz-Joseph Land, Hopen, Kong Karl's Land and Novaya Zemlya. The polar bear is distributed between these sites through the ice-cover, which is particularly important in linking dens to spring feeding areas.

The Barents Sea produces and supports life-forms in vast quantities. The ecosystem is a complex interplay of mid-ocean sites of productivity such as the polar front and the marginal ice edge, the hard-bottomed coastal areas which provide a wide variety of habitats, and shallower banks. The most important areas for the five categories: plankton production, seabed, fish spawning areas, seabird breeding and migration areas and mammal habitats are summarized as priority areas[14]. The physical oceanography and the life-forms are the primary characteristics of this ocean territory. Through mapping these traits, an alternative understanding of the ocean can be constructed as not solely as a surface, but in its third and fourth dimensions of depth and seasonal transformation. The Barents Sea is highly productive, densely populated and inherently spatial due to the topography, the dynamics of water masses and the advancing and receding ice-front.

3.3.3 URBANIZATION

This study takes the physical oceanography as the primary generator of ocean territory and its (un)bounded limits. We have seen that ocean territory is intersected by political borders. When the ocean touches shore, a further border zone emerges marked by material transition, called the lit-

59 *Conservation Value Assessment and Distribution of Selected Marine Mammals in the Northern Barents Sea.*
60 *The Barents Sea Ecoregion*.
61 Ibid.

toral zone. A fully oceanic perspective gives us the opportunity to reverse the view and treat littoral zones as a type of peripheral condition, where an exchange takes place between the systems of land and sea. Although the littoral zone is not the fous of this thesis, urbanization of the sea issues from this exchange. It is expressed through the immaterial but rigid frameworks of fishing grounds, administrative boundaries and exploration licenses and materialized through infrastructure such as ports, shipping lanes and exploration rigs. These forms of urbanization exert spatial claims on the sea and create a fractured zone of overlapping interests along the southern Barents shore.

BORDERS

The Barents Sea straddles the national borders of Norway and Russia. Despite the marked historical, cultural and political differences between these two nations, the Barents Sea, the climatic region, local traditions and indigenous groups are common to both. According to political scientist Geir Hønneland, in practice Russian and Norwegian Barents Sea fishing fleets co-operated across the border in a hands-on manner, exchanging quotas within the total shared space where their shared resource was to be found. Hønneland argues that examples of successful management systems for shared resources mostly have a “local, traditional, unintended and spontaneously developed character.”[62] On land, the Russian/Norwegian border has generated exchange dynamics which have turned the ex-iron curtain into a horizontal zone in its own right. Hønneland describes borders as acting “increasingly as transition zones enabling the flow of cultural, political and economic influences in both directions.”[63] The introduction in 2012 of a visa-free zone for a distance of 30 km from each of the Russian and Norwegian borders illustrates this tendency. Residents within this area are able to freely cross the border to work, shop, sell and for entertainment. Cross-border interaction here at the edge of Europe is already more important than the limit the Schengen-zone once represented.

However recent political events have led to the build-up of military on both sides of the border. On 15th March this year, the Barents Observer reported that aircraft and paratroopers of the Russian Northern Fleet have been relocated to the Arctic in order to carry out military exercises. According to Russian Defence Minister Sergei Shoigu, 38,000 soldiers, 3,360 vehicles, 41 naval vessels, 15 submarines and 110 aircrafts are involved in the “inspection”. The Norwegians in collaboration with their Scandanvian neighbours Finland and Sweden, have organized a similar event, the “Arctic Challenge Exercise 2015”, predominantly a fighter-jet exercise involving 4000 people, 100 jets and nine nations which took place between 25th May and 5th June this year.

In 1993 the Barents Euro-Arctic region was born, an idea of the Norwegian Prime Minister at the time, Thorvald Stoltenberg. Journalist and historian Morten Strøksnes writes of this construct; “Barents was invented by politicians to mark the end of the cold war and the beginning of something new. Nobody knew much of what this new would be...”[64] While Strøksnes is sceptical about the chances of building up a truly cultural iden-

62 Hønneland, *Making Fishery Agreements Work*.
63 Hønneland, *Borderland Russians*.
64 Strøksnes, *The Inner Space of Barents*. p 58

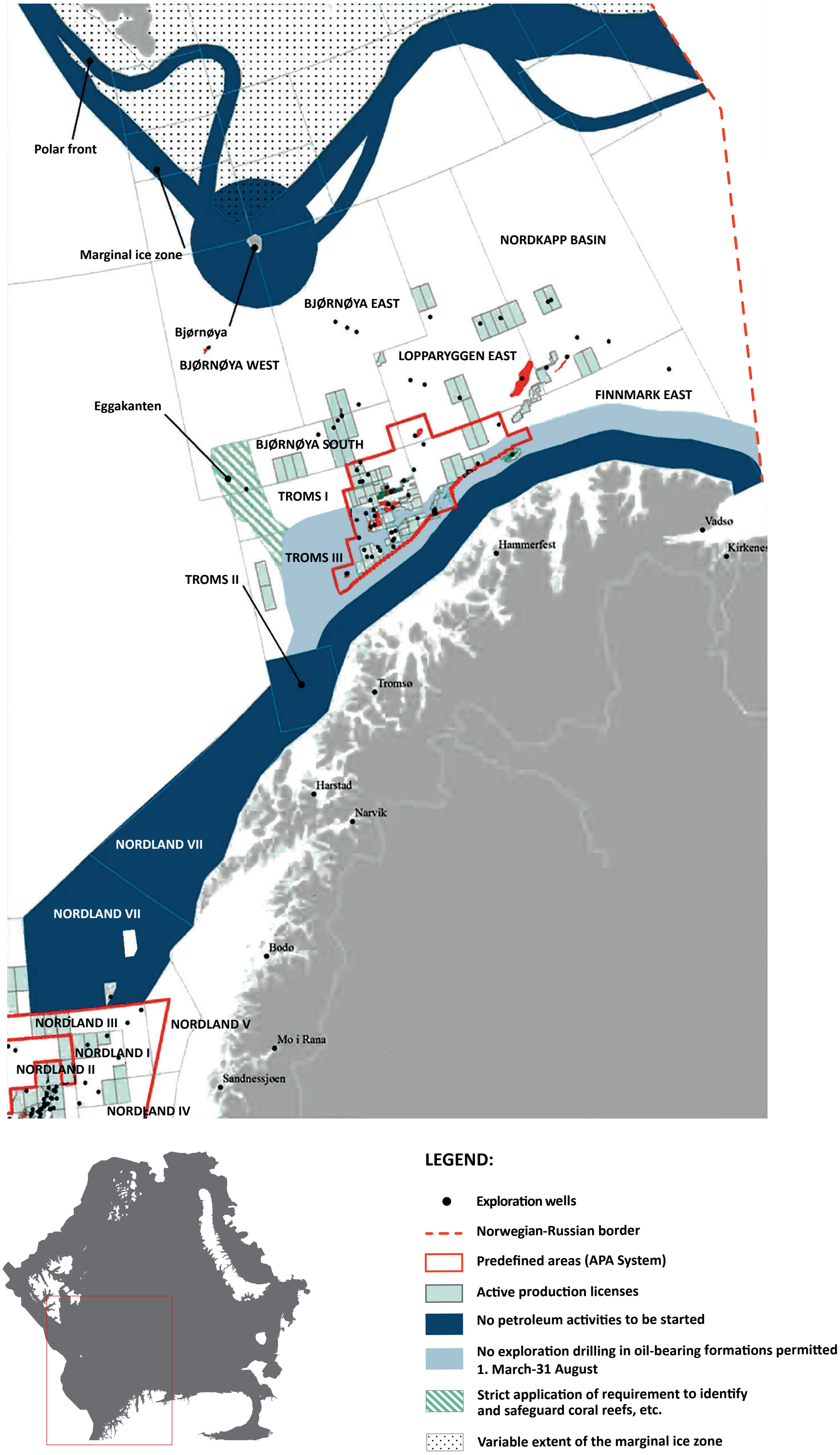
tity through this initiative, he confirms its raison d'être as a geopolitical frontier for natural resources – "an object for penetration and exploitation."[65] This is reinforced, he argues, by the political and cultural energy flows which in both Russia and Norway are centralised towards Oslo and Moscow.

In his foreword to "Barents Lessons", Harry Gugger comments on Statoil's description of the Barents region as the "northern provinces." Provinces, he claims, "belong to someone and are there to be exploited."[66] The term province also implies a relationship to a centre of power. Within this context, the peripheral zone is doubled; it becomes at once the littoral zone peripheral to the Barents Sea territory, but also peripheral to the centralized land-based perspective. In addition, a further critical dimension is the role of the Barents Sea as a bridge to the Arctic region – a region rumoured to be rich in resources and where the borders are still fluid – hence a region to be claimed. The Arctic-rim nations are in fact vigorously pursuing this end in the name of the Arctic resource race.[67]

These examples of imagined and constructed political borders and spheres of centrality are paralleled by an environmental space called the "Barents Sea Ecoregion", defined by the WWF in 1999 as one of the Global 200 Ecoregions with representative biodiversity values for a major type of marine habitat. The WWF sees these ecosystems as being endangered by the impacts of industrial development such as habitat loss, increasing infrastructure and global warming. An ecoregion is a "regional conservation unit whose boundaries roughly coincide with the area over which key ecological processes most strongly interact."[68] Both the Barents Euro-Arctic region and this ecological unit are not reinforced by law, but the WWF sees the Ecoregion as a first step towards establishing a network of protected areas within it. Currently parts of Svalbard, Hopen and Bear Island are a designated nature reserve and Franz Joseph Land has been a sanctuary since 1994. At the declaration of the Russian Arctic National Park in 2012, the northern part of Novaya Zemlya and surrounding waters were incorporated along with Franz Joseph Land [18].

The Norwegian Ministry for the Environment initiated a management plan for the Norwegian part of the Barents Sea and the areas off the Lofoten islands in 2006, which was updated in 2011.[69] This was the first management plan for ocean areas within Norway's EEZ. The objective of the plan was to "provide a framework for the sustainable use of natural resources and goods derived from the Barents Sea-Lofoten area and at the same time maintain the structure, functioning, productivity and diversity of the area's ecosystems."[70] Essentially the plan promotes petroleum activities, arguing that they create value and are an important economic factor for the North of Norway. Therefore the plan is structured around methods and recommendations for the extraction of fossil fuels which involve least risk to the environment. Specific topics include the definition of areas where knowledge is

65 Ibid.
66 Gugger, Couling, and Blanchard, *Barents Lessons. Teaching and Research in Architecture*.
67 Increased interest in potential Arctic resources and in defending strategic positions has led to increased military activity and territorialvclaims from the countries bordering the Arctic Ocean; Denmark (Greenland),Canada, USA, Russia. A left-over area around the size ofvSwitzerland – 48,147 m2 – remains unclaimed. *Barents Lessons*. p 44
68 *The Barents Sea Ecoregion*. p 16.
69 Royal Norwegian Ministry of the Environment, *Meld. St. 10. Report to the Storting (white paper) First Update of the Integrated Management Plan for the Marine Environment of the Barents Sea - Lofoten Area*. See 4.2 MARINE SPAIAL PLANNING IN THE BARENTS SEA
70 Ibid.



[15] Framework for petroleum activities in the Barents Sea-Lofoten area.

lacking and further research should be undertaken and assessing preparedness for acute pollution.[71] The management plan should serve as a base for further legislation, which is governed by different Acts of Norwegian government (Nature Diversity, Marine Resources, Petroleum and Marine Energy). Together with the Norwegian Petroleum Directorate, the Ministry for the Environment define the management framework for dedicated petroleum exploration areas.

FOSSIL FUEL

Petroleum exploration activities began in the Barents Sea in 1980, and up to 2011, 85 exploration and appraisal wells had been drilled in Norwegian waters. To date only one gas-field, Snøhvit is on stream[72] and one oilfield, Prirazlomnoye in the Pechora Sea is currently producing. Norwegian-based Statoil estimates that the Goliat[73] oilfield will not begin field production until autumn 2015. Development plans for the giant Russian Shtockman gas-field, located 550 km from the mainland, have been placed on hold. This field is planned to operate with a floating production unit, with gas being exported through sub-sea pipelines. Norwegian licensing blocks are located within a predefined area, the extent of which has almost doubled since 2006. According to the update of the Barents Sea-Lofoten management plan, the establishment of such special predefined areas has the advantages of concentrating exploration where geological knowledge is greatest, where technical challenges are minimalized, and where well-developed infrastructure is in place.[74] The extent of this predefined area (ARA) is shown at left [15] and its position relative to the environmentally vulnerable areas defined under the management scheme; the polar front, the marginal ice zone and coastal waters important for spawning fish. A structural grid of blocks measuring 25 × 50 km and extending directly from the coastline as far as Bear Island, is utilized to locate and award exploration licenses in Norway.

The Russian Ministry of Natural Resources and Ecology who are responsible for the issuing of oil and gas exploration licenses in Russia, have also defined large blocks around the Pechora Sea, off the coastline of Novaya Zemlya and in the open sea where the Shtockman field is located.

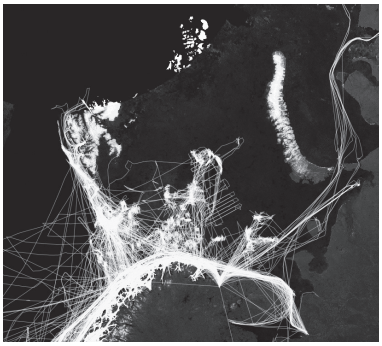
The effects of these boundaries differ in intensity and radius of influence. Compared to the maps in the previous section describing the oceanography of the Barents Sea, it is clear that the new structural layers are prescribed by surface geometry, determined solely by coordinates of latitude and longitude. This grid represents an abstract system of colonization potential rather than physical occupation, however it provides a foundation for the increasing exploration activity.

71 The importance of this topic is seen in relation to the BP Deepwater Horizon spill in the Gulf of Mexico in 2010.

72 The Snøhvit development comprises the Snøhvit and Albatross gas-fields which have been on stream since 2007 and are located ca. 140 km north-west of Hammerfest. Production installations are located on the sea-floor and gas is transported through a pipeline to the liquefaction plant on Melkøa Island near Hammerfest. The system includes a carbon capture and storage facility which re-injects carbon dioxide back into the seabed.

73 The Goliat oilfield is located ca 50 km southeast of Snøhvit. Facilities comprise of templates fixed to the seabed and a fixed, floating production facility. The project is currently running 12 months late and will cost an estimated NOK 45 billion instead of the estimated 30,9 billion.

74 Royal Norwegian Ministry of the Environment, *Meld. St. 10. Report to the Storting (white paper) First Update of the Integrated Management Plan for the Marine Environment of the Barents Sea-Lofoten Area*.



[16] Shipping activity, (all vessels) May 2012.

SHIPPING

Shipping is a form of urbanization with a long tradition, closely linked to historical settlement patterns. The northern Norwegian coastline is characterized by many small harbours which serve the local fishing community. Here 40% of the population live in towns of 2,500 inhabitants or less and 90% live within 4 km of salt water. Although the population is scattered, settlement marks the coast visually with regular frequency, which has been described as "a seemingly uninterrupted scatter of human settlement."[38]
The pattern of coastal movement for non-industrial scaled vessels takes place on the inner side of the coastal islands, protected from the open sea. This is also the route followed by the well-known postal and tourist ferry the Hurtigruten, which runs up and down the Norwegian coast as far as Kirkenes almost on a daily basis year-round, providing multiple services for the small fishing villages. The Hurtigruten is a tourist favourite and is also well-booked throughout the winter season. Passengers are offered a range of activities and tours to inland sites of interest during the port stops, for example from Honningsvåg to the North Cape, mainland Europe's northernmost point at 71° north. But the main experience is the seascape itself. Hurtigruten promotes the coastal trip from Bergen to Kirkenes as "the world's most beautiful voyage."[39]

The second shipping route, which has been recommended by the IMO for heavy transport vessels, in particular oil tankers, follows the coastline at a distance of approx. 25 nautical miles offshore in order to protect the ecologically sensitive and valuable inner-coastal zones. This northern marine highway is testament to the role of the Barents Sea as a transit zone for goods and materials, in particular to and from Russian ports [16]. The northern deep-water ice-free ports have always been of high importance for both Russia and Norway, but in particular Russia intends to strengthen the transport of oil and gas products through the Barents Sea and has recently established two new oil terminals on the Barents coast at Kolguev Island (south of Novaya Zemyla) and Varandey in the Pechora Sea [8]. These ports are relatively close to the production fields in western Russia, therefore connecting these fields to the ports has become a strategic project for Russian energy concerns.[40] The Barents Sea is less congested than Russia's two alternative shipping options of the Black Sea and the Baltic Sea. In 2009, 15 million tons of Russian oil was delivered to western markets via the Barents Sea.[41] In comparison, in 2009 HELCOM report that 111 million tons of Russian oil was exported through the Baltic Sea.

Murmansk is the Russian gateway to the Northern Sea Route [17]. Since September 2010, this route across northern Russia to Asia is open to commercial transit shipments for approximately 2 – 4 months of the year, piloted by Russian ice-breakers.[42] Ships travelling the Northern Sea Route are also required to be constructed according to ice-class Arc4, which is still uncommon for bulk-transport vessels. One exception are the oil tankers

38 Mead, *The Scandinavian Northlands*.
39 www.hurtigruten.com
40 Bambulyak and Frantzen, *Oil Transport Form the Russian Part of the Barents Region*.
41 Ibid.
42 This depends on ice conditions. Navigation of the route can begin in July and last until mid-November. The route itself passes through the one-year ice zone, which is approx. 1,6 m thick. The use of a Russian pilot ice-breaker is a safety precaution and is required by the Russian authorities in order to use the route.

[17] Northern Sea Route from Europe to China across the Barents Sea and Northern Russia, and the Suez route.

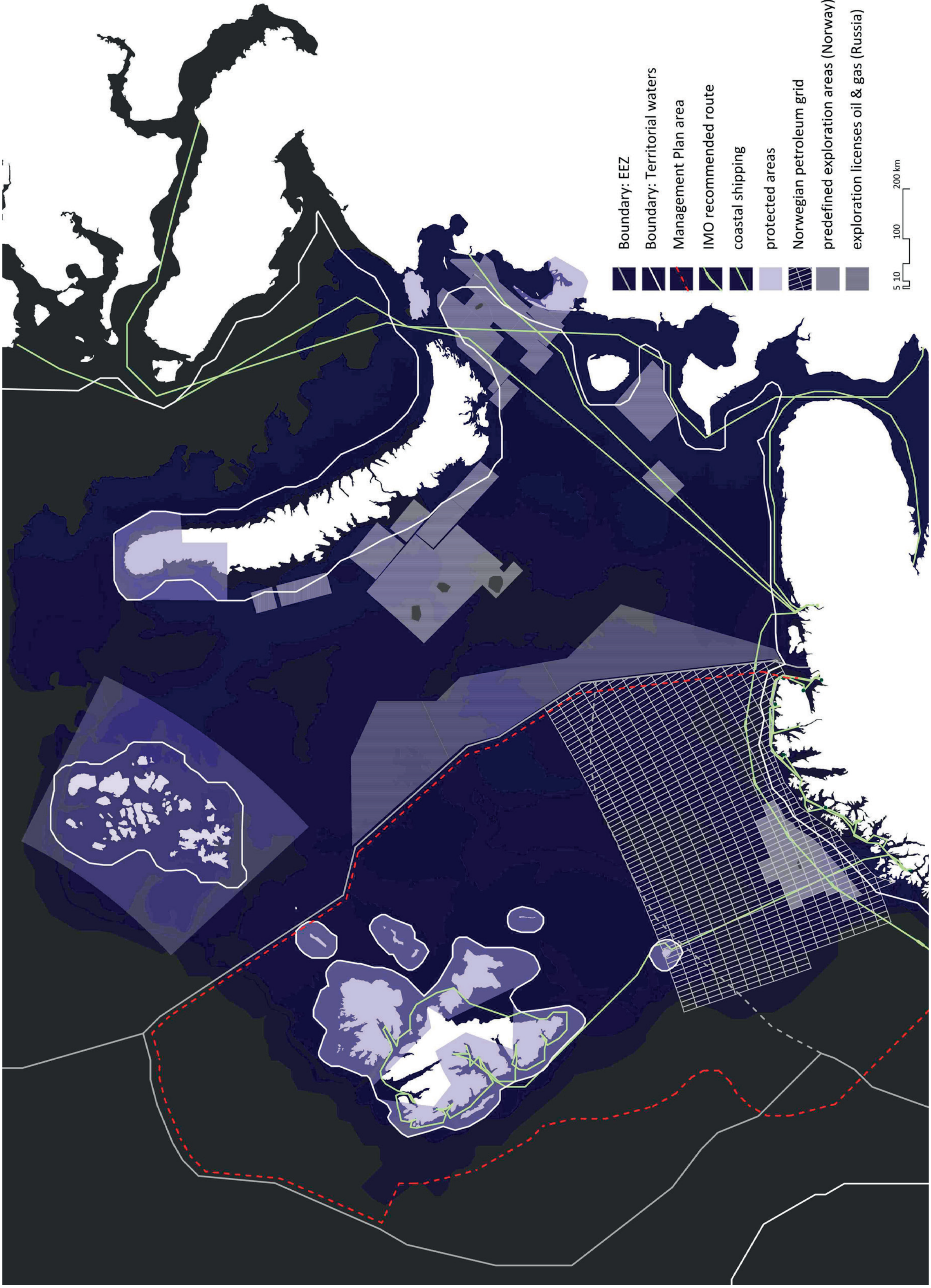
used in the Baltic Sea in winter, which according to one report could be then used along the Northern Sea Route in summer and autumn.[43] Although the first phases of this project were promising, with the number of transit passages increasing from 41 in 2011 to 71 in 2013, the number dropped to 31 in 2014.[44] Researchers report that, “optimism regarding the potential of Arctic routes as an alternative to the Suez Canal is overstated.”[45] Remoteness, lack of search and rescue facilities and more expensive shipping construction are quoted as among the route’s disadvantages, which outweigh the theoretical cost-saving effect.

FISHING

In terms of spatial occupation, it is the larger fishing vessels which, although fewer in number than the smaller coastal fishing vessels, cover a large dispersed area in the centre of the Barents Sea [16]. They also operate from diverse Norwegian ports. The small fishing ports of Øksfjord, Hammerfest, Nordkapp, Havøysund, Kjøllefjord, Mehamn, Berlevåg, Båtsfjord, Vardø, Vadsø and Kirkenes, located along the Finnmark coast, all receive fish directly from the Russian & Norwegian fishing fleet and are able to freeze and transport the fish through different coastal services including the Hurtigruten postal ferry, which stops daily and has significant freezer capacity.[46] On the Russian side, Murmansk is by far the most important fishing harbour by volume.[47] Services are centralised there, including vessel servicing, fuel loading and production storage.

Norway is one of the leading European fishing nations. Out of 18 nations with a catch more than one million tonnes of fish per year in 2011 and 2012, only 3 are located in geographic Europe: the Russian Confederation, Norway and Iceland.[48] In particular, the Barents Sea-Lofoten Islands, are highly productive - one of the richest fishing grounds in the world.[49] Within the area of the Barents Sea-Lofoten Management Plan, a catch of over 800,000 tonnes was recorded in 2009,[50] while the Total Allowable Catch [TAC] for the Barents Sea cod alone was around 600,000 tonnes in 2010, to be shared 50/50 between Norway and Russia.[51] Fishing and the associated industries are still responsible for a significant amount of employment in northern Norway, in some areas on the Barents Sea coast such as Finnmark, this figure is over 40% and includes not only fishing, but aquaculture and fish-processing.[52] Seasonal work in the fishing sector and the associated pac-

43 Balmasov, *Prospects of the Development of International Transit Shipping via the Northern Sea Route*.
44 Northern Sea Route Information Office, Transit statistics. http://www.arctic-lio.com/nsr_transits
45 Buixadé Farré et al., *Commercial Arctic Shipping through the Northeast Passage*.
46 Finnut Consult AS, *Description of Existing Transport Solutions for Seafood*.
47 In 2014, Murmansk port received around 220 thousand tonnes of fish products – 80% of its annual cargo turnover. http://eng.gov-murman.ru/about_region/fish_industry/ See also diagram cargo volumes per harbour, *Barents Lessons* p 35
48 FAO, *The State of World Fisheries and Aquaculture 2014*.
49 Hønneland, *Autonomy and Regionalisation in the Fisheries Management of Northwestern Russia*.
50 Royal Norwegian Ministry of the Environment, *Meld. St. 10. Report to the Storting (white paper)First Update of the Integrated Management Plan for the Marine Environment of the Barents Sea-Lofoten Area*.
51 Hønneland, *Norway and Russia: Bargaining Precautionary Fisheries Management in the Barents Sea*.
52 Royal Norwegian Ministry of the Environment, *Meld. St. 10. Report to the Storting (white paper)First Update of the Integrated Management Plan for the Marine Environment of the Barents Sea-Lofoten Area*.



[18] Urbanization in the Barents Sea through determined boundaries.

kaging and processing industries also accounts for traditional large-scale population migrations throughout the region.

Today fishing in Norway is a highly managed industry. Since the introduction of the Electronic Reporting System (ERS) in 2011, all vessels over 15 m in length operating in Norwegian waters are required to transmit catch and activity data to the fishing authorities. In addition, since 2010, Norwegian fishing vessels over 15 m in length are required to have a tracking device installed on board (Vessel Monitoring System – VMS) which automatically transmits a vessel's speed, position and course every hour. It is the transferral of this information that enables a spatial overview to be generated, and to make it possible to read the forming of the seascape through fishing activities.[90]

In the literature review,[91] I argue that fishing is comparable to agriculture in forming a seascape through the regular and seasonal engagement with the sea for capture fisheries. Fishermen harvest the sea and revisit sites they know to be rich in fish-stocks due to seasonal events staged by the natural environment. The migration of Barents Sea capelin as they return to their coastal breeding grounds is one example, attracting predatory cod en route:

> "It is largely this annual event that makes the coast of Finnmark one of the world's richest fishing grounds."[92]

Fishing is therefore an urbanizing activity which is closely linked to the ocean's inherent spatial and temporal properties.

3.3.4 CONCLUSION BARENTS SEA

Through the analysis, urbanization In the Barents Sea has emerged in two formats; firstly the loose, flexible mesh of activities oscillating with the extreme seasonal changes in the region and tied to the seascape resources, and secondly, the strategic geometries which harden into marine highways and technical sites of extraction. I argue that the interactions described above set up patterns of settlement and trade liaisons which have been mediated by the sea itself. This form of urbanization is not based on density, population numbers or centrality, rather on a double periphery and connections presiding over large, dispersed areas of small settlements. The resulting spatial system embraces diverse forms of movement and exchange: fishing, the seasonal transhumance of the indigenous Sami culture, seasonal population fluctuations and border crossings. These movements consolidate relationships and define the territorial dimensions. The Barents Sea is a region of extensiveness and remoteness, of negotiation, exchange and flux. Since the shores of the Barents Sea are not suitable for commercial agriculture, the specialised crop cultivation and surplus food production which has been a decisive factor in urban history and increasing settlement

90 See 2.2.5 SEASCAPE ONE
91 ibid
92 Hønneland, *Making Fishery Agreements Work*.

[19] Coal-mining infrastructure, Longyearbyen Svalbard

density, did not apply here.[93] Instead, the urban morphology of the Barents region describes its own singular relationship between settlement and territory, mediated through the agency of the sea. Urban systems operate in a loose, shifting mesh across land and sea – a strategy seemingly well suited to an environment of extremes.[94]

The second urban format is comprised of the strategic geometries. While exerting a powerful force on a map, I argue that these formats are still to be verified. They constitute a pre-urban phase of speculation, a phase the Barents region well understands from its history of "boom and bust" resource exploitation. This includes coal mining on Svalbard [19], iron-ore mining at Kiruna (Sweden) and Kirkenes and nickel-mining in Nikel (Russia). The establishment of offshore exploration grids, rigs and pipelines is therefore an extension of this type of preliminary infrastructure as it developed on land. Since the cycles of these industries are out of tune with natural cycles, the offshore Barents Sea environment holds them in check due to the difficulty and expense of deep, rough and cold waters. The double periphery is always in a state of becoming, a receptor for visions of extended urbanization. In the Barents Sea, the resistance to an urbanization of strategic geometries confirms a co-relation between urban activities and oceanography which is stronger than the co-relation of topography to the urban on land. On land, topography and forms of organic organization which adhere to it, have largely been overtaken by efficient geometrical patterns of primordial order.

> "Utopian thinking has a long tradition and a strong presence in Northern Norway. It has been important for surviving in a harsh landscape, and keeping dreams alive in a demographically dispersed region. […] On the one hand Northern Norway has always been a prosperous land, where big dreams can come true. On the other hand the region is a complex field of unrealized dreams and visions."[95]

To investigate these two formats more closely, typological situations are sought which stand out as being specific to the sea, and which reveal critical relationships and contradictions between Networks, Seacape, Ecology, and Technology. Seascape production is dependent on natural phenomena occurring at specific topographical locations, therefore both fishing and petroleum activities in the Barents Sea belong to this category.[96] These two situations reveal particular relationships between the four topics in the Barents Sea, but within each, a distinct spatial configuration is generated and will be investigated as a typology in the second part of this analysis:

93 The production of surplus through intensified agriculture has generally been agreed among researchers to be a prerequisite for the emergence of urban centres and complex societies such as those of Mesopotamia in the 5th century BC. "[…]urban morphogenesis has depended, from its ancient beginnings in the Fertile Crescent, on intensification of the consumption of non-human energy" de Landa, *A Thousand Years of Nonlinear History*. p 28. This energy was mostly in the form of cereal, but there is a debate about the important early urban civilization *Norte Chico* in Peru, which some scholars believe was based on maritime resources and coastal sites. Later discoveries on inland sites suggests an interdependency between coastal fishing sites and inland sites based on the production of cotton. Mann, *Oldest Civilization in the Americas Revealed*.

94 Gugger, Couling, and Blanchard, *Barents Lessons. Teaching and Research in Architecture*.

95 Røyseland and Oystein, *Northern Experiments. The Barents Urban Survey 2009*.

96 See 2.2 SEASCAPE

[20] Baltic Sea bathymetry and oceanic parts.

– Primary production at the marginal ice-edge is the central seasonal event which sustains zooplankton, fish, seabirds and benthic organisims and is therefore critical for the fishing industry and the food-chain as a whole. This is a culminating spatial and temporal node of density. As a natural phenomenon, it is regular, but organic in appearance and can shift in location and composition from year to year. These characteristics are shared with the first urban format in the Barents Sea, and therefore a closer analysis should lead to an understanding of urbanization processes led by inherent ocean spatial dynamics.

– The petroleum grid overlays a technical seabed probed by scans. The intersection of environmental and geological knowledge provided by this technology leads to the extrusion of a terrain of fossil fuel production directly adjacent to environmentally sensitive areas.

3.4 BALTIC SEA : SPATIAL CHARACTERISTICS

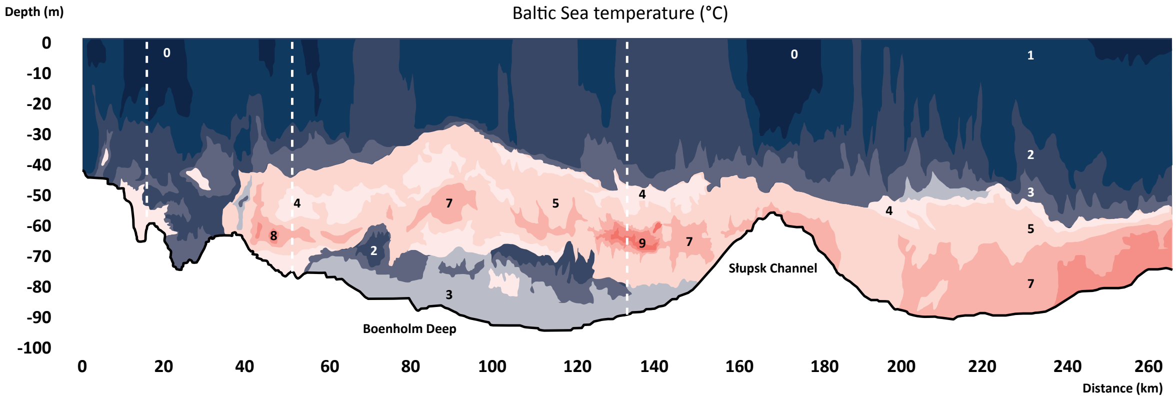
3.4.1 OCEANOGRAPHY

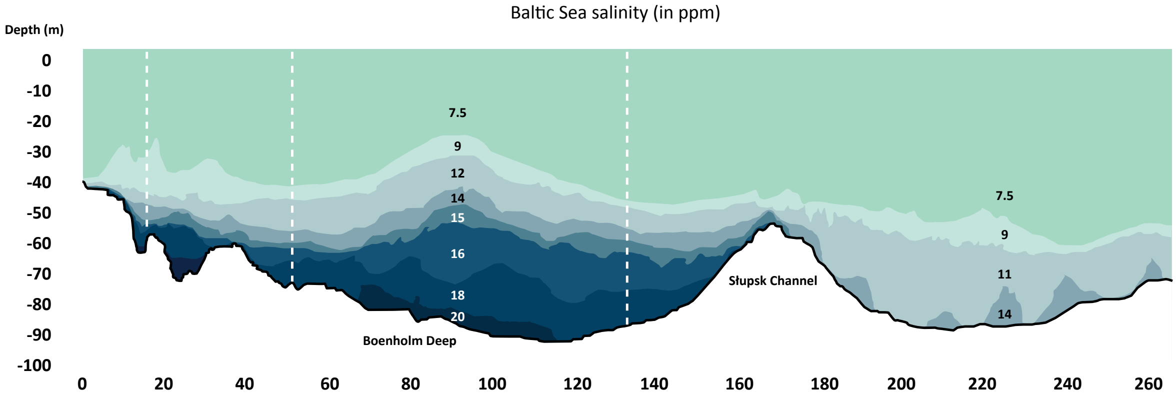
The Baltic Sea covers an area of 393,000 km^2, slightly larger than Norway but less than one third of the Barents Sea. It is geographically located between the Danish Straits in the west, St Petersburg in the east, Haparanda(S) and Tornio (F) in the north. At 65°N, this is just short of the Arctic circle. The coastlines of Germany, Poland, Lithuania, Latvia, Russia (Kaliningrad) and Estonia make up the south-eastern boundary. It is classified as an "intra-continental sea of the Atlantic Ocean."[97] Also a shallow sea with average and maximum depths of 54 m and 459 m respectively, it is composed of a series of gulfs and sub-basins determined by coastal morphology, sills, underwater ridges andother topographical features, making up a total of 14 parts.[98] [20]

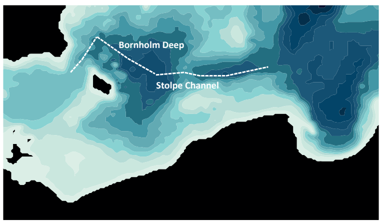
Water exchange occurs through the narrow connections to the North Sea – the Kattegat and the Danish Straits (Belt Sea and Oresund). Baltic waters have a positive freshwater balance, meaning the incoming freshwater from rivers in the drainage basin exceeds incoming salty water from the North Sea. The result is brackish water with a salinity of 7% – only one-fifth of normal ocean water. Salinity decreases with distance from the Kattegat, therefore the Bay of Bothnia and the Gulf of Finland have the lowest salinity. This gives rise to a unique mix of marine and freshwater species living side by side. In its present brackish state, the Baltic Sea is ecologically young, formed ca. 7,000 years ago from the older Baltic Ice Lake dated to 13 – 14,000 years ago. Its development into a sea means that species have had to adapt to many changes over this relatively short period of ecological time and that it is unstable. It is subject to land uplift and the surface area is therefore slowly shrinking at a rate of 2% every 2000 years.

Stratification of the water masses mostly due to salinity creates a permanent 2-layer structure at a depth of 40 – 80 m in the Baltic Sea [21]. Denser, salty water from the North Sea flows into the Baltic on the bottom layer, whereas lighter, less saline water flows out of the Baltic on the surface layer in volumes comparable to a large river (15,000m^3/s) [21]. The relative temperatures of the layers changes with the seasons; the temperature of the lower layer is less affected by wind and solar radiation and therefore

97 Leppäranta and Myrberg, *Physical Oceanography of the Baltic Sea*.
98 Including the Kattegat, the Baltic Sea has an area of 415,265m^2.

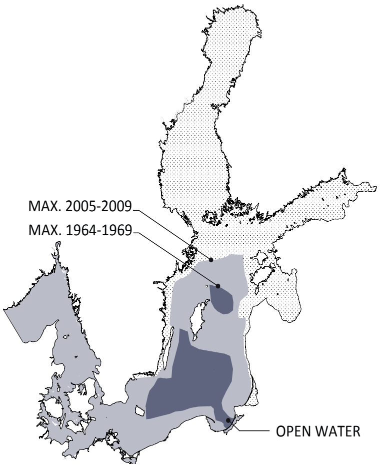






Location, temperature/salinity section

[21] Potential temperature (top) and salinity on February 16 – 18, 2003 along the axis Arkona Basin – Bornholm Gate – Bornholm Deep – Stolpe Channel – Gdansk Deep.

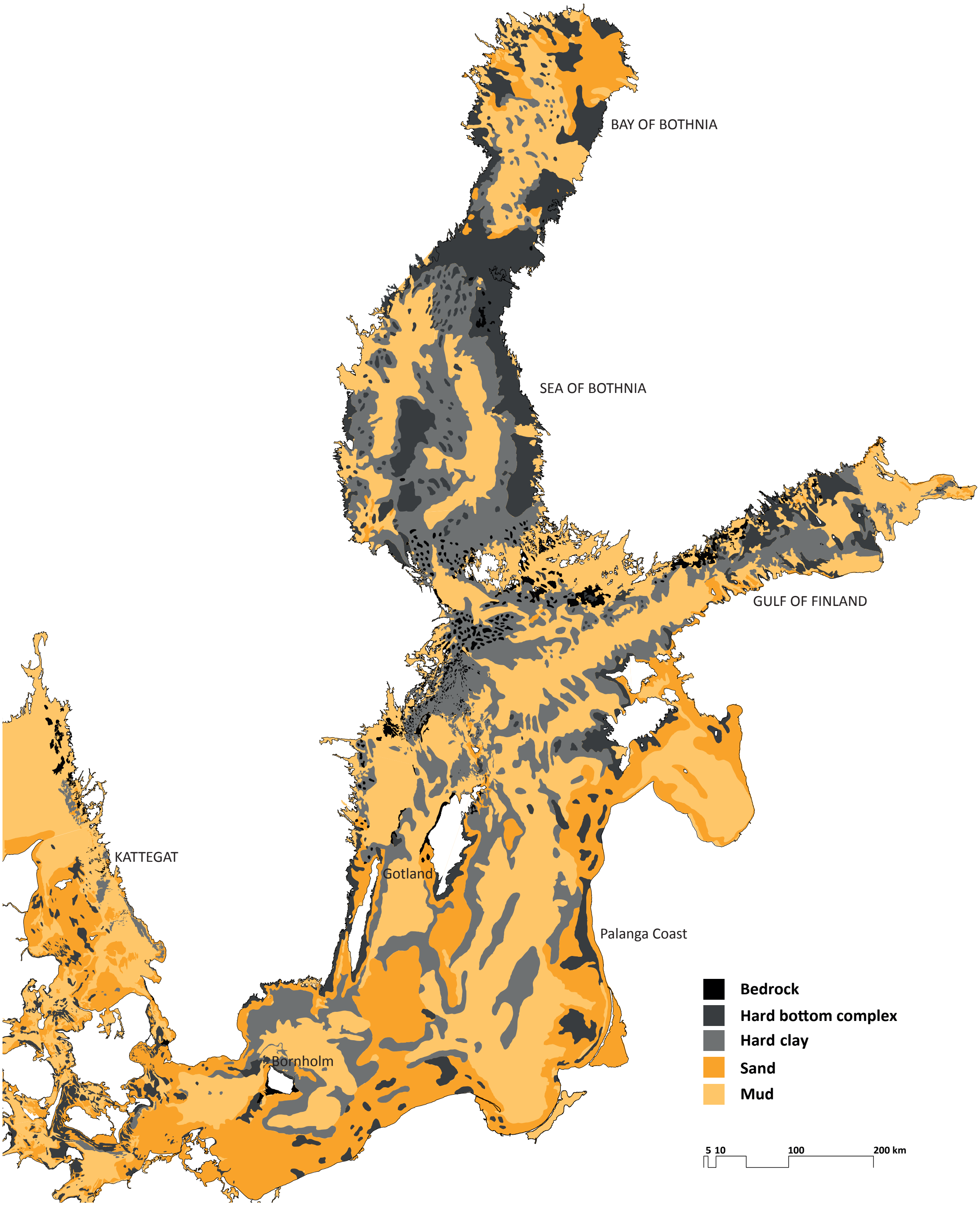


[22] Ice extent Baltic Sea.

remains at a stable temperature of 3 – 6°C. Therefore in winter when the temperature of the surface layer cools down, the bottom layer is actually warmer. In summer the situation is reversed and the upper layer warms up quickly reaching a temperature of 16 – 17° in the Arkona and Bornholm basins.[99] The surface temperatures have increased slightly over the last 100 years, but local variations are strong, for example the eastern end of the Gulf of Finland reached the maximum temperature increase between 1981 – 2011 of 3 – 6°C. Oxygen concentrations have a deep variability in the Baltic Sea, due to the irregularity of inflows of oxygen-rich water through the Danish straits. The 2-layer structure of the Baltic also means lower layers frequently receive too little fresh oxygen from vertical mixing and their oxygen reserves are depleted through the oxidisation of dead organic material. Anoxic conditions, where the oxygen concentration is below 2mL/L, are considered unsuitable for life. Although in the Baltic Sea this situation is dictated by natural conditions, eutrophication due to environmental loads increases oxygen consumption and puts the ecological state of the bottom water at risk. This situation has worsened considerably in the last 20 years.

The elongated north/south form of the Baltic Sea means that it is located between maritime temperate and continental sub-Arctic climate zones.[100] Ice formation in the Baltic Sea varies greatly due to the location at the climatological sea ice margin. This is governed by the North Atlantic Oscillation (NAO), which determines whether wind blows from the west, bringing warmer northern-Atlantic air, or from the north and east bringing cold air from the Russian continental climate. The Baltic can be completely frozen over in very cold winters once every 30 years, or only 12,5% covered in the Bay of Bothnia and the eastern Gulf of Finland. On average, the ice-covered area makes up 45% of the total area between mid-February and mid-March [22]. Transport during the ice season is managed by the ca. 25 – 30 ice-breakers in operation to keep all major Baltic ports open and by ice-roads over short distances where the ice is guaranteed to be at least 25 cm thick, for example in the archipelagos and from the mainland to particular islands. Although scientists cannot recognize any tendencies over time regarding sea ice formation and extent in the Baltic Sea and describe the recorded patterns as “white noise with large variance”[101], models have been developed in accordance with scenarios for climate change, and under these scenarios, a sea surface temperature increase of 2 – 4° C is expected before the end of the 21st century.[102] Such an increase is estimated to reduce the extent of the sea-ice cover by 50 – 80%, and reduce the ice season by 1 – 2 months in the northern parts of the Baltic. This would have many consequences for the Baltic Sea physics and hydrography, and also reduce the breeding possibilities for ringed and grey seals which give birth to their pups on the ice. Long-lasting westerly winds can cause a rise in sea-level, which, when combined with a storm surge, is further exacerbated by the reduction in basin cross-section across the Gulf of Finland, resulting in a rise of up to 4 m at the end of the Gulf in St Petersburg. A 25 km-long series of dams has since been built across the Neva Bay and linking Kotlin Island at the western approach to St Petersburg to protect it from flood-

99 Ibid.
100 The length of the Baltic Sea is ca. 1300kms – the distance from Hamburg to Rome
101 Leppäranta and Myrberg, *Physical Oceanography of the Baltic Sea*. p 87
102 BACC Author Team, *Assessment of Climate Change for the Baltic Sea Basin*.



[23] Baltic seabed sediments.

ing. Since 1740 St Petersburg had been flooded 300 times, causing vast amounts of damage and also loss of life.

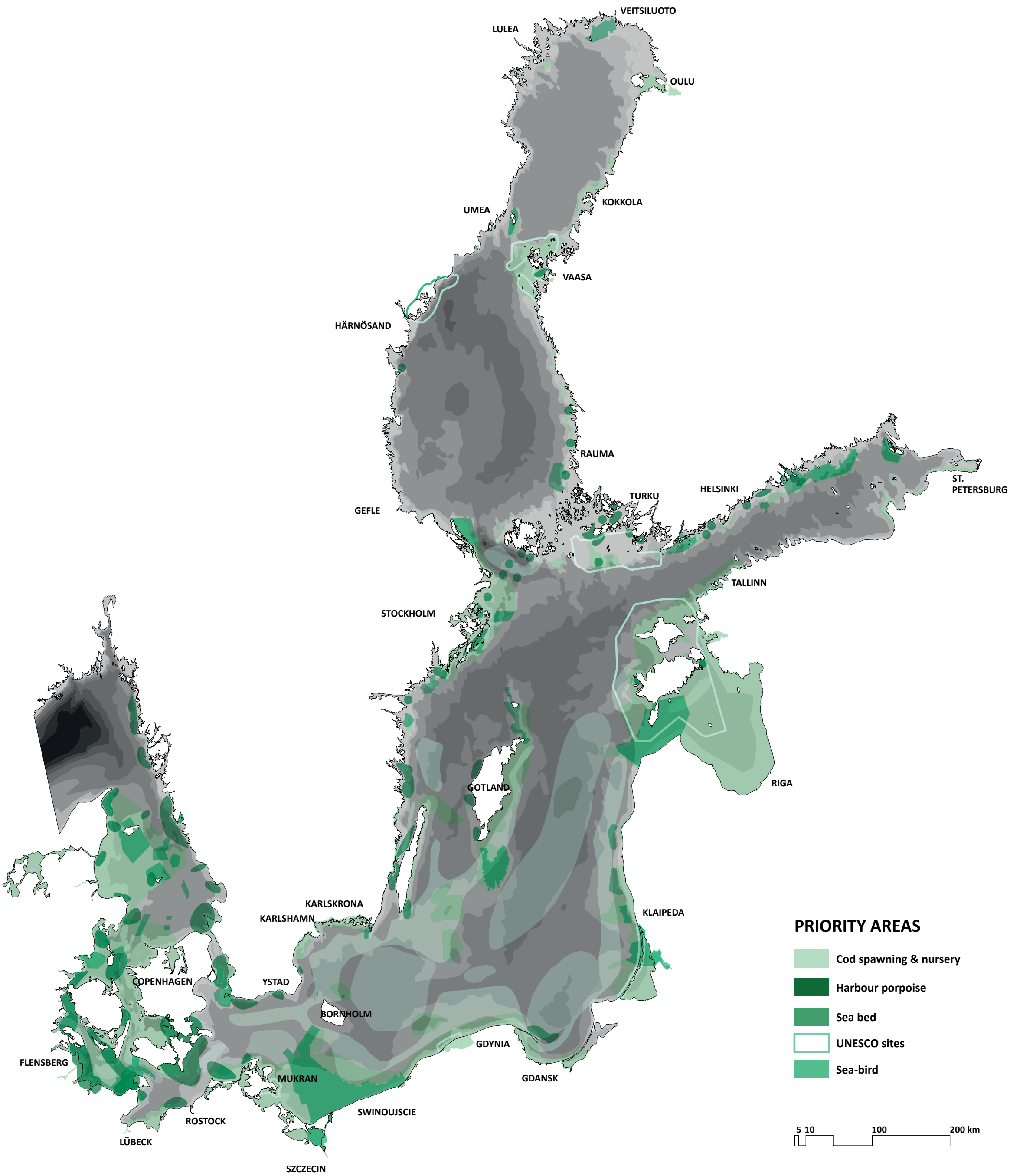
The Baltic seabed plays more of an active role in overall circulation of nutrients and pollutants than in a deeper sea and provides a variety of important habitats. Around one-third is composed of soft, organic-rich sediments (mud), and the remaining seafloor is made up of sand, complex sediments and hard clay, with isolated areas of bedrock [23]. The fringe of bedrock protruding at the northern tip of the Bay of Bothnia is the oldest in northern Europe at 2,6 billion years old,[103] but most of the original bedrock is now covered with deep layers of sedimentary rock. Hard bottoms with good light penetration – ranging from 18 – 30 m in different parts of the sea – are most suitable areas for algae growth. Blue mussels then dominate at depths where light limitation inhibits algae growth and where the substrate still allows them to attach, stopping where the seabed is mostly mud. They have an important filtering function and consume around 35% of the primary production (phytoplankton).[104] Further down on the deep soft-bottoms, the Baltic mussel is predominant and covers large areas. There are a number of shallow offshore banks with stony bottoms between 1 and 5 m below sea-level which offer a habitat for seals, porpoises, resting and feeding birds and spawning fish. Large shallow sandbanks, lagoons and bays along the south Baltic coast also offer important spawning grounds and are of international importance for feeding and wintering birds. The mixed-bottom Adlers Grund, south-west of Bornholm, is home to over 90 species of bottom-living animals. Hoburgs Bank, south of Gotland rises to 35 m below sea-level and is an important site for around one million wintering or breeding birds. Reefs are found in the Kattegat, north and east of Gotland, in some of the archipelagos in the Sea of Bothnia, along the Palanga coast (Lithuania) and the Gulf of Finland. Spectacular “bubbling reefs” are found in the Kattegat. These carbonite-cemented sandstone structures have pillars which rise up out of the seabed and leaking vents of methane gas which attract particular and colourful life-forms.

3.4.2 LIFE-FORMS

Due to the special brackish conditions described above, the Baltic Sea is host to relatively few species, but the species present are often found in large numbers. Primary production in the Baltic Sea is estimated at $5{,}9 \times 10^8$ kg carbon/year. Eutrophication is an excessive amount of nutrients in a body of water, mostly due to run-off from the land where fertilizers have been used. In the Baltic Sea, eutrophication has had the effect of both increasing primary production and therefore also some fish stocks such as herring and sprat, and aggravating the condition of oxygen depletion at lower levels, making them unsuitable for fish which would normally feed there. This has affected the reproductive success of cod. Three main species – herring, cod and sprat – dominate the open sea in the Baltic and have been important for commercial fisheries.

The herring spawns in the spring in shallow areas of algae growth, moving to the upper layers of the open sea looking for food in summer and then to the soft bottom areas for feeding in the winter, when food

103 *Pearls of the Baltic Sea. Networking for Life: Special Nature in a Special Sea*.
104 Kautsky and Svensson, *Life in the Baltic Sea*.



[24] Baltic Sea priority areas.

is depleted in the upper zone. Cod and sprat spawn in the open sea and also move to different habitats at different times of the year. In May-June the cod spawns at 60 – 80 m depth in the areas of Bornholm, Gotland, Gdansk and Arkona Deep where the salinity levels are favourable for the cod. Cod is a predator to both herring and sprat, therefore its relative abundance directly affects these populations. The Baltic Sea is rich in fish- until the 1990s it had a yearly catch of 1,000 million tonnes. However, both cod and salmon have been overfished. The cod population collapsed in the early 1990s reaching a low of 4% of its previous population.[105] Salmon were once plentiful, but their populations have also drastically reduced, partly due to the building of hydro-electric dams. This makes it difficult for salmon to return from their feeding grounds in the sea to their spawning grounds in the rivers.

Three seal species live in the Baltic Sea- the ringed, grey and harbour seal. Their populations have been heavily reduced, partly due to hunting, but also due to pollution, since their position in the foodchain means that they accumulate toxic compounds through their fish diet. An estimated 5000 ringed-seals and 10,000 grey seals live in the Baltic Sea. The estimated population of 200 harbour seals live in the southern part of the Baltic Sea. A number of seal sanctuaries have been established; Hallens Väderö (Kattegat), Rødsand (Belt Sea), the Vilsandi National Park (part of the West Estonian Archipelago Biosphere Reserve- the largest breeding area for grey seals) and Møyly Island in the Bothnia Bay National Park. The harbour porpoise is one of the smallest types of toothed whale. It was hunted extensively until the end of the 19th century and its population has declined from about 20,000 at the beginning of the 20th century to probably less than 600 individuals in the Baltic Sea today. It is listed as "vulnerable" in the "Red List of Globally Threatened Animals and Plants" by the International Union for the Conservation of Nature (IUCN).[106]

In comparison to the relatively low species diversity for the underwater animal communities, the Baltic Sea is rich in both marine and freshwater bird species and around 340 species are found regularly in the region. Important breeding and wintering areas for birds are located here and for 15 species more than one-third of the total northwest European winter population resides in the Baltic Sea region.[107] The total number of wintering birds has been estimated at around 8 million.[108] Breeding areas are concentrated along the coasts and in the archipelagos. While many nesting birds are attracted to the region's long northern summer daylight hours and the plentiful food supply, a large proportion also leave for warmer areas to winter. A second group of birds, including the long-tailed duck, tufted duck, mute swan, Canadian goose and herring gull, migrate from northern Russia to winter in the Baltic. The largest bird population is the eider, with 800,000 individuals, whose main source of food is the blue mussel. In addition to the habitual bird population, the Baltic Sea lies on the East Atlantic Flyway, and therefore many birds stop to rest during their annual migration

105 Ibid.
106 Elsam Engineering and ENERGI E2, *The Danish Offshore Wind Farm Demonstration Project: Horns Rev and Nysted Offshore Wind Farm. Environmental Impact Assessment and Monitoring*.
107 Kautsky and Svensson, *Life in the Baltic Sea*.
108 Ibid.

[25] Exclusive Economic Zones in the Baltic Sea.

southwards in autumn, returning again in spring.[109] The sandy Vistula and Coronian spits are important migration resting sites [24].

3.4.3 URBANIZATION BORDERS

Examining the littoral zone described for both the Barents and the Baltic Seas as the zone of land/sea transition, the stretched, lineal shape of the Baltic Sea emerges as an almost continual littoral condition.[110] The land/sea border is relatively large compared to the entire area of the sea and is charged with anthropogenic and hydrographic pressures.[111] Therefore the littoral border forces are able to fully penetrate the central body of water and forge links across this common space.

National borders divide the Baltic Sea into 11 zones, representing nine different nations [25]. However, this division is also matched by a long history of collaboration, which according to political scientist Marko Joas, has been the reason for the the success of common governance policies:

> “Transnational city networking, which has a long tradition in the Baltic Sea Region, appears to be further developed than in the other regions discussed here… The Baltic Sea Region is special because it is managed by a limited number of highly advanced industrial societies”.[112]

The Baltic States became a model for European integration after the fall of the Iron curtain. Their borders to Russia have then cemented into EU, Schengen and NATO borders of strategic importance. Particularly the NATO border has become the site of demonstrations of collaborative military strength in the form of reconnaissance exercises, such as the annual “Open Spirit” offshore de-mining exercise involving 9 nine NATO member states.[113]

Within this strategic geo-political context, local borders are more complex. Although the current Russian borders are almost identical to the Russian kingdom 400 years ago under Peter the Great, many Russians who were once living within the USSR since find themselves outside the border.[114] Border towns such as Narva/Ivangorod (Estonia-Russia) and Daugavpils-Braslaw (Latvia-Belorussia) demonstrate similar cross-border dynamics as described for Kirkenes, where the border may be crossed several times daily.

Corresponding to the level of EU interest in developing the Baltic as a coherent region, a host of organizations have been formed and projects launched with objectives in the realms of transport, commerce, energy and environment. These are also met with the initiatives of the Baltic rim

109 *Pearls of the Baltic Sea. Networking for Life: Special Nature in a Special Sea*. The East Atlantic Flyway is used by ca. 90 million birds annually as they migrate from northern European and Canadian breeding areas to western European or southern African wintering areas.
110 See 3.2.2 HISTORICAL BACKGROUND – BALTIC SEA and 3.3.3 URBANIZATION – BARENTS SEA
111 Leppäranta and Myrberg, *Physical Oceanography of the Baltic Sea*.
112 Joas, Jahn, and Kern, *Governing a Common Sea*. p 228
113 The annual Open Spirit operation seeks and detonates underwater explosives in the Baltic Sea from WWI & II in the interests of securing safe sea lines, but it is also conceived as a exercise to coordinate techniques, tactics and procedures. Further to this, the US European command, EUCOM, have launched operation “Atlantic Resolve”, a build-up of military along the Russian border in the Baltic States, to “deter potential Russian agression” EUCOM 2015 posture statement: http://www.eucom.mil/mission/the-region
114 Mezhevich, *Borders and Identity in Theory and Practice of the Eastern Baltic Region*.

countries themselves – in 1996, Agenda 21 was launched by the Council of Baltic Sea States as a cooperative project between the Baltic rim countries (including Russia) and the EU, as a "macro-regional expression of the global Agenda 21 adopted by the United Nations Earth Summit" (1992) and aimed at sustainable development. It is linked to five International Financial Institutions (IFIs); the European Bank for Reconstruction and Development (EBRD), European Investment Bank (EIB), Nordic Investment Bank (NIB), Nordic Environment Finance Corporation (NEFCO); and the World Bank. Also financial instruments developed by the EU under the Life, Phare, Interreg IIA and IIC and Tacis programmes, were seen as opportunities for project specific project funding. These activities serve to demonstrate the political apparatus behind the Baltic Sea as a sensitive, yet vital EU border zone.

PLANNING

Offshore, the territorial boundaries have generated national planning initiatives. Of the rim countries, currently only Germany has developed a legally-binding marine spatial plan, but pilot plans have been initiated for several neighbouring countries as well as for the trans-boundary area of the Pomeranian Bight/Arkona within the BaltSeaPlan project.[115] Considering the inherent spatial properties of this sea as described by its oceanography and life-forms, it is clear that the delineation of these political borders is not derived from natural systems. Instead, the Baltic is sliced following geometrical extensions of national boundaries on land [25]. Military exercise areas, maritime transport corridors, offshore wind, dredging sites and protected areas compete for space within each nation's ocean boundary. Waste has often been (in)conspicuously dumped at the furthest extremity.

PROTECTION

Pressures on the Baltic Sea have led to environmental degradation and population reductions in many species. In contrast to the Barents Sea, the Baltic has been described by the as WWF as "probably the worlds most polluted sea", but its unique water properties provide habitats for unique species, the protection of which has become a priority. The WWF has been successful in achieving a "Particularly Sensitive Sea Area" (PSSA) status for the Baltic Sea as recognised by the International Maritime Organisation in 2005.[116] This tightens safety requirements for ships and enables the IMO to decide on the best routing measures.

The 1992 Helsinki Convention was the first ever regional sea agreement to include a policy and set of instruments for nature conservation of coastal and marine areas.[117] Currently, 61 species are on the Helsinki Commission (HELCOM) red list of threatened or declining species. For 30 of these species, areas have been designated within the 163 Barents Sea Protected Areas (BSPA) network.[118] These areas do not restrict activities un-

115 Marine Spatial Planning (MSP) Pilot plans completed in the Baltic Sea: the Danish Straits, Pomeranian Bight/Arkona Basin (Germany/Sweden/Denmark and Poland), Western Gulf of Gdansk, Middle Bank, Lithuanian Sea, Latvian Sea, Pämu Bay (Gulf of Riga), Hiiumaa and Saaremaa Islands, and the Sea of Bothnia.
http://www.baltseaplan.eu/index.php/Pilot-Maritime-Spatial-Plans;831/1
SEE 4.3 MARINE SPATIAL PLANNING IN THE BALTIC SEA

116 *Sensitive Baltic Sea Areas Now Protected from Shipping Activities*.

117 *Pearls of the Baltic Sea. Networking for Life: Special Nature in a Special Sea*.

118 The 30 species includes 13 bird species, 9 fish species, 4 seal or porpoise species and 2 algal and 2 vascular plant species.

less they are also protected under national legislation, but each requires a management plan for any proposed development. They now make up 7% of the Baltic Sea area.

At the EU level, Natura 2000 is a network of legally protected habitats and species.[119] It differs from the Helcom MPAs in that it also includes inland areas. Although these sites often overlap, they are not identical. Seven UNESCO world heritage sites are located in the Baltic Sea [24]; the Biosphere reserve Rügen (Germany), Biosphere reserve Slowinski (Poland), Coronian Spit National Park (Russia & Lithuania), Biosphere reserve West Estonian Archipelago, Biosphere Reserve Finish Archipelago Sea Are, the High Coast (Sweden) and Kvarken Archipelago (Finland).

ENERGY

The Baltic Sea has been identified along with the North Sea and the Mediterranean, as one of the important European locations for concentrated offshore wind-energy potential at sites between 10 – 30 km from the coastline with a water depth of less than 50 m.[120] Windspeeds are higher offshore, reaching over 8 m/s around most of the Baltic coastline. These parameters are deemed to be the maximum feasible depths and offshore distances for lucrative wind-power up until 2030 which is the time-frame of this EEA study. The pressure to meet national and international environmental targets for the reduction of greenhouse gases has been directed to a large extent towards the development of wind power, in particular in EU countries without hydro-electric potential. Denmark and Germany are world leaders in scientific development, engineering and the commercialization of wind turbines and both have ambitious renewable energy targets within which wind plays a decisive role.[121] Denmark aims to achieve 50% electricity production through wind power by 2025 and Germany 30% through renewables by 2030.[122 – 123] Currently 13 windparks are fully commissioned in the Baltic Sea, including the world's first offshore wind park Vindeby (1991) in the Great Belt, Denmark [26].[124] Several other small, 5-turbine parks in Swedish waters also belong to the first generation of offshore wind and are soon due to be repowered or dismantled. Other Baltic countries are lagging behind Germany, Denmark and Sweden, but large areas have been set aside as sites of national wind-development interest by Poland, Lithuania, Latvia and Finland, as well as further areas within German, Swedish and Danish EEZs. Often the optimal site conditions for wind correspond to those optimal for Baltic life-forms; shallow water, offshore banks and a sandy substrate.

Oil production in the Baltic Sea is limited to two sites in the southern Gotland Basin. One Russian oil platform is operating at the Kravtsovskoye oil field, ca. 22 km off the coast from Kaliningrad, and three Polish

119 Natura 2000 is an EU network of nature protection areas including birds sites, habitats sites and the marine environment. Member states designate Special Areas of Conservation under the 1992 Habitats Directive, and Special Protection Areas under the 1979 Birds Directive.
http://ec.europa.eu/environment/nature/natura2000/index_en.htm

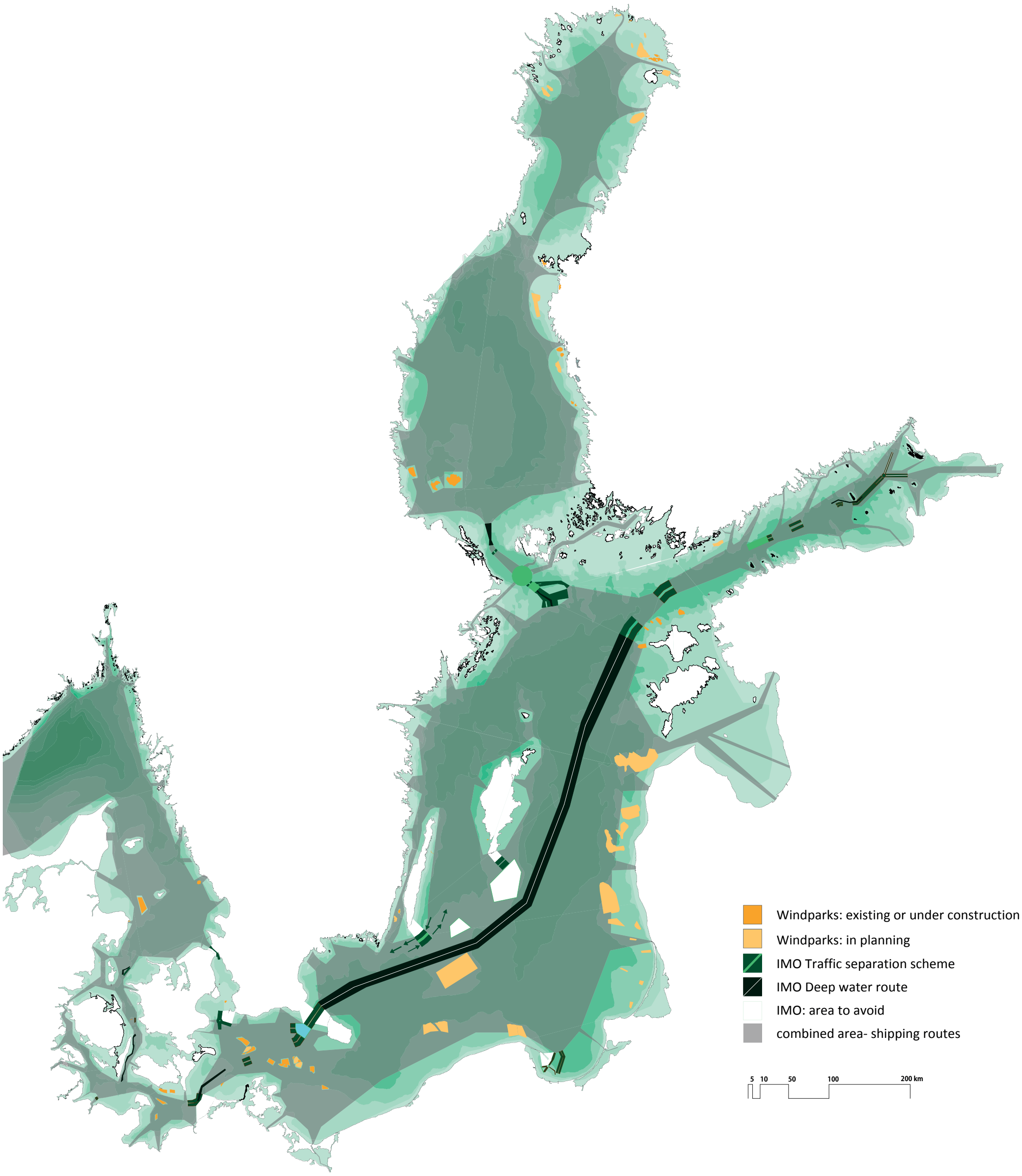
120 European Environment Agency, *Europe's Onshore and Offshore Wind Energy Potential. An Assessment of Environmental and Economic Constraints*. See 3.6.1 WIND POWER

121 Dismukes, Miller, and Bers, *The Industrial Life Cycle of Wind Energy Electrical Power Generation*.

122 *The European Offshore Wind Industry – Key Trends and Statistics 2013*.

123 BMU: Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, *Long-Term Development Pat*h.

124 See Appendix 1: Table of Windparks in the Baltic Sea.



[26] Shipping and Windparks in the Baltic Sea, existing and planned.

rigs operate the B-3 field, one drilling rig Petrobaltic and two production rigs.[125] The Polish Lotos Petrobaltic Group hold seven exploration licenses for oil and gas in the Polish EEZ, two of which were recently obtained in 2013. According to the WWF, these reserves are estimated to last until 2030 or longer and there is continued interest in further developing oil exploration in the area.[126]

Two 1,2 m-diameter gas pipelines were laid on the Baltic seabed over a distance of 1220 kilometres from Vyborg in Russia to the delivery and distribution point in Lubmin, Germany between 2010 – 12. The Nord Stream project is owned by an international energy consortium of which the Russian giant Gazprom owns 51%, two German companies E.on Ruhrgas AG and Wintershall Holding GmbH both 15,5% and the Dutch and French firms N.V. Nedelandse Gasunie and GDF Suez 9% each. As a trans-boundary project which traversed the Russian, Finnish, Swedish, Danish and German offshore boundaries, Nord Stream demanded a comprehensive consulting process and rigorous environmental assessments and monitoring according to the ESPOO convention.[127] This pipeline was ground-breaking in terms of logistics, but for Nord Stream, the under-water solution through the Baltic presented significant advantages compared to overland options, such as tax savings, avoiding sensitive political areas and the relative ease of transporting oversized construction components through the ocean. An extension project involving an additional 1 – 2 lines was still in its initial stages when Gazprom officially put this project on hold in January 2015.

FISHING

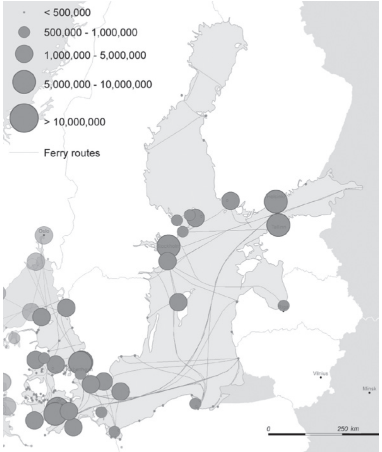
Fishing is declining in the Baltic Sea, and some areas have been closed for cod fishing in an attempt to build up the stocks. Of the total number of fishing vessels, 85% are small motorized vessels less than 12 m in length and without towed fishing gear, officially called "artisanal fishing vessels" in the EU.[128] Fishing is concentrated mostly in the Eastern Gotland Basin, the Bornholm Basin and the southern Sea of Bothnia. While these vessels operate in a more environmentally-friendly way, and provide important employment for fisherman in relation to the biomass of landed fish, their catch represents only 9% of landed fish in the Baltic Sea[129]. A small number of large vessels are responsible for 71% of the total catch.

SHIPPING

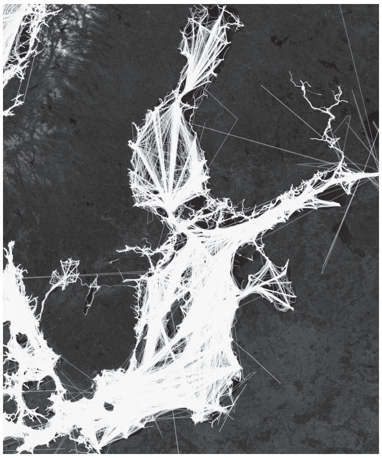
Shipping in the Baltic Sea is intense and according to HELCOM, comprises 15% of the world's cargo transportation on the world's 5th busiest shipping routes. There are 2000 ships in the Baltic Sea at any one time.[130] Oil transport has grown considerably and is expected to increase due to the opening of new Russian oil terminals such as Ust-Luga located just south of St Petersburg. There are now 17 large oil harbours in the Baltic Sea

125 WWF, *Future Trends in the Baltic Sea*.
126 Ibid.
127 UN Convention on Environmental Impact in a Trans-boundary Context. Espoo Finland, 1991.
http://www.unece.org/env/eia/eia.html
128 Oceana, *Fisheries Management in the Baltic Sea*.
129 Ibid.
130 Stankiewicz, Backer, and Vlasov, *Maritime Activities in the Baltic Sea – An Integrated Thematic Assessment on Maritime Activities and Response to Pollution at Sea in the Baltic Sea Region*.

[27] Recreation, Gulf of Finland, Baltic Sea



[28] Baltic ferry passengers 2008.



[29] Shipping traffic Baltic Sea 29 May 2012, all types.

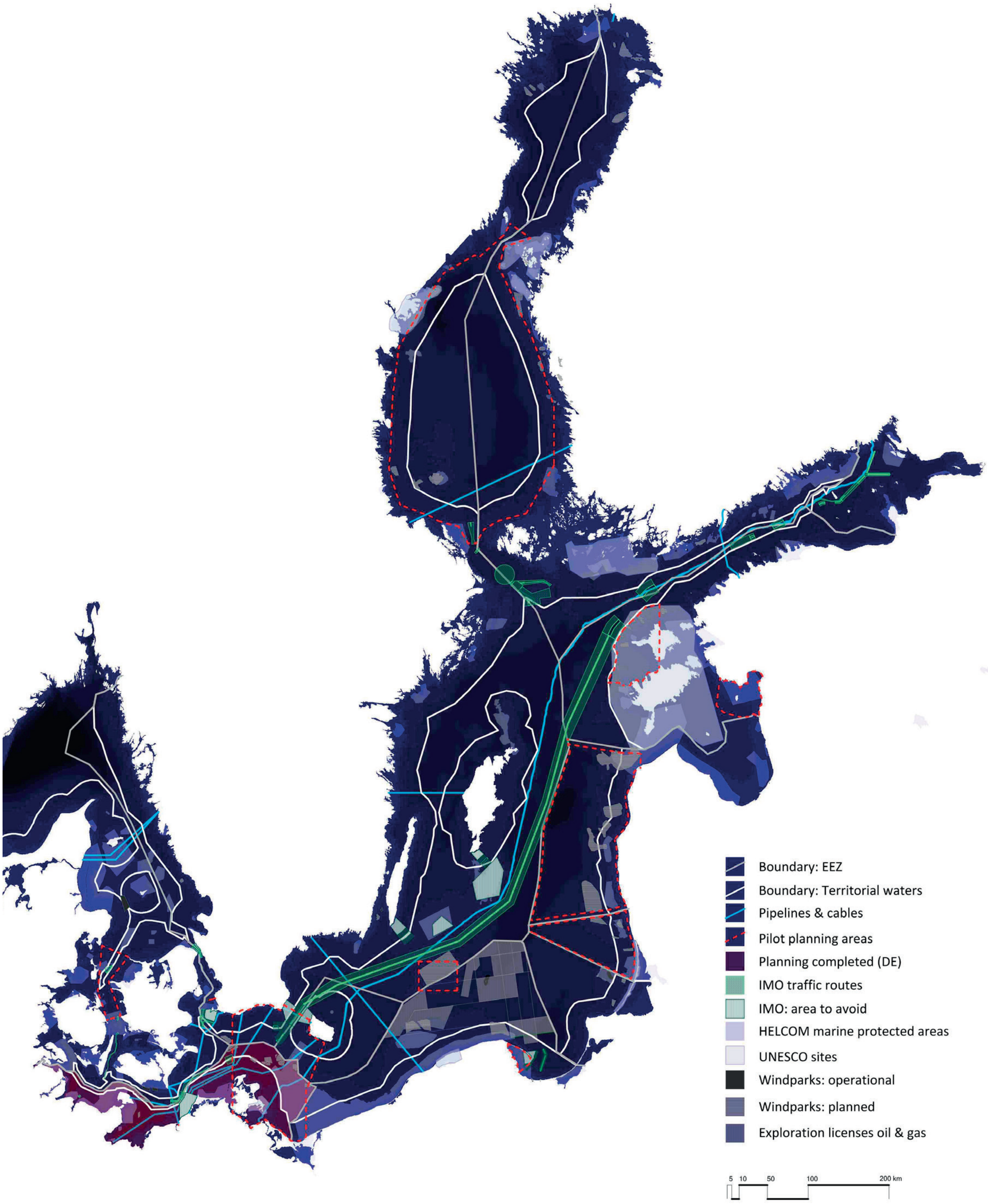
transporting over 250 million tonnes/year. Shipping traffic is dominated by short sea shipping (SSS) internally between different neighbour states. This demonstrates the intensity of intra-Baltic trade.[131] Baltic ports also provide "feeder" services to the larger northern ports of Hamburg and Rotterdam.

The cruise shipping industry is continuing to experience significant growth and about 10% of the world's cruise tourists visit the Baltic, in particular the cities of Copenhagen, Helsinki, Stockholm and Riga.[132] Ferry crossings in the Baltic are relatively short and several are among the most highly frequented in the world; for example the Helsingør (Denmark) – Helsingborg (Sweden) car-ferry connection in the Øresund, with a crossing time of 20 mins and an average of 70 departures per day from each harbour and the Tallinn (Estonia) – Helsinki (Finland) connection in the Gulf of Finland, which takes approx. 3 hours and is serviced with a minimum of 17 departures from each port daily in the busy summer season [28]. According to a HELCOM report, 91 million passengers passed through over 50 Baltic ports in international traffic in 2008.[133] This figure includes ferry and cruise passengers on both arrival and departure.

In terms of numbers only, the majority of boats on the Baltic are leisure boats, with an estimated 1.6 million belonging mostly to Danes, Swedes and Fins.[134] This combination of individual recreation, ferry services and the booming cruise shipping industry, result in what tourism geographer Jan Lundgren calls "a high volume of personal recreational consumption" which makes the Baltic unique and has contributed to the geographic bonding between Baltic States.[135] Lundgren goes further to introduce the concept of a Sea Common, defined as "a collective resource and a popularly used collective space." Shipping activities in the Baltic have not only produced a dense network, but according to Lundgren, also communal spaces at the regional scale [27].

The passage of all ships in the Baltic Sea in May 2012 as transmitted through the AIS (Automatic Information System) as ships cross control lines, is shown at left [29]. Of these ships, approximately 20% are oil tankers, 46% other cargo ships and 4,5% passenger ships.[136] This image demonstrates that there is hardly a space in the Baltic Sea which is not traversed by shipping activities. In comparison to the Barents Sea, the space is occupied by a combination of all shipping types, rather than different vessels dominating specific areas. An exception are the heavier vessels with a deeper draught which follow the the deep-water route determined by the International Marine Organisation (IMO). A second IMO measure is the introduction of traffic separation schemes to reduce the risk of collision in heavily trafficked areas. Since internal distances are relatively short and a large number of ports are connected, the sea has been described as "the main economic and logistic artery of the region, one of the oldest trading routes in Europe and still

131 Eurostat, *Maritime Transport Statistics- Short Sea Shipping of Goods*.
132 Nilsson et al., *Cruise Tourism in the Baltic and Bothnian Sea – A Pilot Study on Maritime Tourism*.
133 Stankiewicz, Backer, and Vlasov, *Maritime Activities in the Baltic Sea – An Integrated Thematic Assessment on Maritime Activities and Response to Pollution at Sea in the Baltic Sea Region*.
134 Ibid. Swedes, Danes & Fins, boats: head of population = 1:7
135 Lundgren, *The Transformation of a Geopolitical Space into a Tourist Space*.
136 Stankiewicz, Backer, and Vlasov, *Maritime Activities in the Baltic Sea – An Integrated Thematic Assessment on Maritime Activities and Response to Pollution at Sea in the Baltic Sea Region*.



[30] Borders and enclosures, Baltic Sea.

remains one of the busiest routes in the world. The Baltic Sea connects the nations and it constitutes a platform for business and socio-economic development."[137] The result is a taunt blanket of shipping activity, punctured by windparks and pinned to the coastline through the ports, but avoiding the sensitive and shallow coastal areas. The central deep-water-route running in the north south direction creates narrow passageways and nodes of compression at multiple junctions [26]. Illustrated in this way, the common spaces of the Baltic Sea come into focus; the central spaces of cross-Baltic exchange as mapped out by the shipping activities, and the common coastal zones and archipelagos where a high frequency of recreational boating takes place.

3.4.4 CONCLUSION BALTIC SEA

The Baltic Sea is delineated by borders and enclosures [30]. These ocean borders are abstract fixtures, some of which define operational systems such as zones of marine planning or traffic routes, and some of which are projections of competing activities not yet reinforced by law. The zones earmarked for windpark developments and marine protected areas, which appear scattered and small in scale compared to the scale of environmental degradation, are examples of the latter. The result is a complex, fragmented series of singular but frequently overlapping spaces. Traversing the sea, the deep-water shipping route creates a central backbone of transit.

Bathymetry and the morphology of the Baltic coastline create a natural division of the sea into 14 parts. This segmentation is exacerbated by the overlay of anthropogenic borders as traced out above. The exclusive economic zones of the 9 surrounding countries create 11 zones which do not correspond to natural divisions, but which generate national and sometimes trans-boundary planning efforts to organize the space. Superposing these layers, the combined shipping passages describe a space of perpetual movement irrespective of borders. Intersecting all of these spaces is the movement of species between important natural habitats. Combined, these manifold relationships create a dense network of spatial claims in the Baltic Sea.

But these spaces are inherently contradictory. On the one hand, borders describe increasing forms of static control applied to both the commercial/productive and the environmental spaces of the Baltic Sea. On the other hand, networks of linear connections define a common, fluid, periodic space. Over time, these connections appear to wholly consume the space, as the snapshot of movements during the month of May 2012 demonstrates [28]. The environmental capacity is close to saturation.

Urbanization in the Baltic Sea is then characterized by the complete interpenetration of spaces of movement, both organic and inorganic, with an increasing number of fixtures and artefacts. While new technological seascapes are forming through wind parks, the leisure seascape and bird resting areas persist close to the same locations. All kinds of boating activities use the space periodically and the sea is characterized by a high degree of human interaction. This interaction, both physical and virtual, has created a common referential space which unifies the region. It is a complex realm of cohabitation hanging in a delicate (im)balance. In order to obtain a clear

137 Gajewski, Kowalczyk, and Osowiecki, *The Baltic Sea – main common resource and model region for an integrated maritime policy*.

understanding of these relationships and the spaces they are producing, three typological conditions have been chosen for further investigation:

– An offshore windpark directly adjacent to both important shipping routes and a protected wintering-area for birds. This is a situation of relative density at the intersection of Seascape, Technology and Ecology where installations have been constructed and their effects can be spatially analysed in relation to the cyclic systems of the ocean context.

– A network infrastructure- the Nord Stream pipeline, which has been constructed to channel energy flows through the Baltic Sea. This is a trans-boundary intervention which operates at the scale of the sea as a whole, yet is dematerialized through its location on the seabed. Even as a permanent artefact, its perceived occupation of ocean space is characterized by extreme fluctuation. Here, the conclusions drawn from network theory can be tested in relation to Technology and Seascape.

– A space of dispersed surface interaction generated by singular shipping trajectories. At a more detailed scale, the surface coverage of shipping activities in the Baltic is porous, uneven and constantly changing. The large, open spaces in the Baltic Sea traversed by different shipping types and routes create a type of fluid, periodic unbounded space characteristic of the sea.

3.5 SUMMARY

3.5.1 RADICAL URBANIZATION

The above analysis of the Baltic and Barents Seas is structured around defining the spatial characteristics of two ocean territories according to physical oceanography, life-forms and urbanization processes. I argue that ocean territory is defined by the interconnection of these three spatial categories. Urbanization in ocean space can be the result of a chain of interdependencies originating in oceanography, which produces habitats, followed by life-forms which are attracted to these habitats, and which then become a resource utilized in production processes. A profile of each sea is summarized in the table below [31].

However the two seas also demonstrate an acceleration of interactions which go beyond the logical chain of relationships described above. A quantum shift in the scale and intensity of ocean activities is evident not only in the traditional maritime sectors of fishing and shipping, but also in new offshore sectors associated with energy production. The emerging seascape has a high technological component and is spatially dispersed yet tightly connected through networks. Spatial indicators located in different ocean layers dissolve and reappear temporarily through different scales. I argue that these interactions describe a form of *radical urbanization* mediated by the sea itself. Radical in the sense that urban indicators are periodic, diffuse and embedded in abstract ordering systems. They are unevenly dispersed over vast areas but are aligned to specific locations and/or phenomena with technical precision. These factors all contribute to the apparent unfamiliar and radical nature of urbanization processes operating within ocean space.

Equipped with our current understanding of planetary urbanization, we can also revisit history to trace the development of this radical urbanism linked to the Barents and the Baltic Seas. Apart from the city of Murmansk, which was established within the Russian governmental policy of deliberately populating the north, the fringes of the Barents Sea have traditionally never given rise to dense urban areas. Instead, numerous, small, widely dispersed settlements developed along the coast at natural harbours since the end of the last ice age. Ocean trading routes were the vehicle of exchange between settlements and with international partners. Today these towns are connected through coastal services, are economically reliant on diverse forms of ocean production and are remote and detached from nationally centralized modes of organization. The density of ocean activities is comparable to activities on land.

Industrialization and the discovery of coal and iron ore bought infrastructure to the region adapted to extraction and the related production processes. While operating on longer time-cycles than the seasonal rhythm of the sea, these mining settlements were however, developed in a temporary way and many have since been abandoned. The installation of extractive infrastructure in the sea is an extension of this type of urbanization.

The history of the Baltic Sea demonstrates a persistent network component, which has accelerated interactions and created an interconnected space which has been called the sea common.[138] This is reinforced through the relative proximity of ports and shorelines – a ship in the Baltic Sea is at no point more than 130 km from land.[139] Extensive maritime interaction across the Baltic can be traced through the Viking trade routes, the Danish Kingdom, the Hanseatic League, the Swedish Empire and the contemporary post-Soviet collaboration between the Baltic States. This interaction takes on many forms, both physical and virtual, however the intensity of all shipping activities in the sea today is manifest to this kind of urbanization comprising diverse, singular, independent urban units connected through a broad, tightly interwoven ocean surface.

From this overview, I conclude that contemporary urbanization processes have been able to link into “habitats” provided by the legacy of radical urbanization facilitated by, and in connection with, the Barents and Baltic Seas. The intensification of these processes has bought such habitats into relief, and enabled us to recognise their urban characteristics which until now, had remained unfamiliar.

The radical nature of ocean urbanization is also due to one further critical characteristic. The space outside of territorial waters but within an EEZ, is according to the Law of the Sea both a common, fluid resource and a potential site for national production and extraction. Therefore this space is a site of continual negotiation between these two conditions.

3.5.2 NINE PRINCIPLES OF OCEAN URBANIZATION

The following nine principles of urbanization in the Barents and Baltic Seas result from the analysis:

1 – The seas are vital producers

Spatially, economics dominate the use of both seas. Environmental aspects are either completely integrated into production through research and technology as in the Barents Sea, or tentatively outlined through “soft” legislation and therefore largely ignored, as is the case of the Baltic Sea. Shipping is an economic priority in both seas, but more extreme in the Baltic Sea due to many ports providing the link to large trans-shipment volumes or land-based transportation networks.

138 Lundgren, *The Transformation of a Geopolitical Space into a Tourist Space*.

139 Stankiewicz, Backer, and Vlasov, *Maritime Activities in the Baltic Sea – An Integrated Thematic Assessment on Maritime Activities and Response to Pollution at Sea in the Baltic Sea Region*.

2 – Production activities create new seascapes

Types of energy production which have not traditionally been located offshore, such as wind in the Baltic Sea or fossil fuel in the Barents Sea, create new seascapes. The integration of such technical seascapes into the imagination of an urban population is well-advanced in the Baltic Sea, where millions of ferry and cruise passengers experience the sea annually. In addition, the technical seascapes there are replacing the inherent seascapes on which the fishing profession has traditionally relied. In the Barents Sea, the new production sites are further offshore and are characterized by less surface infrastructure. The limited number of passengers crossing the open sea means that few will experience these seascapes.

3 – Urbanization is supported by specialized technology.

The primary step in the process of urbanization in the ocean is the acquisition of knowledge. This means that vast amounts of research and data exist for the Baltic Sea- the most intensively urbanized of the two seas. The space of the sea is therefore integrated into systems of monitoring, control, strategic forecasts and economic programmes. Oceanographic scanning and monitoring require specialist technology and equipment and large-scale financial investment. The Barents Sea still contains large areas about which little is known, but the complete integration of the knowledge-base for both the environment and petroleum-production are evidence of the same phenomenon. Extensive scanning has been carried out in the areas deemed most promising for fossil fuel production. This knowledge is then translated into grids of possible exploration licenses which comprise one of the most extreme urban typologies in the sea.

4 – The seas are a common referential space.

The cultural and historical context, combined with current political forces, determines the form in which this common space emerges. In the Baltic, manifold crossings and connections, both historical and contemporary, have constructed this space- a space currently being reinforced by political efforts to create a stable Baltic region on the EU border. In the Barents region, the ocean is richer in resources than the land. I argue that the regular interaction with the sea, and its connecting role between small scattered settlements, also makes it a common referential space. The northern districts are distant to the controlling central governments in both Norway and Russia. Identity has developed under local conditions. While the political efforts to reinforce this space under the title of the Barents Euro-Arctic Region have met with local skepticism, they are proof of the mounting strategic importance of a region with the Barents Sea as the central point of reference.

5 – Both regional and international urbanizing forces are exerted on the seas.

In the Baltic Sea, urban forces issuing predominantly from the regional coastline have structured different strata of ocean space– the seabed is fitted with pipelines and cables, the surface is organised around shipping movement, and the airspace is designed to trap wind energy. These forces are relatively evenly distributed, but are reduced towards the less populated northern region of the Bay of Bothnia. In the Barents Sea, the two dominating forces of urbanization issue from different sources- the local fishing industry and the strategic, international interests of the oil and gas industries.

6 – Spatial and ecological budgets are closely linked in the oceans.

Regarding the ecological systems in terms of the available spatial budget, life-forms in the Barents Sea enjoy generous, uninhibited habitats over large areas and depths, further enhanced by the open oceanographic borders to the Atlantic and Arctic Oceans.[140] However, environmental threats come in the form of the long-range transport of pollutants.[141] In the Baltic Sea, species compete spatially with wind-farms, large transport vessels and coastal development. This is referred to as habitat loss, or displacement.[142] The same habitats are often favoured by both organic and “inorganic” species, such as shallow sandy bottoms for wind farm development, fish spawning grounds and bird resting areas.

7 – Urbanization patterns are characterized by dispersed intensities. The forms of urbanization in both the Barents and the Baltic Seas are made up of loose, diverse, shifting fragments which are widely dispersed, but connected by precise, specialized trajectories. This is a specific type of *urban extension*. In the case of the Baltic Sea, the trajectories are more numerous and more frequent. Rather than density, the seas are characterized by situations of *periodic intensity*. A periodic intensity can be manifest as the technological link to a resource which is exploited for a certain amount of time. While the intensity itself may be localized, singular and of a short duration, its existence is reliant on sophisticated, large-scale spatial systems which have been constructed on the basis of extensive research, coordination and investment and are centrally controlled. Such a situation of intensity can align Networks, Seascape, Technology and Ecology within one single operation.

8 – Infrastructure is the hardware of ocean urbanization.
The large-scale spatial systems described above are mostly of an abstract nature. Extended urbanization in the Barents and Baltic Seas is materialized through infrastructure. Infrastructure utilizes linear arrangements which have a small spatial impact in one direction, but may be of large dimensions in another. It fulfils the function of transferring forces, therefore the spatial implications of forces are also transferred giving rise to oscillating spatial expansions and contractions.

9 – Natural conditions support urbanization processes.
Extended urbanization is anchored in systems utilizing the natural properties of ocean space. Ice conditions, oceanic life-forms, deep-water harbours, winds, currents and bathymetry all support urbanizing activities to differing degrees. Oceanic forces increase the efficiency of transportation methods and the common status of the space itself outside unilateral control allows for an enhanced freedom of exchange.

3.5.3 TYPOLOGIES

Further to establishing nine principles of urbanization from the analysis of the Barents and Baltic Seas, the ambition of this thesis is to examine a selection of situations in greater detail in order to extract the mechanisms and dynamics of these principles at a higher resolution. This involves a more detailed investigation of concrete territorial situations. However, the object is also to probe such situations to the point where their properties

140 Physical oceanography uses the term “budget” for the relationships of inflows, outflows and storage in reference to water, salt and heat. The idea of a “balance” is inherent to the term. Applying this term to space refers to the changing spatial requirements as populations fluctuate, flourish, migrate and adapt.

141 Royal Norwegian Ministry of the Environment, *Meld. St. 10. Report to the Storting (white paper. First Update of the Integrated Management Plan for the Marine Environment of the Barents Sea-Lofoten Area*. p 48

142 The Environmetal Group, *Danish Offshore Wind. Key Environmental Issues – a Follow-Up*. p 72.

COMPARATIVE TABLE OF PROPERTIES

	BARENTS SEA		BALTIC SEA	
Area	1,405,000 km^2		393,000 km^2	
Depth avg.	230m		54m	
Depth max:	600m		459m (Landsort deep)	
Length N/S	ca. 1200 km		1300 km	
Width E/W	ca. 1170 km		max Stockholm/St P. = 640 km	
			avg. width 193 km	
Borders:	Norway/Russia		Denmark/Germany/Poland/Lithuania/	
	/Denmark (Greenland		Latvia/ Russia (Kaliningrad)/Estonia	
	Sea w. of Svalbard >200nm*)		Finland/Sweden	
coastline	open		8000 km	
salinity	34.7 %		7% (20% of normal salinity)	
population	5.5 million		85 million	
	(Barents Euro Arctic Region**)		(drainage basin)	
urban centres	Arkangelsk 348,600	64° N	St Petersburg 5 million	60° N
	Murmansk 317,500	69°	Stockholm 2.2 million	59°
	Severodvinsk 193,000	64°	Copenhagen 1.9 m	55°
	Tromsø 72,000	69°	Helsinki 1.4 m	60°
	Alta 19,800	70°	Riga 696,000	56°
	Hammerfest 10,287	70°	Tallinn 543,000	59°
	Kirkenes 3,500	69°	Gdansk 462,700	54°
	Honningsvåg 2,415	71°	Kaliningrad 431,500	54°
climate	sub-arctic		maritime temperate + continental sub-arctic	
Avg. Air temp				
winter	-25° (N)/ -5° (SW)		- 11° (N) / 0.5° (S)	
summer	0° (N) / 10° (SW)		14-17°	
avg water temp	atlantic water 3.5-6.5°		deep water 3-6°C (all year)	
	coastal water 3.5-6.5°		winter surface water -0° (N)/ 2-3° (S)	
	arctic water -0°		summer surface water 12-15°(N) /16-18° (S)	
	summer surface +0°			
	winter- arctic water = 150m			
	summer- 5-20m melt water.			
Thermocline	s-w all warm Atlantic current		Bay of Bothnia- summer wind-mixed surface	
	n-e warm>30-50m depth		water 10-25m (ends in autumn)	
			Bottom layer colder/denser	
Pycnocline (density)	20-30m (nth of polar front)		halocline (salinity) 60-80 m (Baltic Proper & Gulf of Finland)	
Mixing of nutrients	40-60m (ice-free area)			
Sea surface temp:				
summer	5.5° (SW)		15-20°	
winter	4.5° (SW) -1° (N)		N- ice / 2-3° (S)	
avg winter ice-cover	60-70%		45% (Feb-March)	
pred. wind	sth-westerly (winter)		westerly	
	nth-easterly (summer)			
avg. windspeeds	10 m/s (summer less windy)		8 m/s (winter- stronger winds)	
topography	plateau		basins/sills	
seabed composition	hard bottom /gravel complex		soft sediments (mud) = 1/3	
	sand/sandy mud		sand/ hard sediments/clay	
exchange	fluid		limited- water remains for 30 yrs	

* the Barents Euro-Arctic region (1993) includes the northern half of Norway, Sweden & Finland, and the north/northwest of Russia and hence also includes cities on the Baltic Sea; Lulea, Haparanda (S)/Tornio & Oulu & Raahe (F). Only towns & cities with direct access to the Barents coast have been included in this table. (source: Røyseland and Oystein, *Northern Experiments. The Barents Urban Survey 2009*.)
** Ref www.barentswatch.no/en/Maps1/Law-of-the-sea/Oceanic-borders/
Sources Baltic: http://data.bshc.pro/#2/61.3/17.3 portal The *Baltic Sea Bathymetry Database* (BSBD) / HELCOM www.helcom.fi / Leppäranta & Myrberg. 2009. *Physical Oceanography of the Baltic Sea /* Environmental Science- *Understanding, protecting and managing the environment in the Baltic Sea Region.* 2003. Lars Rydén, Pawel Migula and Magnus Andersson (eds) The Baltic University Programme, Uppsala University.
Barents: WWF. 2003. *Barents Sea Ecoregion- a biodiversity assessment* /Sakshaug et al. 2009. *Ecosystem Barents Sea*
http://geodata.npolar.no/barentsportal/?&extent=-816757,7499650,2399214,9612023&layers=layer3:0

[31] Comparative properties of the Barents and the Baltic Seas.

can be abstracted, classified and generalized within larger socio-spatial processes and where new knowledge is generated.

This research followed an integrated approach using both empirical and theoretical methods. The four topics of Networks, Seascape, Technology and Ecology implicitly run through all nine principles in particular combinations to differing degrees. A more detailed view will also allow these four topics to be examined "on site" and to merge the findings of the literature review with the results of the spatial analysis.

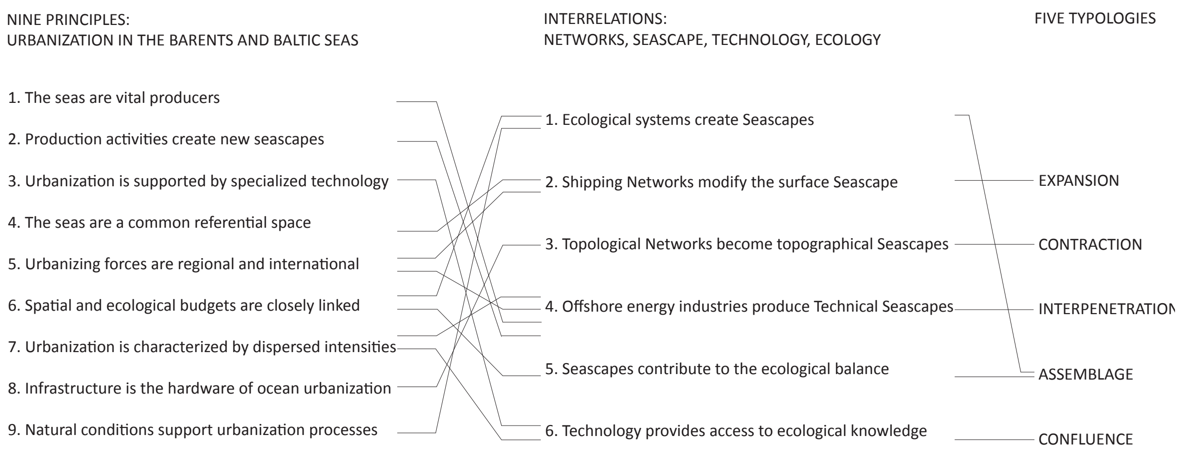
Therefore, through a combination of the conclusions drawn to date from both theory and practice as illustrated in [33], a distillation of five conditions takes place. Within the following chapters, these conditions are analysed and translated into five typologies of ocean space; Expansion, Contraction, Interpenetration, Assemblage and Confluence. Translation refers to the process of extracting generalized properties out of these concrete situations, which then qualifies each to be considered as a typology. I argue that through the typologies, a deeper understanding of ocean space under urbanization processes is gained.

The ocean is highly inter-scalar. On an individual basis, many "urbanizing" features of ocean space are relatively restricted in area compared to the sea as a whole. This is a repeated argument used to justify the encroachment of habitats through infrastructural projects. The foraging range of a harbour porpoise will be, for example much larger than the area of a windpark. But since environmental conditions are worsening, particularly in the Baltic Sea, I argue that the scale of interactions at the single sites chosen is significant. The dissolution of "natural" space and the disappearance of the wilderness have been discussed in previous sections of this thesis. The implication is that each type of ocean space is shared and contested. The scale of offshore activities is no longer outside the range of human concern. Further to this, as typologies, the single sites shed light on urbanization processes in the ocean in general. The sites can be compared to Studio Basel's "drill holes", or Boeri's eclectic atlas.

The typologies undergo a "conventional" analysis structured around the same themes as the seas themselves; physical oceanography, life-forms and urbanization forces. In addition, some situations reveal details which can be investigated down to the architectural scale. In this respect I have been led by the situation and have chosen different angles of inquiry according to the site and principles involved. The typologies are then linked to what I consider appropriate architectural texts and references in a more unconventional way. With this approach I aim to juxtapose the typologies to "partner" conditions which have been explored by other architects or researchers and therefore to underline their potential as universalized categories.

	BARENTS SEA	BALTIC SEA
Physical borders	Open	Semi-enclosed
Inherent seascapes	Archipelagos / rocky shores / deep-water ports / ice-edge / wide spaces / primary production high / abundant fish / abundant bird-life	Archipelagos /sandy shores / shallow bays /ice-edge /narrow spaces / primary production too high / fish in danger / abundant bird-life
Segments	3	14
Water exchange	High	Low
Loading capacity	Absorbent	Saturated
urban /ocean space	Strategically merged	Overlapping
density	Loose, even	Congested nodes
Border effect	Low	High
Cycles	Seasonal	Perpetual
Strongest urban force	Fishing/petroleum	Shipping/ wind energy
Regional significance	Medium	High
International forces	High	Med-low
Network type	International industries	Local Shipping / energy
Cultivated seascape	Fishing	Energy /recreation
Ecological systems	Clean / functioning /robust	Polluted /overloaded / fragile
Production relevance	High	High
Local accessibility	Restricted (shoreline)	High
Human interaction	High	High

[32] Profiles of the Barents and the Baltic Seas.



[33] Distillation of Typologies.

[33] MS Amigo

3.6 INTERPENETRATION

INTRODUCTION

This thesis aims to reveal specific typologies of extended urbanization in ocean space. The analysis of the Baltic Sea showed that wind-energy production is creating new seascapes through the command of large offshore areas and that sites suitable for wind power are important habitats for other species, in particular for wintering birds or spawning fish. The Baltic Sea is characterised by these interrelations between ecology, seascape and technology. An examination of an offshore windpark should lead to a clearer understanding of how these relations are structured in time and space.

TECHNOLOGY, ECOLOGY, SEASCAPE

Offshore wind-power installations represent an extension of technology developed and refined on land.[143] In addition to structural responses to the harsh marine environment, the technological component includes a high degree of automation, requiring minimal manual intervention for servicing and maintenance. The wind-energy industry generates a significant degree of employment. These occupations are stretched over many fields and disciplines and are geographically widely dispersed.[144] This has been recognised as a characteristic of "technological zones",[145] where specialized industries operate on a global scale, largely independant of existing local resources. Hence the final assembly of an offshore windpark represents the last stage in a process involving intense human activity on and offshore.

While in the Baltic Sea the closest human residents are located some distance away on land, offshore windpark areas are inhabited by important bird, fish, plant and mammal life, some of which are protected both at the European and national level. These life-forms are part of the definition of ocean territory and charge the ecological systems at work on the site. The erection of a windpark in ocean space – also referred to as a *wind farm* - presents a new physical articulation of seascape production processes. The Danish Energy Agency call this "harvesting the wind".[146] This type of harvesting has a marked effect on the visual environment, constructing a new type of productive seascape.

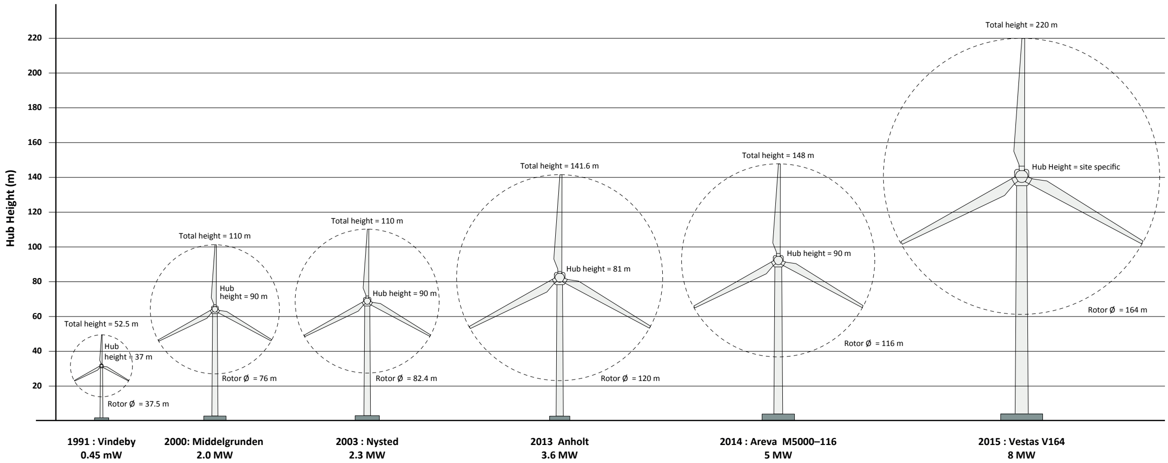
The examination of an exemplary windpark as a spatial typology, should therefore enable us to:

– Reach an understanding of the reciprocal effects and mutual dependencies between organic and inorganic systems. An analysis of the space in terms of its visual, structural and temporal qualities for all "users" should reveal these effects.

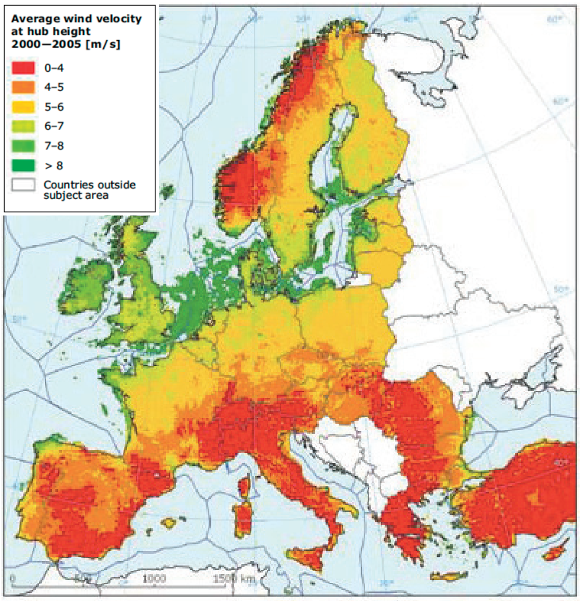
– Link these installations to urban discourse through interrogating the windpark as an urban ensemble and its parts as architectural objects. External references assist this process.

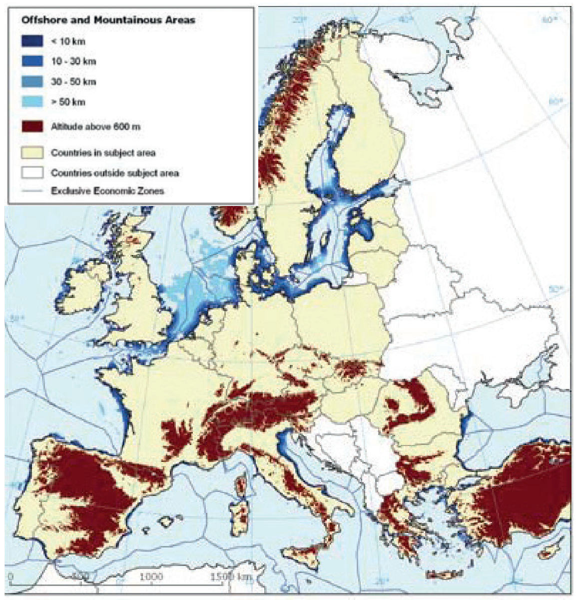
The Nysted offshore windpark, in Danish territorial waters, has

143 See. 2.4 TECHNOLOGY
144 Reichsteiner, Wind P*ower in Context- A Clean Revolution in the Energy Sector*.
145 Barry, *Technological Zones*.
See 2.4 TECHNOLOGY
146 The Environmetal Group, *Danish Offshore Wind. Key Environmental Issues – a Follow-Up*. p 21.



[34] Offshore wind turbine development.





[35] Wind speeds m/s at hub height.

[36] Offshore locations with a water depth < 50m.

been chosen as the object of this study due to its accessibility.[147] A site visit was crucial to this research in order to experience the windpark at close-range from the human perspective. The possibility of gaining unproblematic access to the park is a significant factor in the definition of the Interpenetration typology which follows at the end of this chapter.

3.6.1 WIND POWER

Wind power is linked to geography. Optimal locations for offshore windparks are determined both by natural phenomena such as the wind, water and subsea ground conditions, as well as infrastructural conditions such as grid connections and proximity of end-user populations. In Europe, the fact that 40% of the population live in coastal areas strengthens the argument for offshore wind energy. The production of offshore wind energy is a new type of activity for ocean space. The first offshore installation of 11 turbines was built in the Baltic Sea at Vindeby, Denmark, in 1991 at a distance of 2 km from the coast. Since then the quantity and size of offshore turbines has increased exponentially [34].[148]

The European Environment Agency has identified the Baltic Sea, the North Sea and the Mediterranean as the important European locations for concentrated offshore wind-energy potential [36].[149 – 150] Winds passing over the sea encounter no obstructions and less surface friction, therefore offshore wind speeds are considerably higher and more regular than on land [35].

Denmark boasts a long tradition in the development of wind energy and is one of the European leaders in the field. Innovations have been implemented across a broad range of users, parties and government agencies. These include a streamlined system for issuing the three required licences, models that offer local individuals shares in the ownership and consulting processes with communities affected by developments. The Danish cultural-technical context reveals a high social acceptance of windparks, due largely to these innovations.

Nysted windpark was chosen as a test site for one of five demonstration wind energy projects by the Danish government in 1995, with the objective to expand power supply with offshore installations. Currently, with wind-energy production at 1,271 megawatt (MW), Denmark is assumed to be on target for their goal of 50% electricity production through wind power by 2025 (= 4,200 MW).[151] The windpark at Nysted consists of 72 turbines of 2.3 MW capacity, arranged in 9 rows of 8 turbines and covering an area of 28 km^2. Energy production began in December 2003.

This typological study adheres to the structure offered by the definition of ocean territory and will therefore revisit the oceanographic site

147 During the course of this research, three earlier attempts had been made to visit an offshore windpark in three different locations. The failure of these attempts was due to; unfavourable weather conditions in which case the boat was cancelled, technical issues which meant the windfarm was not actually functioning at the time of the planned visit, and security regulations which meant the application to visit was denied. In October 2014 a private excursion departing from Gedser harbour to Nysted windpark was organised on a chartered fishing boat, MS Amigo, with three further guests from the wind-energy industry in northern Germany.

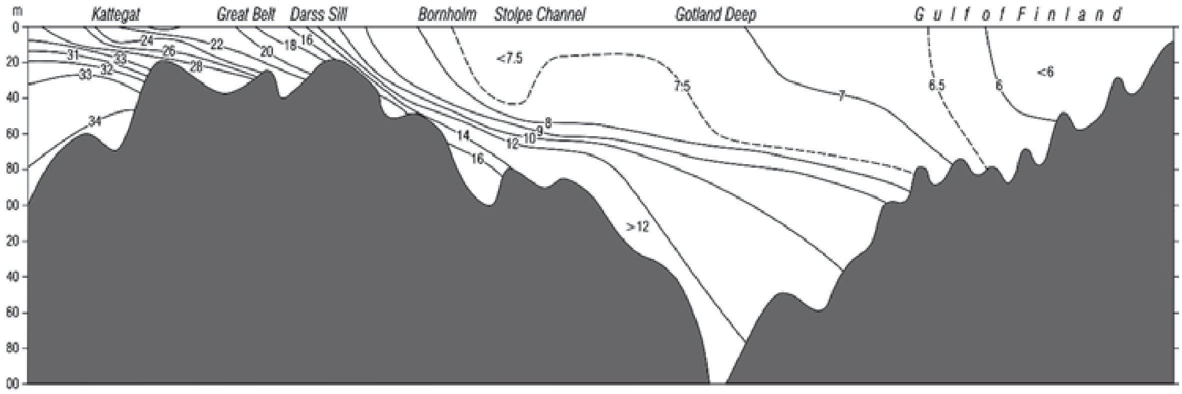
148 See APPENDIX: Baltic windparks

149 At sites between 10 – 30 km from the coastline with a water depth of less than 50 m.

150 *The European Offshore Wind Industry – Key Trends and Statistics 2013*.

151 Ibid.

[37] Location of Nysted windpark



[38] Bathymetry and salinity, February 1971

conditions, life-forms and forces of urbanization operating in the area. In addition, the *architecture of wind* will be discussed as well as the windpark layout in reference to utopian urban concepts offered by *architettura radicale*.

3.6.2 TERRITORIAL CONTEXT

PHYSICAL OCEANOGRAPHY

The Belt Sea in the south-eastern Baltic is a transitional zone between the Baltic Sea proper (Gotland Basin) and Great and Little Belts, which provide access to the North Sea [37]. The space is defined through the bathymetry of the Fehmarn Belt to the west and the Darss sill to the east (-18 m depth). The water is shallow with a maximum depth of just over 20 m. Islands and narrow waterways are numerous towards the west and the Belts leading to the North Sea. The islands are largely flat, subject to flooding, and interconnected through a system of bridges and ferries. The margin between the condition of land or sea is blurred; islands and sandbanks are partially exposed, partially submerged, and particularly the sandbanks, move and expand- a preliminary type of interpenetration between land and sea.

In this part of the Baltic Sea the water-masses create a transitional zone where the temperature and salinity of the incoming water from the North Sea changes as it moves further into the Baltic Sea proper. The water can be either mixed throughout the water column or stratified, depending on wind and flow conditions. Near the seabed water masses flow slowly inwards, while the lighter surface-water flows faster out towards the North Sea.[152] In the Baltic Sea proper, which begins in the Gotland Basin, the inflow of fresh water from rivers results in brackish water of low salinity [38]. Ice conditions are variable in this part of the Baltic Sea and it is regularly frozen over but tidal differences are insignificant.

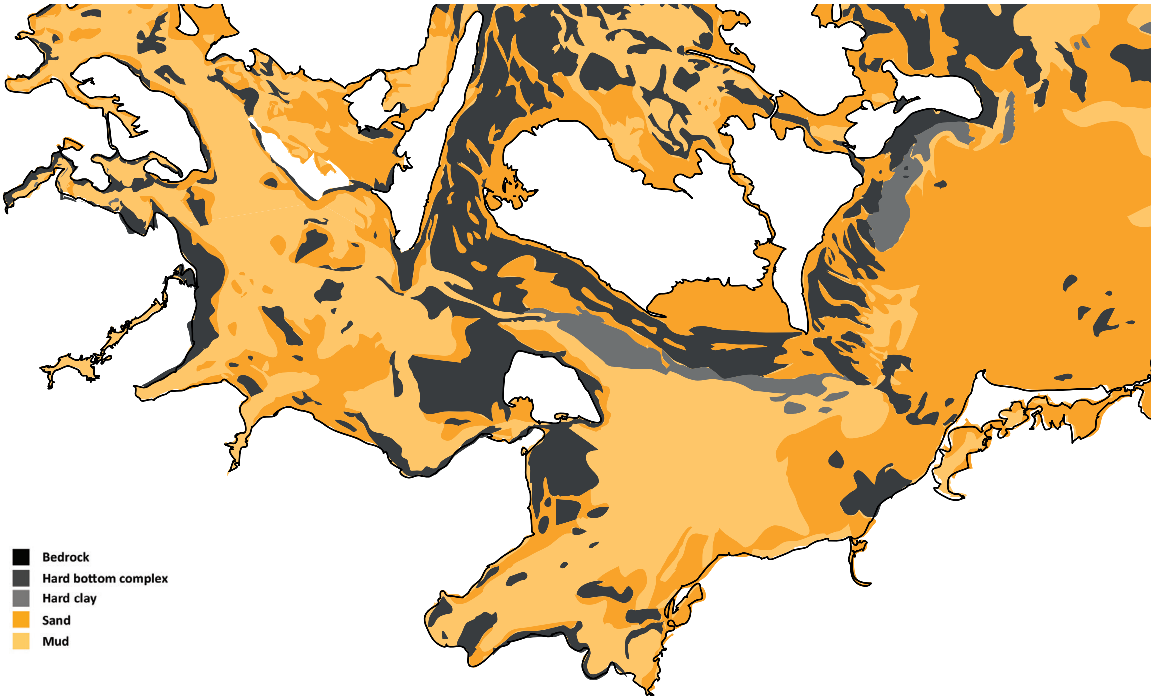
The seafloor is composed of a mixture of sand and hard-bottom complex sediments with mussels dominating the benthic fauna [39]. They in turn provide a substrate for brown algae which grow May to June. The Rødsand Lagoon is defined by natural sand formations at its entrance, called eastern Rødsand and western Rødsand which move and change according to the flow of materials in the water. The environmental impact assessment describes a natural movement of 15m/year to the east.[153] In the soft-bottom areas of the western lagoon, a wide distribution of flowering eelgrass can be found.

LIFE-FORMS

The sheltered conditions and plentiful food supply make the Rødsand Lagoon an important breeding, resting and feeding ground for birds. Swans feed on the eelgrass in winter and birds use the area to breed including the March Harrier, Avocet, and the Arctic, Common, Little and Sandwich Tern. The lagoon and windpark also lie on an important bird migration

152 Brøker, Hansen, and Middelboe, *Eia for the Fehmarnbelt Crossing: the World's Longest Immersed Tunnel*. Outflowing water can reach 1.3 m/s, whereas incoming water is around 0.4 m/s.

153 Elsam Engineering and ENERGI E2, *The Danish Offshore Wind Farm Demonstration Project: Horns Rev and Nysted Offshore Wind Farm. Environmental Impact Assessment and Monitoring*.



[39] Sediments, detail.

[40] Important bird areas and Helcom Marine protected areas.

[41] Mussels colonising the protective boulders, foundations Nysted windpark.

route, the East Atlantic Flyway.[154] The Eider, Mute Swan, Whooper Swan, Brent Goose, Bean Goose, Goldeneye and Coot gather here to rest during migration. For these reasons the lagoon has been protected under the European Community (EC) Habitat directive, the EC Bird Directive and the Ramsar Convention [40].[155 – 156] During the spring migration between April and May around 43,000 Eiders and 4,000 Brent Geese pass through Rødsand Lagoon. During the autumn migration, in September and October, around 515,000 birds of different categories pass through every day.[157]

The Atlantic Cod, Sprat, Baltic Herring and Small and Grey Eel use the windpark as part of a larger feeding, breeding and spawning ground. Trawling is prohibited in the area, therefore fish populations are indirectly protected after the construction phase. In many windparks, the solid foundations and large stones used to protect them, provide a new hard-bottom substrate for marine communities which would not normally be present in a sandy-bottom location [41]. This can improve biodiversity and attract fish species. At Nysted, however, the main population to colonise the substrate was the large common mussel, which is only “moderately attractive for creating a diverse fish habitat.”[158]

A resident population of Harbour Seals and a few Grey Seals are present at Rødsand, with numbers estimated at “a few hundred” and sixteen respectively.[159] The foraging range of a Grey Seal is greater than the Harbour Seal, which tend to stay in the immediate area. A seal sanctuary has been established on the eastern sandbank, ca 3 km from the closest turbine. This is an important breeding site for Harbour Seals [40]. The protected Harbour Porpoise also uses the area around Nysted as a foraging ground, and although the population density there is relatively low, the designation of the EC-habitat and HELCOM protected area at Rødsand is directly due to its presence. They are sensitive to noise disturbance and have been sighted in reduced numbers and only at distances of up to 15 – 20 km from Nysted windfarm during the construction and operation phases. The close proximity of heavy shipping traffic is also a disturbance for the Harbour Porpoise.

URBANIZATION

The Rødsand Lagoon region reveals a higher degree of urbanization in the offshore zones than in the collection of small coastal towns of Gedser, Nysted and Rødby which have populations of 764, 1336, and 6,590 respectively. Nysted was originally the only natural harbour on the south Lolland coast and is historically the most established settlement. North Germany was part of the Danish Kingdom until Denmark’s defeat to Prussia and Austria in 1864. Up until that time a strong connection existed across the

154 Many arctic and boreal birds that breed in North-Western Russia between the White Sea and Taimyr migrate to and from their East-Atlantic wintering grounds through the Baltic Sea. This migration route is the East-Atlantic Flyway.

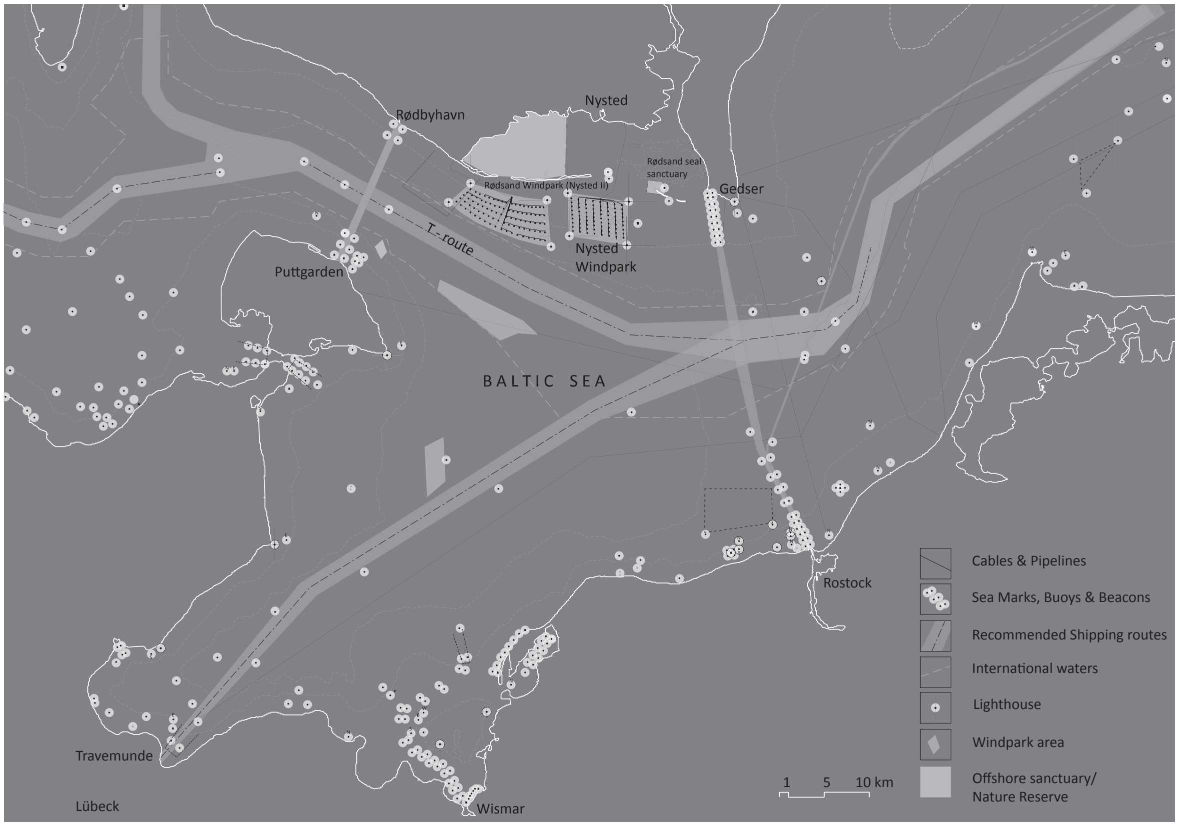
155 Elsam Engineering and ENERGI E2, *The Danish Offshore Wind Farm Demonstration Project: Horns Rev and Nysted Offshore Wind Farm. Environmental Impact Assessment and Monitoring*.

156 Ramsar Convention- the Convention on Wetlands of International Importance. www.ramsar.org

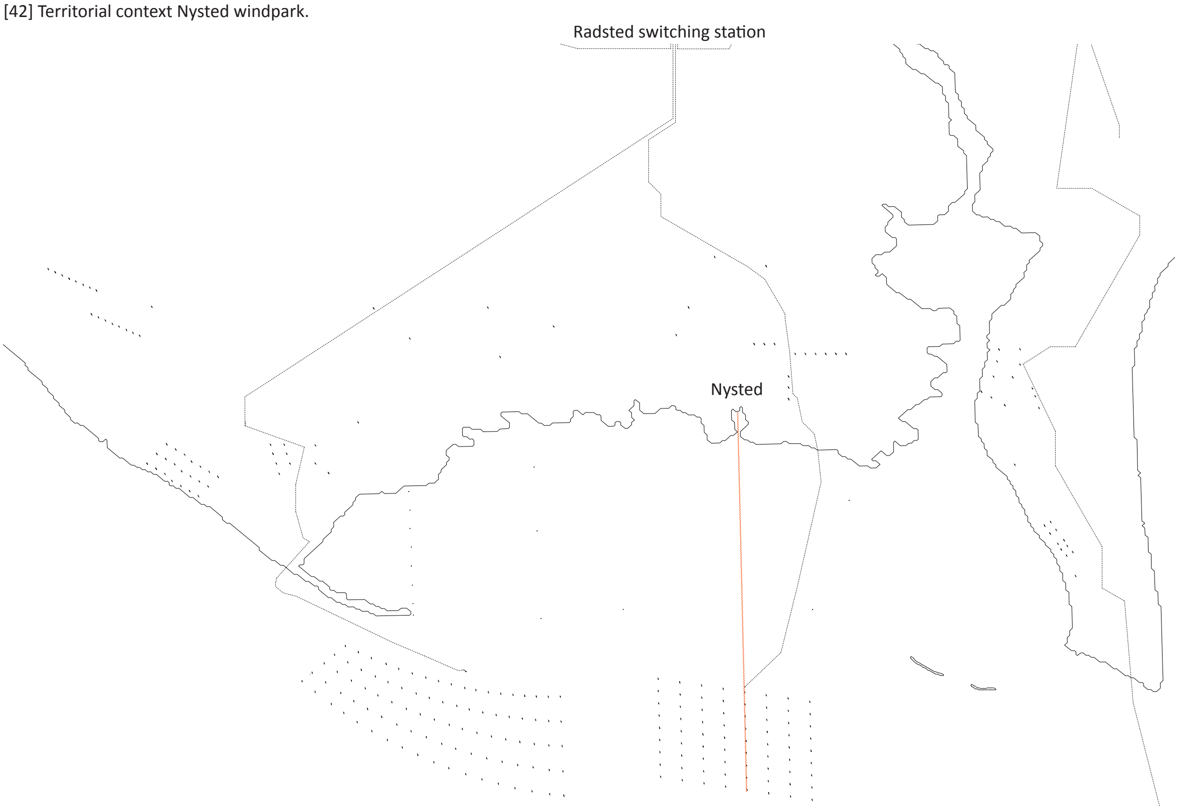
157 Elsam Engineering and ENERGI E2, *The Danish Offshore Wind Farm Demonstration Project: Horns Rev and Nysted Offshore Wind Farm. Environmental Impact Assessment and Monitoring*.

158 The Environmetal Group, *Danish Offshore Wind. Key Environmental Issues – a Follow-Up*.

159 Elsam Engineering and ENERGI E2, *The Danish Offshore Wind Farm Demonstration Project: Horns Rev and Nysted Offshore Wind Farm. Environmental Impact Assessment and Monitoring*.



[42] Territorial context Nysted windpark.



[43] Wind energy infrastructure on- and offshore, Rødsand lagoon.

Baltic Sea with a regular exchange of livestock and materials over centuries. Rødby and Gedser have gained importance through direct ferry services to Germany; between Puttgarden and Rødby (18 km) and Rostock-Gedser (66 km). Scanlines operate both routes and offer 45 daily Puttgarden-Rødby crossings which take around 45 minutes, making it one of the busiest ferry routes in Europe. The Rostock-Gedser route operates around 10 times daily, taking approximately 1 hr 45 minutes. Currently feasibility studies are being carried out for the construction of an underwater tunnel or a permanent bridge between Puttgarden and Rødby in order to increase the capacity of this crossing.[160] With its cente-line at a distance of just 8 km to the south of Nysted windpark, the T-route shipping lane connects the Baltic Sea to the North Sea with a volume of 48,000 ships/year [42].[161] Combined, this shipping activity creates a zone of intensive sea crossings.

Within the lagoon itself, the sandbank barrier to the Belt Sea creates a natural route for boats through the shallow lagoon to Nysted harbour – the Ostre Maerker. Reports indicate 800 pleasure boats pass through this route annually. This course has been continued diagonally through the windpark and visits to the park can also be organised through a charter fishing boat. While the windpark creates a visually "dotted" border, access to the ca. 28 km^2 park itself is not restricted, but anchoring and mooring at the turbines and trawling are prohibited due to the risk of damaging the undersea cables. Additional restrictions are generated by the protected bird and habitat zones described above. The potential of the "natural and anthropogenic landscape" is firstly derived from existing conditions such as those described above.[162] Once a windpark is established, these conditions are mutually modified.

Nysted's selection as one of the five offshore demonstration project locations was due to local windspeeds, the shallow water-depths of 6,5 – 9 m and the proximity of the high-voltage grid connection at Radsted switching station 18 km away [43]. The port of Gedser was also able to provide the necessary infrastructure for the operational service base. Since maintenance teams are on site daily during the summer service season, the vicinity of the port was a deciding factor. These long daily offshore distances and potentially rough seas represent considerable additional costs for the running of the windpark.

The exact orientation of the 72 turbines was established in consultation with the local community in Nysted in order to minimalize the volumetric visual impact of the park. An almost north-south orientation of the eight rows of nine turbines was agreed [43]. Turbine and row spacing is otherwise determined by predicted maximum efficiency of capturing wind energy, including the wake effects of upwind turbines. Hence distances are calculated according to rotor diameter. The cross-wind and downwind spacings at Nysted are 5.8 x and 10.5 x rotor diameter respectively.

During the 20 year life-span of the project, the operational phase represents an almost static period in urban terms, since the prefabrication, transport and construction of the park mobilized different faci-

160 Brøker, Hansen, and Middelboe, *EIA FOR THE FEHMARNBELT CROSSING THE WORLD'S LONGEST IMMERSED TUNNEL*.

161 Elsam Engineering and ENERGI E2, *The Danish Offshore Wind Farm Demonstration Project: Horns Rev and Nysted Offshore Wind Farm. Environmental Impact Assessment and Monitoring*.

162 The Environmetal Group, *Danish Offshore Wind. Key Environmental Issues – a Follow-Up*.

[44] Visual occupation of surface zone through perspective of turbine alignment.

[45] Minimal human-scale details.

[46] Approaching turbine F1, Nysted.

lities, dispersed throughout the Baltic and beyond. The disturbance factor through noise and vibrations is highest during the construction phase – in the case of Nysted the excavation and construction was carried out between August 2002 and November 2003. Neighbouring Rødsand II, was constructed between 2008 and 2010. Together, the two farms present a curtain of towers to the Belt Sea, but are however conceived, owned and operated as two distinct projects. Nysted windpark has been owned by the Danish concern Dong Energy since 2003 (Pension Danmark 50%, DONG energy 47,25%, Stadtwerke Lübeck 7,25%) whereas Rødsand II is owned and operated by E ON Climate & renewables GmbR.[163] The two sites do not comprise a unified area. The curved layout of Rødsand II represents the application of new knowledge in terms of efficiency and wake studies, whereas Nysted suffered wind-loss after the construction of the second park upwind. Rødsand II and Nysted windparks comprise 162 turbines in total. In the immediate region, around 100 on-shore turbines have also been installed in smaller groups with more individual ownership structures [43].

CONCLUSION TERRITORIAL CONTEXT

Windparks seek some of the the same environmental criteria as other users of ocean space. They prefer sandy sea-beds, high wind-speeds and shallow water within 10 – 30 kms from shore. Each of these elements becomes a resource shared with, for example benthic life, recreational sailors, migrating birds and fish. Wind energy in the form of air currents is also utilized by migrating birds to transport them across the Baltic and further. The environmental impact report for Nysted concluded that migrating birds “show a natural response to the windfarm, specifically reacting by increasing lateral avoidance to the north and south of the windfarm”.[164] In this sense, birds and windparks must come to “share the wind”.[165]

3.6.3. THE ARCHITECTURE OF WIND

I claim that offshore windparks are a form of extended urbanization. The key generator is the wind itself. The “urban” configuration of the farm layout has been described above. From the human perspective, 3 vertical zones can be identified:

– Undersea: occupied by foundations, sea-bed organisms, fish and mammals.

– Surface: occupied by turbine shaft, shadows, sounds, boating, human visual realm where the airspace is perceived.

– Air-space: capturing of the wind energy through blade movement and nacelle, bird habitat.

Of the three zones, human perception is most affected by the zone we occupy, hence the surface zone. At Nysted, this zone has a height

163 See APPENDIX: Nysted Facts.

164 Elsam Engineering and ENERGI E2, *The Danish Offshore Wind Farm Demonstration Project: Horns Rev and Nysted Offshore Wind Farm. Environmental Impact Assessment and Monitoring*. p 93

165 Nadaï and Labussière, *Birds, Wind and the Making of Wind Power Landscapes in Aude, Southern France.* This paper discusses the ways in which windpark planning can be informed by the behaviour of birds; *We approach landscape through the logic of affect, that is to say, by following the way in which birds might come to share the wind with wind power (and vice versa) and the way in which emerging wind power landscapes and planning might succeed (or not succeed) in recomposing the relations between these parties.*

[47] Nacelle F1 in windzone, Nysted.

[48] Nysted windpark from Rostock-Gedser ferry, 19.30pm 3.08.13 distance ca. 10km.

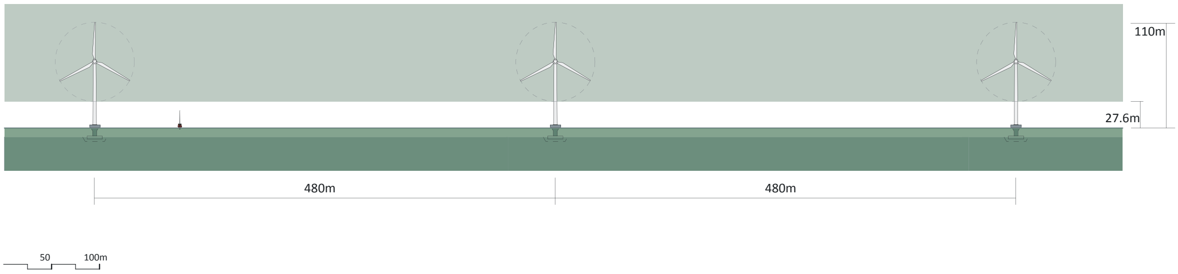
[49] Nysted windpark from from Kelby beach, 18.20 pm 16/10/14 distance ca. 10km.

of 26.4m up to the blade tip, which has a rotor diameter of 82,4 m [50]. The normal mode of experiencing the park is from a distance. At a distance, perspective effects bring the rotor zone into the surface zone, hence a larger segment of space is visually occupied [44]. Due to the lack of detail at the human scale, the turbines remain intangible and abstract on closer inspection. Architecture will reveal new information at closer range; surface texture, material qualities, connections, relief and contact hardware. However, changes to turbine detail revealed with the change of scale, are the minimal elements of human access; handrails, a “house” number and an entrance door [45]. The shaft is immutable smooth steel, coloured “airforce grey” to blend in with the atmospheric effects at sea [46]. The energy source of wind remains invisible, but its effect is transmitted through the turning rotor blades [47]. Even at close range, the turbines retain an icon-like abstraction, hardly to be perceived as structures in their own right, rather silent background figures to be perceived at a distance. The vertical shaft fulfils a primary function of transmitting the energy to the sub-sea cable, and a secondary function of structural support.

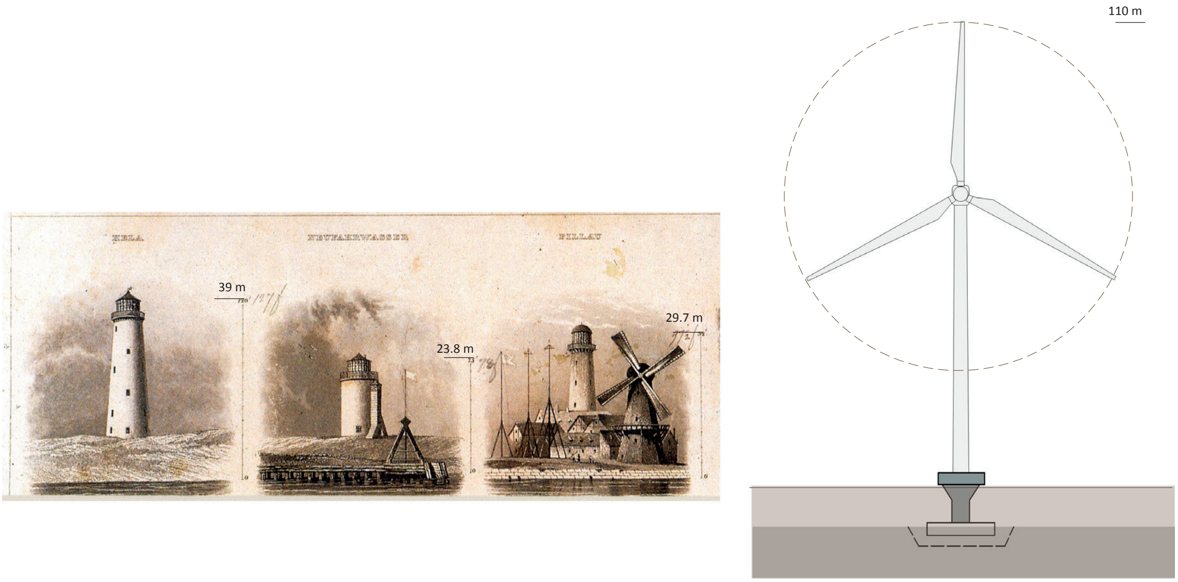
Wind turbines are not the first marine infrastructural towers. The Prussian Sea Atlas from 1841 describes lighthouses in the Baltic Sea; Hela (in the Bay of Gdansk), Neufahrwasser (Gdansk) and Pillau (entrance to the Vistula lagoon, Kaliningrad) with heights of 127` (ca. 39 m), 798` (23.8 m) and 97.5` (29.7 m) above sea-level respectively. At Pillau, a windmill stands next to the lighthouse [51]. These lighthouses are roughly the height of the surface zone at Nysted (24 m). Lighthouses are also structures in the domain of engineering, not generally designed by architects, but since lighthouses were designed to be seen, visual features were often included such as the expressive use of colour. The lighthouse is, however, a singular structure, not conceived in a group formation. The architecture of contemporary wind turbines is generated by high-technology building materials and surfaces which provide least resistance to the wind. While they are often highly visible, windparks aim at visual discretion and have not been the subject of performative or artistic expression. Through the comparison with historical lighthouses, I propose that wind turbines present a new generation of infrastructural towers located in the marine environment. Proportionally, wind turbines far exceed the height of a “human” surface zone, and so inhabit, or occupy a new zone of ocean space: between 30 and 110 metres and beyond. At Nysted, the turbines installed in 2003 have a capacity of 2.3 MW, which also indicates their relative size. Due to the scale advantages of offshore sites, the latest turbines have reached 8 MW capacity with a total height of 220m, double the height of the installations at Nysted [34].[166]

The visual seascape at Nysted is dependant on weather conditions. In the environmental assessment it was concluded that the “normal“ visibility would be reached from shore only on relatively few days a year. Hence the atmospheric elements contribute to the visual definition of this new seascape, and in masking it [48- 49]. Surveys undertaken with residents in the Nysted, and other Danish offshore windpark areas, reveal a positive attitude to existing and to new offshore windparks.[167] However in Nysted,

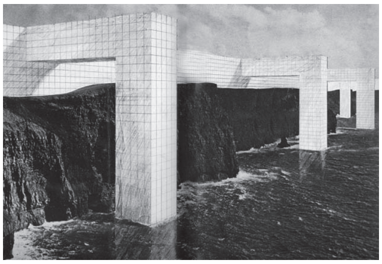
166 Zarin, *World’s Most Powerful Wind Turbine Now Operational*.
167 Ladenburg et al., *ECONOMIC VALUATION OF THE VISUAL EXTERNALITIES OF OFF-SHORE WIND FARMS.*



[50] Three vertical zones; wind zone, surface zone (white) and sub-surface.

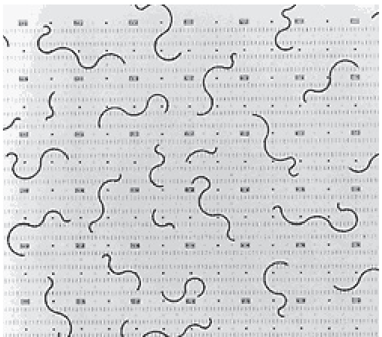


[51] Scaled comparison of Baltic Sea lighthouses and a Nysted turbine.

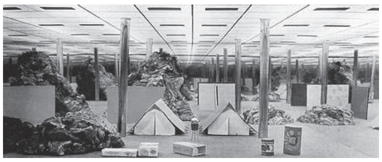


52] Superstudio: Monumento Continuo.

[53] Superstudio installation *Italy: The New Domestic Landscape,* MoMA 1972.



[54] Archizoom, No-Stop City, 1970.



[55] Archizoom, No-Stop City, 1970.

the question of proximity is more sensitive than in other areas, as it is located only 10 km offshore. Nysted survey participants were ready to pay slightly more for electricity produced from a windpark further offshore.

3.6.4 RADICAL ARCHITECTURE – TOTAL URBANIZATION

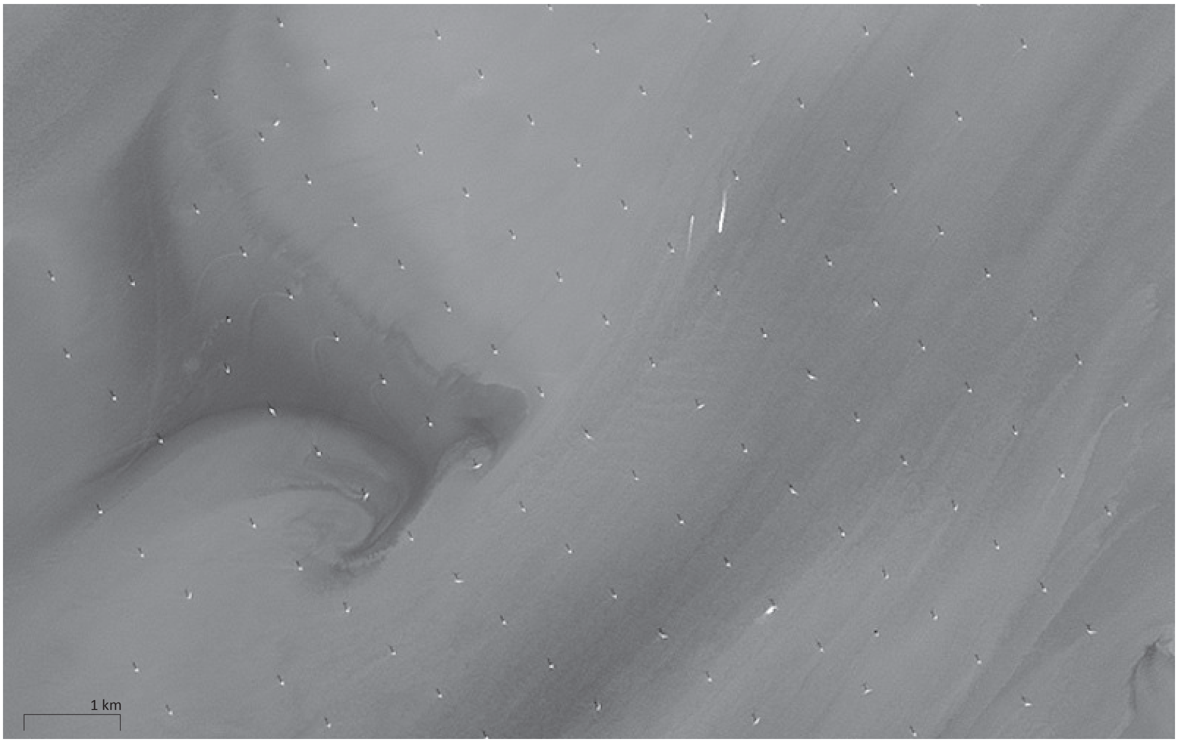
The layout of the Nysted windpark is a regular grid extending over an area of 28 km^2. It is a space at once defined through the grid as a referential system, yet vacant as a surface. Hence it is a space of potentials. The scale of both the vertical objects and the in-between space is generated by the scale of wind and exceeds normal urban experience. As an urban intervention, the surface zone comprises a minimum of elements – regular "structural" columns of monumental scale and purely functional form, and a shifting, shimmering plane of reflected light, mostly devoid of human activity. The space is loose and diffuse, yet determined with precise and geometrical precision. As a spatial concept, it is radical in its reductionist and technological format and almost utopian in its scale. In order to examine these characteristics, I propose to compare the windpark to the radical, "utopian" projects of Superstudio and Archizoom, two groups of architects belonging to what was post-humously called the Italian movement *architettura radicale* by the art historian Germano Celant.[168]

In 1969 and in connection with the Graz Biennale, Superstudio won the competition for a "Utopia for the Immediate Future" with their entry *Il Monumento Continuo*. The accompanying catalogue was entitled "Architektonisches Modell einer totalen Urbanisation" (Architectural model of a total urbanization). The project was both a reaction to the process of expanding urbanization they observed during this period and a provocation to visualise a radical alternative. Il Monumento Continuo was presented as an abstract orthogonal volume organised by a regular grid, in stark contrast to both the existing urban fabric or *natural* areas which interrupted the continuous monument [52]. No information on the interior space was given. This project initiated Superstudio's theoretical work on urban utopias and was to be followed by Archizoom's No-Stop City in 1970.

Superstudio went on to develop the continuous urban surface in their contribution to the 1972 MoMA exhibition "Italy: The new domestic landscape"; which comprised of nine panels and a film entitled *Supersurface*. *An alternative model for life on the earth*. This film describes a uniform, expandable horizontal surface articulated through a regular grid. Nodes formed at the intersections of the grid provide services and communication. Life unfolds across this surface through human relationships and events which require no further formal articulation – cities, streets and squares are no longer required. It is essentially a "life without objects" [53].[169] While the vision presented in this film is not intended to be a realistic proposal, in his review of the book *Superstudio: life without objects*, Gabriele Mastrigli comments on the prophetic similarities to the contemporary global condition; "individual but hyperconnected, flexible but rigorously controlled, surrounded by soft, wireless technology".[170]

The utopian aspect of these projects has been discussed by art historian Marie Stauffer, who argues that they are not utopian in the sense of offering a better future, rather they criticize the present, and through

168 Stauffer, *Utopian Reflections, Reflected Utopias*.
169 Lang and Menking, *Superstudio*.
170 Mastrigli, *Book Review: Superstudio. Life Without Objects*. Author's own translation



[56] London Array windpark.

their work, redefine the concept of utopia itself:

> "Ultimately the Florentine architects present Utopia as a conceptual framework for critical debate, in fact rejecting Utopia as a modern instrument in the progress of architecture. In so doing they deconstruct the modern type of Utopia- and replace it with their own: Utopia as a tool for critical reflection."[171]

Archizoom's *No-Stop City* used a similar visual language, and also offered a radical alternative to existing urban discourse, but in contrast to the *Monumento Continuo's* exterior volume, *No-Stop City* consisted of vast interiors inspired by contemporary supermarkets and factories and structured by regular columns based on a grid of typewritten points [54].[172] In *No-Stop City*, production and consumption are carried out side by side throughout the homogeneous and artificial spatial system [55]. For Archizoom, this project represents the logical continuation of the industrialization process to which modernism also belongs, to the point of eliminating form completely in order to arrive at a naked, inexpressive structure.

Both projects arise out of a response to the architectural questions of the period relating to a criticism of functionalism, but at the same time a fascination for its technological potential in the form of megastructures and flexibility, the leisure society, globalism and the new nomadism.[173] The geometrical grid is the system applied to resolve these questions, and together with the horizontal plane, an extreme reduction of spatial elements is achieved to the point of eliminating architecture altogether. This was Superstudio's ultimate intention and provocation.

In his discussion of the grid, Jacques Lucan writes of the No-Stop City : [it] "cesse d'être un 'lieu' pour devenir une 'condition'",[174] a comment originally made by Koolhaas about the city based on a typical grid layout.[175] I argue that these radical interpretations of total urbanization are relevant to the discourse on planetary urbanization, in particular the form of extended urbanization under examination in the Baltic Sea. The critical link is the organisational tool used to achieve each model; the grid. The utilization of a reduced, non-architectural "structural" system as proposed by Archizoom, is adopted at Nysted *by default*.

Offshore windparks, while not having been conceived as an *urban* vision, are however packaged as a *technological* vision in response to the demand for renewable energy. In the case of Nysted, the windpark is part of an urbanized realm bridging the Baltic Sea and bears evident visual and spatial witness to the otherwise distant and invisible worlds of energy production. At the same time, the vast horizontal surface, while providing essential infrastructural nodes, is decoupled from the society for which it is intended, and offers few opportunities for human experience, let alone habitation. This is not the case for windparks erected on land.

London Array is currently the world's largest windpark, comprising of 175 × 3.6 MW capacity turbines over an area of 100 km^2. The satellite Landsat 8 photographed this park on April 28, 2013 [56]. Here the precision and regularity of the grid appears in sharp relief against the tidal offshore

171 Stauffer, *Utopian Reflections, Reflected Utopias*.
172 Stauffer, *Figurationen des Utopischen*.
173 Stauffer, *Utopian Reflections, Reflected Utopias*.
174 Lucan, Composition, non-composition. "..ceases to be a place, to become a condition". Author's translation.
175 Koolhaas, *Delirious New York.*

context, which however, passes through the complex. Spatially, the elements comprising the grid are too slender to inhibit the ocean flows. In densely populated northern Europe, the layout of a grid of these dimensions across uninhabited regions is only possible offshore. *No-Stop City* and the *Supersurface* project are also uncompromising in their elimination of existing urban form. Through the lens of the Italian *architettura radicale* it is possible to view an offshore windpark as an urban configuration characterised by rigid geometry, a reduction of architectural elements to a minimum, a vast horizontal plane and a utopian dimension. The space itself is open-ended.

However, a critical difference lies in the lack of conceptual thinking, which would tie such technological achievements back to an integrated socio-spatial concept. The *architettura radicale* discussed here, while partly ironic, were the result of a critical interrogation of contemporary life, technology and culture. While, from a spatial point of view, similarities exist between these two, the realisation of the utopian dimension of offshore windparks has escaped discussion. Until now this domain has not been considered part of the urban realm. A critical difference also exists with regard to the natural world. As described above, windparks have distinct vertical zones. While the offshore *supersurface* is not inhabited, as illustrated by the London Array satellite shot, existing systems pass through the park below and above this space. The stripping away of the infinite horizontal surface from the spatial models of *architettura radicale* is a condition imposed by the ocean site as opposed to land. This enables an *interpenetration* of overlaying spatial systems.

3.6.5 SUMMARY INTERPENETRATION

Through the above analysis of physical oceanography, ecological systems, urbanization and the comparison to *architettura radicale*, I argue that the combined conditions at Nysted windpark are characterized by interpenetration. The particular location of Nysted within the Danish territorial waters is not yet completely *offshore* as defined in the Introduction to this thesis,[176] however I argue that this windpark can still be treated as exemplary, and that the critial characteristics of Interpenetration are transferrable to other offshore contexts. At Nysted the levels of integration are high, and therefore the relative extension of urban systems into distant ocean sites is not extreme. In the case of an offshore windpark, if the physical structures of the extended urban system are dispersed, singular interventions in an open configuration, technology, seascape and ecology will form a condition of *interpenetration* defined by the following interactions:

– Interdependencies are developed between marine life and new underwater materials, creating “artificial reefs” which attract shellfish and subsequently new species feeding on shellfish.

– Birds appear to avoid the park when migrating- this demands that the birds learn to adapt. The possibility of adapting the turbines themselves to bird migration also exists, but is seldom put into practice due to the

176 See 1.1.3 DEFINITION

high costs involved.[177]

– Differing levels of openness and closure allow different kinds of penetration. Regulatory boundaries are open and regular crossing of the space take place through individual sailing routes, tourist and research visits and daily maintenance. But in the case of trawling vessels, the underwater structures pose a security problem and the park is effectively "closed". This results in a partly protected habitat for fish populations within the zone.

– The defining boundary between land- and sea-*scapes* is blurred in this location due to shifting sandbars, low topography and the dispersion of wind turbines across land and sea.

The interpenetration typology at Nysted disproves the hypothesis that windparks are isolated, restricted, specialist areas. It forms a new energy landscape on numerous levels; It takes advantage of the "smooth space" of the ocean where there is less surface interference and generates energy in the upper zone. While the Danish model of decentralised energy production and local ownership is highly successful, Nysted has not been developed in this way. Social interpenetration is therefore lower than it potentially could be, but higher than other offshore windfarms, particularly outside Denmark. The phenomenon of displacement associated with extended urbanization, is here applicable to natural habitats for birds and mammals and the consequences must be closely observed. The environmental report for Nysted concludes that the size of the windpark is small in comparison to the habitats of birds and mammals, and therefore the environmental impact is minimal. However the condition of interpenetration implies that "uses" and relationships can be simultaneous and reciprocal rather than competing. This depends on a spatial and temporal arrangement of fixtures and disturbances which allows for ocean systems to adapt and to flow through.

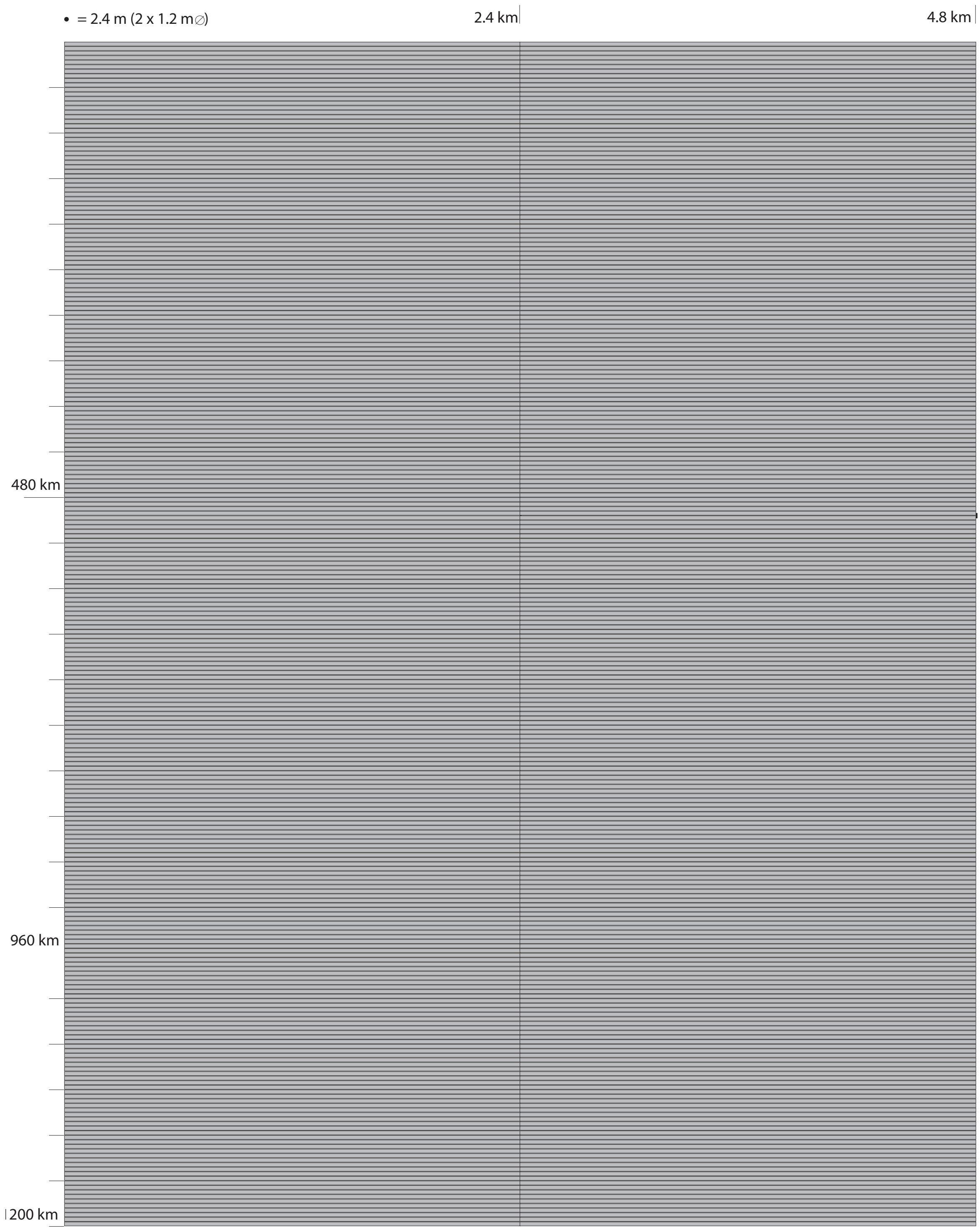
3.7 CONTRACTION

INTRODUCTION

Offshore cables and pipelines are large-scale infrastructures with a deceiving double scale; they are minimal in cross-section at the micro scale, but secure long-distance connections at the macro-scale. They form critical network links. The effects of such a network infrastructure, composed of multiple and potentially infinite connections, then becomes disproportionately large compared to their slight physical proportions [57]. In *Science in Action,* Bruno Latour describes this effect in relation to technoscience; "resources are concentrated in a few places- the knots and nodes- which are connected with one another- the links and the mesh: these resources transform the scattered resources into a net that may seem to extend everywhere."[178] He uses the example of telephone networks, which are fragile and minute, even invisible on a map, yet cover the whole world.

177 German legislation for a windpark building permit requires that the operator provides further data on flight patterns (of migrating cranes in this example) and develops a plan to avoid collision, for example with "averse conditioning installations" about which little is known, or by switching off the turbines in the case of a mass migration and low cloud, which means the cranes fly low and risk of collision is heightened. This must be delivered six months the park begins operating. Genehmigungsbescheid, Kriegers Flak, Bundesamt für Seeschiffsfahrt und Hydrography, Hamburg 06/04/2005. Available from: http://www.bsh.de/de/Meeresnutzung/Wirtschaft/Windparks/Genehmigungsbescheide/Ostsee/Kriegers_Flak/Genehmigungsbescheid_Kriegers_Flak.pdf Own translation.

178 Latour, *Science in Action*. p 80.



[57] Scale relations length/section. Nord Stream pipeline.

Such infrastructural elements are today de-spatialized as pure conduits which occupy a non-space between important points of supply, emergence or performance. Their singular role is a mere connection. But infrastructure is also an urban tool which equips and prepares territory. Its potential to support ecological functions, cultural production or to strengthen communities has been recognised by contemporary researchers.[179] From its original use in the domain of strategic military planning, infrastructure has an implied public dimension which extends beyond its direct physical range.[180] Landscapes are both transformed and created through infrastructural developments; "Landscape and infrastructure merge and movement corridors are (re)worked as new vessels of collective life."[181]

Infrastructure is employed by the forces of extended urbanization for territorial ends. In ocean space, the seascape is certainly transformed, but this type of urbanization is not accompanied by complimentary collective or ecological programmes. Instead, the specific nature of territorial modifications is closely aligned to the double-scale effects described above and the resulting ambiguity of presence/non-presence. Geographer Erik Swyngedouw describes these infrastructural elements as "the material mediators between nature and the city"[182] which have been buried and concealed from everyday urban life since the middle of the twentieth century[183]. He argues that it is through this networked commodification of nature*,* that for example gas or water becomes "severed from its historical and geographical (hence social) production processes:"

> "The use value of networks dwells exactly in their capacity of and role in facilitating the process of socio-environmental transformation and metabolization; the networks permit exactly the urbanization of nature and the fetishization of the commodities it carries."[184]

Through its burial, infrastructure is transformed into an abstraction and a discreet screening of the associated social relations and political alliances are enabled. Rendered invisible, infrastructure ceases to exist as a spatial phenomenon, while in reality it physically occupies and transforms large parts of ocean space. This inherent contradiction arises from the translation of network systems as a theoretical model - essentially non-scalar and made up of *vertices* and *edges*[185] – to the industrially-scaled reality of their physical implementation.

Linear network elements set forces in motion through the very connections they secure. At the same time, the in-between space – in this case of the ocean - has been transformed. A subsea pipeline is part of a *network* system, is executed using infrastructural *technology* and utilises and

179 Katrina Stoll and Scott Lloyd, *Infrastructure as Architecture*.

180 The essential characteristics of the post-war Infrastructure Programme of the Western Union are described as "responding to conditions, transcending geographies and serving as the ground for political negotiation", by Dana Cuff in *Architecture as Public Work*, Stoll & Lloyd, *Infrastructure as Architecture*. p 19.

181 Kelly Shannon and Marcel Smets, *The Landscape of Contemporary Infrastructure*.

182 Kaika and Swyngedouw, *Fetishizing the Modern City*. Gas, electricity, information etc.

183 Previously, in the 19th century, the urban infrastructure of dams, water towers, cables and tubes, was celebrated as a form of progress and incorporated into the everyday urban experience. Called *urban dowry* by Swyngedouw, they "became prominently visible in the urban during early modernity". Kaika and Swyngedouw, *Fetishizing the Modern City.*

184 Kaika and Swyngedouw, *Fetishizing the Modern City*.

185 See 2.1.1 ABSTRACT NETWORKS

transforms specific properties of the *seascape*. The Baltic Sea is characterized by a high network component, which is partly expressed through social liaisons and hence immaterial in nature. The examination of an offshore pipeline however, is an opportunity to test the spatial dynamics and dimensions of a *physical* network component, which is charaterized by *contraction*.

NETWORKS, TECHNOLOGY, SEASCAPE

As a liquid medium, the ocean is an environment of minimal friction, ease of transfer, and reduced boundary situations for systems of flow and exchange. It harbours the ambiguous space outside territorial boundaries, which in economic terms, directly translates into tax advantages for infrastructural systems.[186] Undersea pipelines are chosen precisely for these reasons; “Offshore lines minimize issues of land ownership and concerns of political instability.”[187] The political neutrality of this space combined with its extra-territorial status and the relative technical ease of offshore operations, make subsea pipelines an attractive logistical solution compared to overland options. Pipelines serve energy networks by steering energy flows through compressed pathways and defined connection points. They represent an underwater materialization of trading networks and provide a semi-permanent link between the energy source and the market. This is their primary function within the network.

The construction of a pipeline network is enabled by the application of specific technologies. These technologies are infrastructural in nature, forging links and compressing distance. Offshore pipeline construction technology has developed as an adaptation of land-based experience and in tandem to the industry’s offshore advancement into more difficult conditions.[188 – 189] A further technological component of the network comprises sophisticated logistics and long-distance systems of monitoring and control which operate at a global scale.

The interactions between pipelines and the seascape are largely concealed, since they take place on the seabed, out of the range of normal perception. Here the seascape acquires a specific infrastructural function over long distances. Knowledge is accumulated and assessments made. Clearing and preparation activities establish security zones, some of which remain long term. The pipeline is linked to the continuous space of the seascape for its duration- the seabed and the network components are physically bound here. The essentially topological network system becomes attached to the

186 The location of the Nord Stream pipeline outside the territorial waters of the Baltic rim countries presented interesting tax advantages for the company. This gave the undersea-routing option significant advantages over alternative routes on land. Source: Interview with Nord Stream Deputy Communications Director, 10/07/12.

187 Timmermans, *The Future of Offshore Pipelining*

188 Pratt, Priest, and Castaneda, *Offshore Pioneers Brown & Root and the History of Offshore Oil and Gas*.

189 The track record of offshore pipeline specialists Saipem, provides an insight into the progress in pipeline technology and reflects the demands of the industry including its global distribution over the last 70 years since the 1950s. Saipem built pipelines off the Egyptian coast in 1956 – 7, the Sicilian coast in 1961 and the first North Sea pipeline (with Brown & Root) 185 km long from the BP forties field to Cruden Bay, Aberdeen in 1973. At water depths of 100 – 130m, this was the deepest large-diameter (32 inch = 812 mm) pipeline ever laid (Pratt, Priest, and Castaneda 1997). Saipem were also contracted with the laying of the Nord Stream pipeline, which was carried out by subcontractor Allseas

underwater topography.[190] At the nodes of exchange, the pipeline emerges from its role as conductor to create an industrial seascape- a site of expansion of forces and space, which is marked by juxtaposition to recreational beach activities, protected natural areas and small-scale settlements.

WHY A PIPELINE?

The reason to examine the apparent banality of an offshore pipeline within this investigation, is to expose the spatial contradictions of scale, time and presence/absence implicit to the pipeline's system as it interacts with ocean space. Its real dimensions are concealed by the temporality of construction manoeuvres, the subsea site and the abstract nature of network systems. An examination of an offshore pipeline as a spatial typology therefore aims to:

– Analyse and represent the types of spaces on which a pipeline is dependant, the spaces it generates as a network component and the physical seascape transformations it effects.

– Evaluate the specific role of the ocean as a site for pipeline infrastructure compared to land.

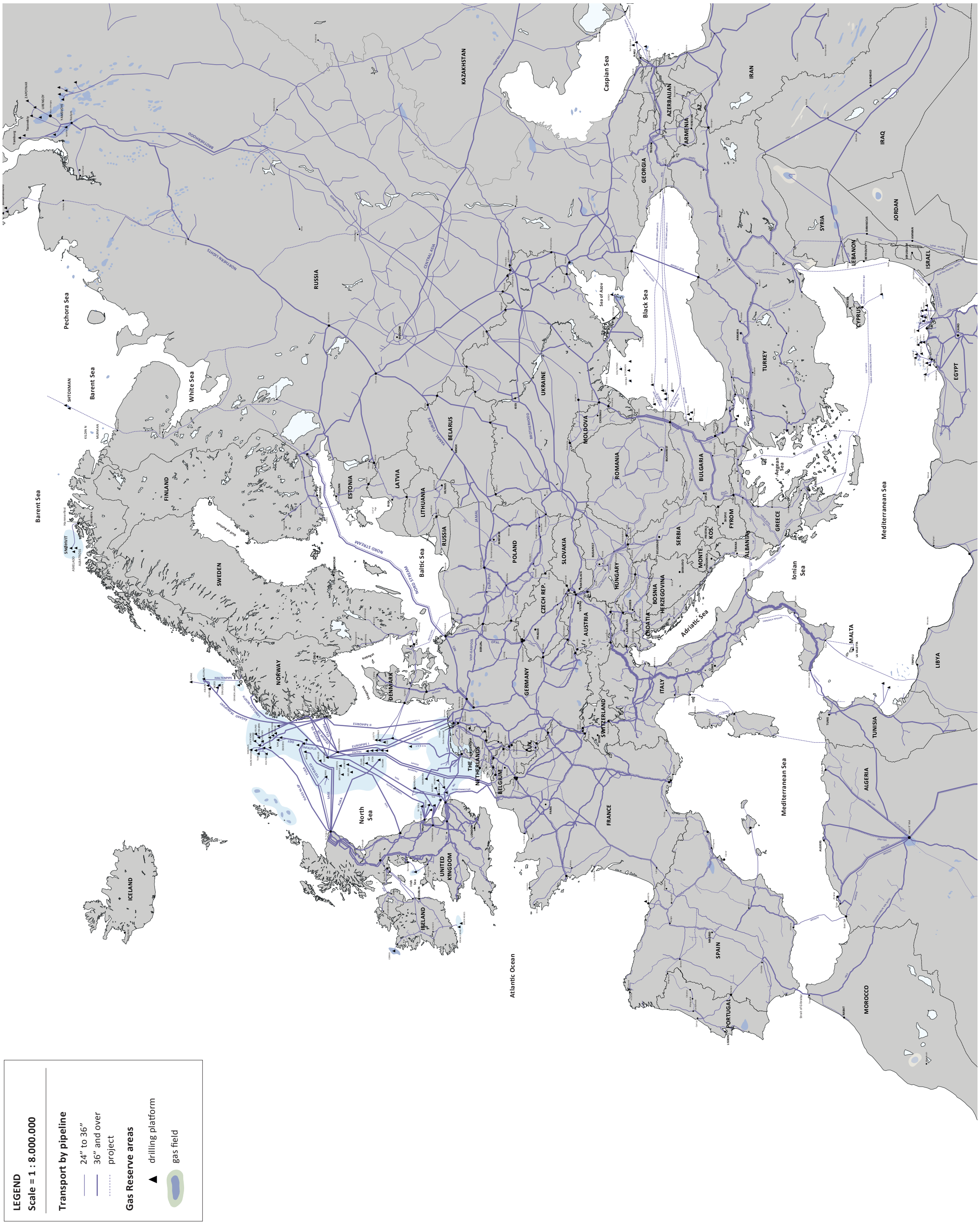
– Link and compare these findings to the theoretical discourse on networks.

NORD STREAM

The Nord Stream project – a twin, 1.2 m diameter gas pipeline installed along 1224 km of Baltic Sea-bed between Portovaya Bay near Vyborg in Russia and Lubmin in Germany – is chosen as the object of study. Nord Stream was constructed between 2010 – 2012 and is still the world's longest subsea pipeline, closely followed by the Langeled pipeline delivering natural gas from the Nyhamna gas processing plant in Norway to the Easington receiving terminal on the east coast of the UK – a distance of 1166 km. It therefore represents a major transformation to both the local Baltic Sea territory and the global energy network. Basic data on the pipeline is introduced for general orientation in Appendix 3.

The German landfall acts as a connection point for European energy networks within a gas extraction and supply system stretching from northern Russia to North Africa [58]. This new energy alliance between Germany and Russia was not unanimously favoured and the plans to double the line, which were already well underway by the time the second pipeline was on stream in October 2012, were finally put on hold in January 2015, according to a Gazprom announcement.[191] Baltic countries opposing Russian policies, such as Estonia, refused to allow Nord Stream surveys in their waters, indirectly determining the routing of the proposed extension.[192] The pipeline therefore represents a tightrope between both national politics and trans-national energy concerns and between the Baltic Sea environment and industrial degradation, since any leakages or technical failure would have immediate and detrimental consequences for the Baltic Sea ecosys-

190 For definitions and a discussion on *topography* vs *topology,* see 2.3 NETWORKS
191 Denis Pinchuk, *UPDATE 2-Gazprom Mothballs Extension of Nord Stream Pipeline*.
192 David Langlet, *Nord Stream, the Environment and the Law: Disentangling a Multijurisdictional Energy Project*.



[58] Gas pipelines in Europe.

tem.[193] Despite some protests, the pipeline managed to occupy a grey area in legal, environmental and security terms, since there was no EU precedent for infrastructural projects of this dimension in ocean space shared between nine nations.[194] According to UNCLOS, pipelines and cables hold a privileged position in ocean space, and in fact their installation cannot be prevented by bordering states.[195]

The investigation concentrates on the spatial characteristics of the pipeline, which, due to its network function, are both physical and virtual. Two site visits were conducted in July 2012:

– To the managerial control centre in Zug, Switzerland.[196]
– To the landing site at Lubmin, Germany.

The pipeline crosses a major part of the Baltic Sea, therefore new relationships to oceanography, life-forms and urbanization forces have been established at both the micro- and the macro-scales.

3.7.1 TERRITORIAL CONTEXT

PHYSICAL OCEANOGRAPHY

The 1224 km path of the Nord Stream pipeline from Portovaya Bay, Russia to Lubmin, Germany negotiates different seafloor conditions. The Baltic seabed morphology features troughs and valleys formed by erosion of softer bedrock layers. Deeper, sheltered areas are more likely to be zones of sedimentation (where sediments have accumulated), whereas areas exposed to water motion through waves or currents, such as south and south-west of Gotland, are zones of erosion. Depending on the seabed topography, sedimentation zones may not provide a stable substrate for the pipeline and interventions are required.

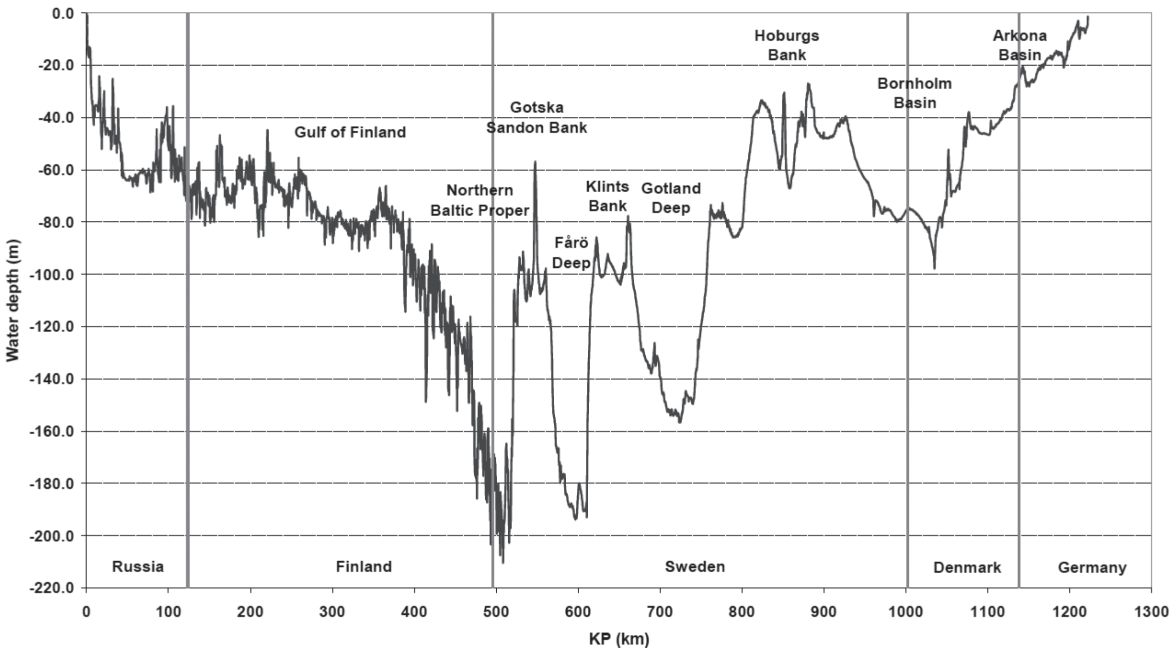
Water depth varies from 43 m in the Gulf of Finland to 203 m at the border between the Finnish and Swedish EEZs, then decreases towards the German landfall, but also with marked changes across this segment according to sills and deeps [60]. Pressure on the pipeline caused by underwater waves and currents called hydrodynamic loading was a further reason for protecting the pipeline. Four types of interventions were utilized to ensure stable foundations for the pipeline on the seabed; trenching the pipeline into the seabed (where the trench is left open), placement of rock berms, installation of prefabricated support structures and dredging at the landfalls. At these locations the pipes are back-filled with 1 – 5 m of material, depending on local requirements [61]. Dredging and trenching are

193 Richard Freedman, *Press Release: Environmental and Geopolitical Concerns Mix in EP Objections to Nord Stream Project*. The Nord Stream project was supported by the EU – it was selected as a Trans-European Energy Networks Initiative (TEN-E) & considered a “project of European interest that will help meet the EU’S future energy needs,” therefore protests from other EU states should be understood within this context.

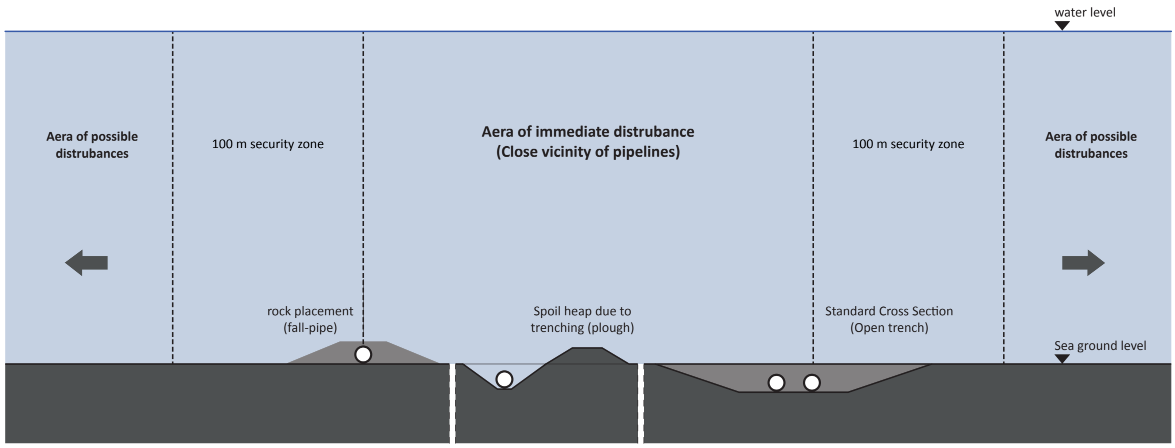
194 Also in the same press release the EU states: “there is a lack of institutional structures capable of responding adequately to the environmental and geopolitical security issues associated with this project.”

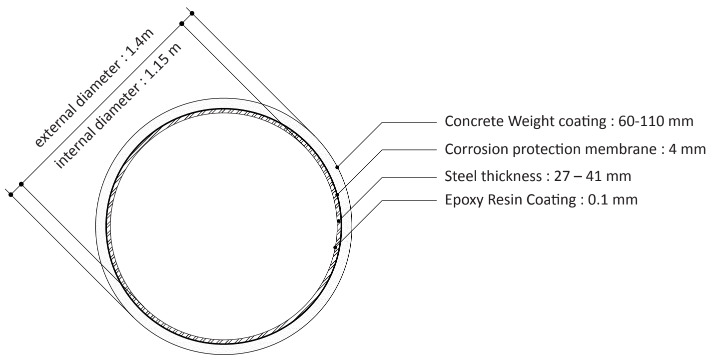
195 According to UNCLOS, Article 79 (1): “all States are entitled to lay submarine cables and pipelines on the continental shelf. Subject to its right to take reasonable measures for the exploration of the continental shelf, the exploitation of its natural resources and the prevention, reduction and control of pollution from pipelines, the coastal State may not impede the laying or maintenance of such cables or pipelines.” In: Langlet, D *Nord Stream, the Environment and the Law…* p 86.

196 Zug is one of the Swiss cantons known for its low tax rates. The corporate tax for canton Zug in 2014 was 14.6%. http://www.kpmg.com/ch/en/services/tax/pages/swiss-tax-report.aspx



[60] Bathymetry along the surveyed route corridor





[61] Seafloor interventions (above) with pipe cross-section (below): Rock placement (left), trenching (centre) and dredging to leave an open trench.

[59] location seafloor section.

required at the landfalls and the central and southern Baltic proper. At the Russian landfall, a soil cover of 2 m above the pipeline is also necessary to prevent damage from ice-gouging.[197]

Rock placement is required in the Gulf of Finland and the northern Baltic proper due to the uneven seafloor. In addition, special flexible concrete mattresses ware installed at cable/pipeline crossings to ensure permanent vertical separation between the two.[198] According to WWF predictions, 7,000 km of pipelines and cables will be traversing the Baltic Sea by 2030 [62] [s. APPENDIX 4].[199] This means that many more crossings of this type are to be expected. The environmental impact reports delivered before permit issue, estimate that impacts to the biological environment caused by seabed disturbance are generally local, short term and therefore insignificant or minor.

LIFE-FORMS

The pipeline traverses major fish habitats and fishing areas in the Baltic Sea. Vessels carrying out dredging, rock placement, trenching, munitions clearance and pipe-laying were active at different positions along the length of the pipeline for a period of two years. Comparable studies have revealed that fish can detect the sound of a pipe-laying vessel (162 dB) at distances of more than 10 km. However this is not as loud as the noise of tankers (177 dB) which pass through the Baltic Sea at a high frequency rate, therefore it is assumed that fish are already used to the former levels of disturbance.[200] The pipe-laying vessel advances at a speed of 2 – 3 km/day. Further to this, the environmental impact assessment report expects an *avoidance response* from the fish, and that they will move back into the area once the construction is completed. During the construction phase, the disturbances have therefore been evaluated as short term and negligible.[201]

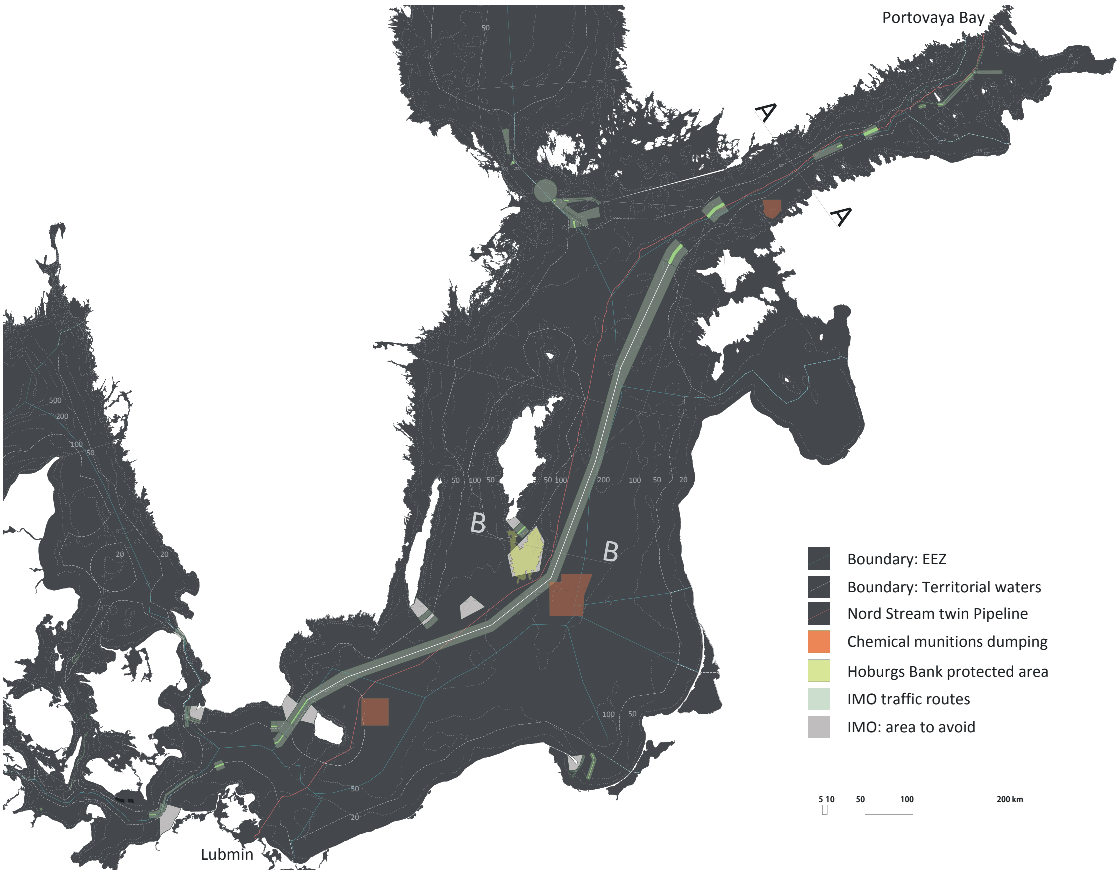
The pipeline can be sensed by fish during the operational phase through; noise of the gas moving within it, temperature change, emissions from corroding metal bands and maintenance ships. The physical presence of the pipeline has also resulted in the loss of spawning grounds for species such as herring. It is estimated that each of these disturbances will have negligible effect on fish populations, due to the relatively small area in each case. This is described as a "negative, local impact of long-term duration."[202] The Baltic Sea is already under a high level of stress from anthropogenic sources and many of its species are endangered. Commercial fishstocks are overfished and have drastically declined. However, the impact on life forms due to the construction and operation of the North Stream pipeline is measured on the level of disturbance *they are already used to*, which is high. Therefore the impact is generally estimated as being negligible.

URBANIZATION

The pipeline occupies a small cross-section of the Baltic seabed at individual locations, but continues over a large proportion of the total

197 Nord Stream Espoo Report: Key Issue Paper. Seabed Intervention: Works and Anchor Handling.
198 Rambøll, *Environmental Monitoring in Swedish Waters,* 2013.
199 WWF, *Future Trends in the Baltic Sea*.
200 Sound travels in water about five times faster than in air and absorption is less compared to air. Sound in water is a traveling wave, which can be measured by pressure changes and particle motions (acceleration).
201 Nord Stream Espoo Report: Key Issue Paper. Fish and Fishery.
202 Ibid.

[62] Pipeline and cables, Baltic Sea 2030.



[63] Location of the Nord Stream pipelines and detailed sections.

length. Hence it operates at both the micro- and the macro-scale and establishes relationships with other urbanizing forces. These relationships are evident from the preliminary concept and planning phases through to routing decisions and the feasibility of system expansion. As the world's longest underwater gas pipeline, it is an infrastructure of major dimensions, however to combat the deceptions of scale characteristic for the ocean context and to capture the pipeline's urbanizing effects, the following points should be taken into consideration:

– Time: the site preparation and laying progressed over a period of two years, alternating between laying phases to lay the second line. The overall calculated life expectancy of the project is 50 years. Adding feasibility studies, environmental assessment and permit applications, the project beginning can be dated to 1996 and completion to 2012. The proportion of project preparation relative to to its life expectancy is therefore 1:3, not including any dismantling work.

– Emissions: The pipeline emits sounds, vibrations, certain chemicals from exterior metal bands and heat.[203 – 204] Sound carries twice as far in water as in air, and although the sound during the operational phase is considered negligible compared to the construction phase, at the micro scale the pipeline should be understood as creating a vibrating soundscape in the direct vicinity.[205 – 206]

– Accumulative effects: the "space" of the Nord Stream tract either coincides with other urbanizing elements occupying different ocean layers, or is positioned in an adjacent corridor. This produces either horizontal or vertical intensification of large parts of the Baltic Sea.

These micro-effects are documented at two representative sites; the Gulf of Finland and the Eastern Gotland Basin [63]. In addition, the macro-effects are explored through an "expanded geography" of the pipeline which includes temporary areas, materials and workers, hence this diagram represents elements which are no longer visible in their original form, but which have had a considerable spatial impact [68].

3.7.2 CONTRACTION AT THE MICRO-SCALE GULF OF FINLAND

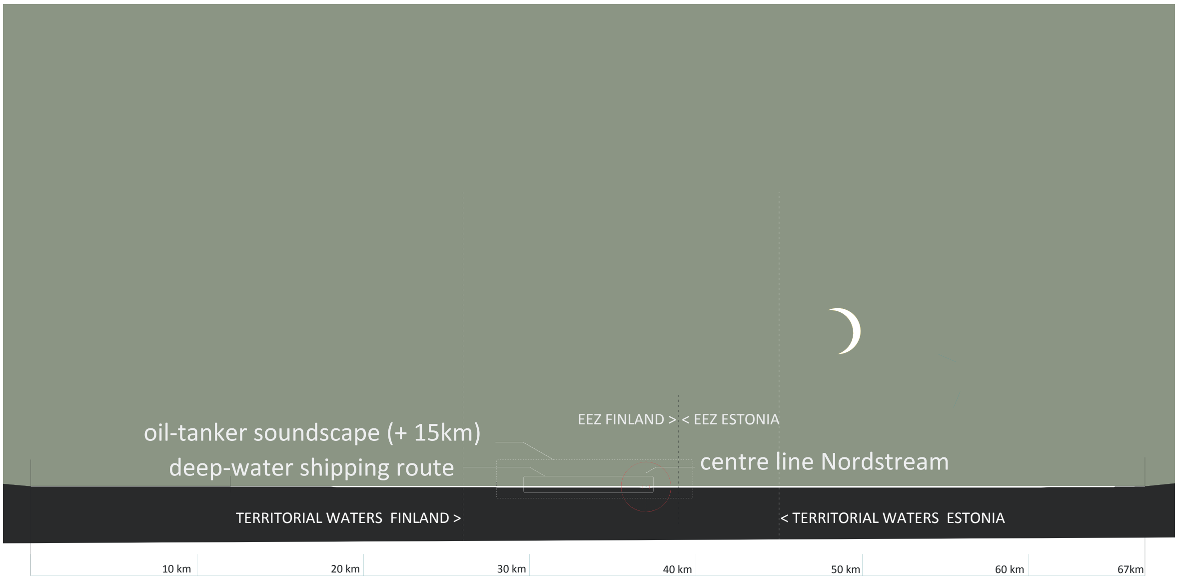
The chosen section [AA] through the Gulf of Finland reveals the accumulation of activities into the narrow, shallow international strait between the territorial waters of Estonia and Finland [64]. Here intensification takes place vertically; the deep-water shipping route occupies the surface, sometimes crossing the Nord Stream path. This relationship is then illustrated more closely [65]. The strait has a depth of between 50 and 80 metres, and is characterized by rough seabed topography. Seabed interventions for the installation of this part of the pipeline comprised of placement of

203 A temperature difference of 0.5° C greater than the surrounding water can be recorded at the pipe surface. *Nord Stream Espoo Report: Key Issue Paper: Fish and Fisheries.* p 43

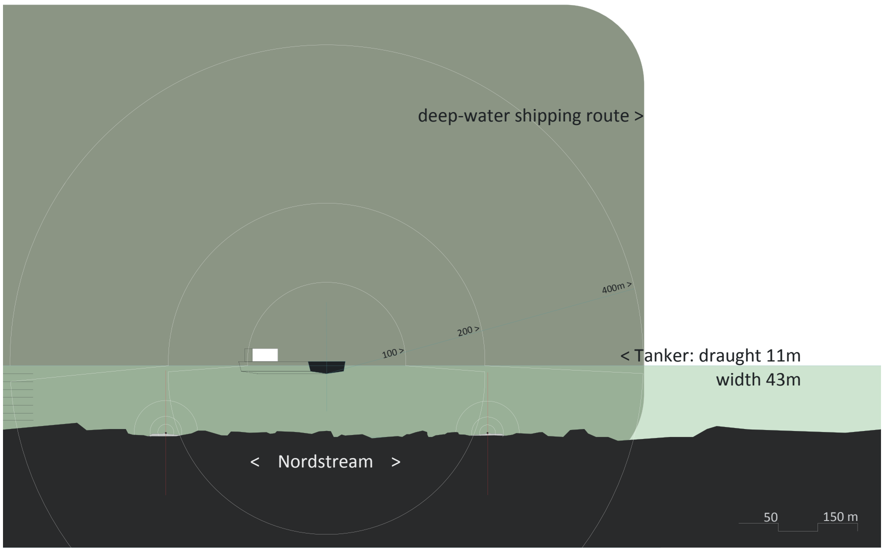
204 "Sacrificial anodes" are external bands which corrode in preference to the steel of the pipeline. *Nord Stream Espoo Report: Key Issue Paper: Fish and Fisheries.* p 44 "As the dissolved metal enters the water, the levels of cadmium will be too small to measure, the zinc will be similar to background levels – each year around 3,000 tonnes of zinc enters the Baltic Sea from other sources."

205 Jaanearu and Klauson, *Principal underwater noise sources in Baltic Sea and metrics used in noise level assessment*.

206 Nord Stream Espoo Report: Key Issue Paper. Fish and Fishery. p 44



[64] Section AA- Gulf of Finland



[65] Detail AA: deep-water route, Gulf of Finland

180,176 m^3 of rock and gravel.[207]

Oil tankers frequenting this route have a minimum draught of 11 metres. Their occupation of the sea is both direct and indirect; while the surface is visibly and directly occupied by passing tankers and other vessels, the underwater seascape is indirectly occupied by acoustic emissions. Tankers emit low-frequency sound (below 40 Hz), which depending on waves, salinity and direction, is perceptible underwater from distances of at least 13 km.[208] The Nord Stream pipelines also lie within this *soundscape* and although acoustic emissions from the pipeline itself are estimated to be negligible, they still occupy an (undetermined) spatial range which intersects that of the deep-water shipping route.[209]

Further temporary sources of emissions in this section of the route are caused by the detonation of mines laid during the first and second world wars. In the Gulf of Finland, 31 of the 68 mines detected within a 25 m security corridor of the pipeline were required to be cleared through detonation. Depending on the seabed sediments, the detonation created craters of 10 -15 metres in diameter and shock waves detectable by fish of a ca 1.5 km radius.[210]

EASTERN GOTLAND BASIN

The Eastern Gotland Basin is a spacious part of the Baltic Sea, but still only has water depths of between 100 – 200 m at the chosen section [66]. Here different zones are organized horizontally across the space, including the deep-water shipping route, the Nord Stream route and the protected Hoburgs Bank which rises up to a depth of 35 m [67].[211] An estimated one million birds gather here to winter and breed, feeding on the large supply of mussels on the reefs.[212]

The Bank is also rich in fish, including turbot, Baltic cod, flounder and salmon, which in turn attract the grey seals of the central and southern Baltic. Testing between 2010 and 2013 concluded that in the autumn season, this area may function as a nursery area for Baltic cod, whose population has been dramatically depleted due to overfishing.[213]

Over a distance of ca 600 km in the central Baltic Sea, the laying works for the Nord Stream pipeline included 67 km and 69 km of trenching on the first and second lines respectively. A total of 55,650 m^3 of rock and gravel were placed around both pipelines during the 3 phases of pre-lay, pressure test and operation, in particular along the Hoburgs Bank segment. Although the distances between zones seem generous in [66], the move-

207 Nord Stream Espoo Report: Key Issue Paper. Seabed Intervention: Works and Anchor Handling.

208 McKenna et al., *Underwater Radiated Noise from Modern Commercial Ships*. In this study, a distance of 13 km was recorded in water depths of 580 m in the study area off the Californian coast. Although tests have been made in the Gulf of Finland through the research project BIAS (Baltic Sea Information on the Acoustic Soundscape), the results have not yet been processed.

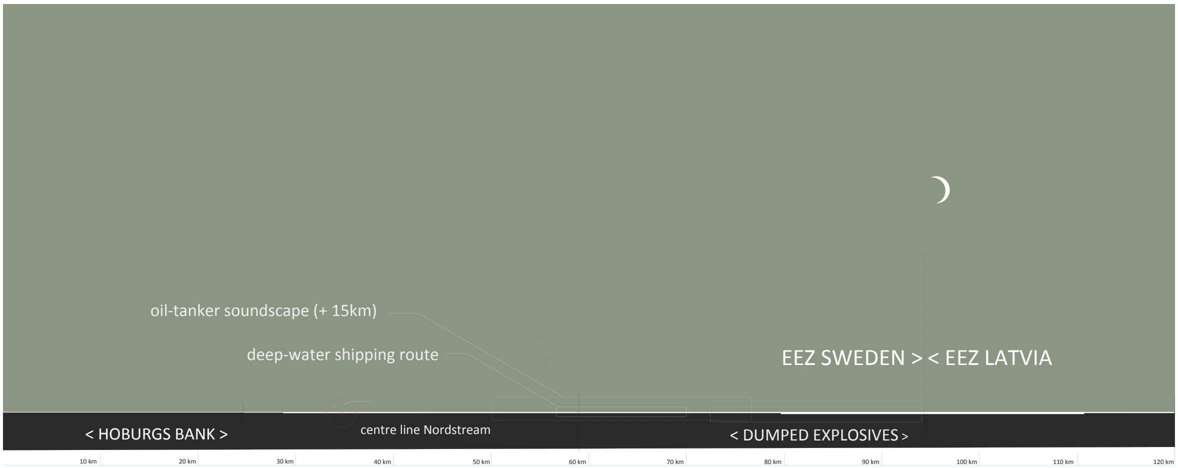
209 The noise levels of natural gas movement through a pipeline are known to have frequencies between 0.030 and 0.100 kHz, which is at the lowest levels detectable by many fish species. Nord Stream Espoo Report: Key Issue Paper. Fish and Fishery

210 Nord Stream, Espoo Report – Key Issues Paper: Munitions: Conventional and Chemical.

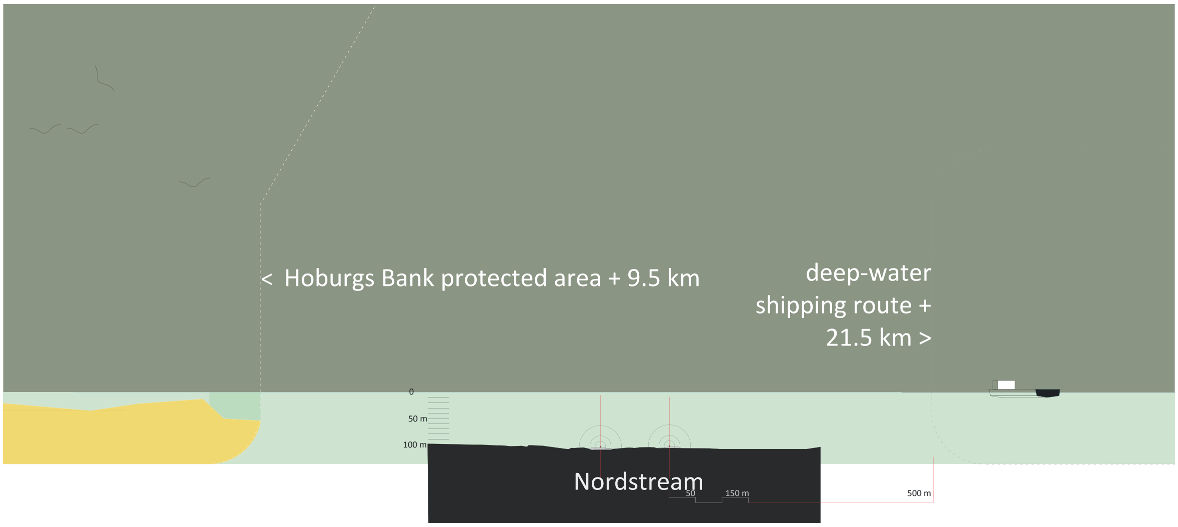
211 Hoburgs Bank was designated under the Natura 2000 programme as a SAC (Special Area of Conservation) in 2011, SPA (Special Protection Area) in 2002 & a SCI (Sites of community importance) in 2005. The site is both a Bird Protection Area for 3 species: Eider, Black Guillemot & Long-tailed Duck and a Protected Marine Habitat of reefs and sandbanks slightly covered by seawater all the time. Site SE 340144, Natura 2000 data bank: http:\\2000.eea.europa.eu/Natura2000/SDF.aspx?site=SE0340144

212 Pearls of the Baltic Sea. Networking for Life: Special Nature in a Special Sea.

213 Rambøll, *Environmental Monitoring in Swedish Waters,* 2013. p 31.



[66] Section BB- Eastern Gotland Basin



[67] Detail BB- Eastern Gotland Basin

ments of fish and mammals around Hoburgs Bank cross these zones transversely irrespective of abstract boundary lines [67].

Construction work for the pipeline was estimated by the assessment to effect minimal, localized environmental impact here. It was also considered that the pipelines as a new, hard substrate could potentially initiate the "reef effect" and provide a more varied habitat for fish.[214] The 2013 Nord Stream environmental monitoring report for Swedish waters concludes that no such reef effect can be detected, and that the sediment composition of the seabed in the test area closest to Hoburgs Bank has changed since the construction works from fine sand to silt and clay. There has also been a reduction in abundance and biomass of the benthic community, most probably in connection with this seafloor change.[215] The impact of construction works therefore covered a larger area than anticipated, and the changes to the seabed environment at this particular location have been more marked and longer-term than anticipated.

CONCLUSION- MICRO-SCALE

These results indicate a high degree of sensitivity in the marine environment and a larger area of spatial impact than estimated by the first environmental assessment reports. Therefore the construction works have significantly affected the seascape. Calculation of possible effects was based on static criteria, such as impact distances from the fixed pipeline.[216] Cumulative effects of several related "disturbance" factors combined with the natural variation in sea conditions is difficult to predict. But the ocean is characterized by dynamic borders unrestricted by delineation in a single plane and therefore susceptible to intersecting spheres of influence.

The correspondence between spatial and ecological budgets has been recognised in the comparative study of the Barents and Baltic Seas.[217] The Baltic Sea is environmentally charged and according to environmental reports, has already reached the saturation threshold. Alone in terms of space, such a large infrastructural project generates a far greater *field of occupation* at the micro-scale than the 1.2 m diameter of each pipe. The twin pipeline is firstly a semi-permanent fixture wrapped in a 500 m security zone, to which other uses are required to adapt. Further to this, it subtly emits chemicals and sounds into the immediate environment and reduces the habitat for life forms.

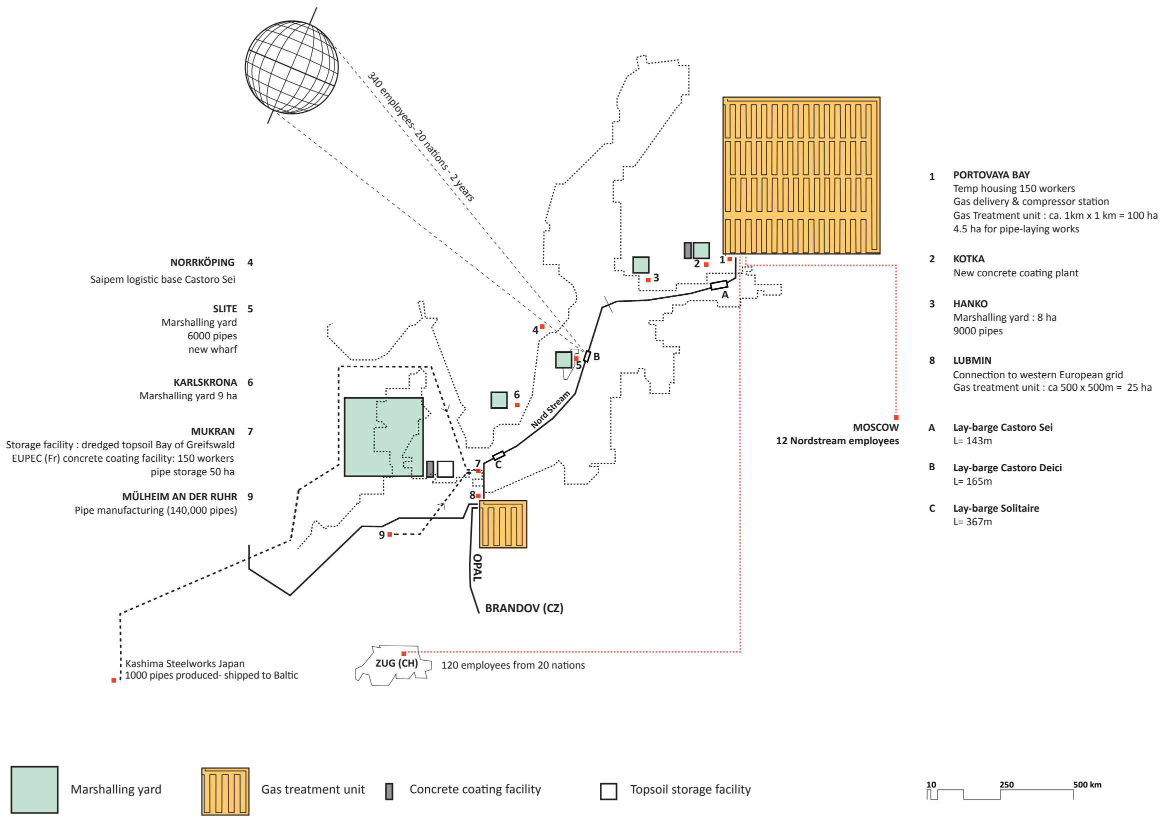
The combined effect of the pipelines is to install a carpet of infrastructure along the seafloor, together with its foundations, crossroads, maintenance and servicing. A submerged, semi-private service channel has been created which largely mirrors the deep-water traffic route on the surface. Together, a double cord of infrastructure for energy transfer is established, both of which are strategically positioned within the grey zone of the *common* international waters. At the micro-scale, the effects of compressing

214 The *reef effect* refers to the formation of an artificial "reef" on the seafloor through the introduction of hard substrates, which can attract certain life-forms by offering a hard surface for colonisation and thereby increase the biodiversity of, for example, a sandy-bottomed area.

215 Rambøll, *Environmental Monitoring in Swedish Waters,* 2013.

216 An example is the range and duration of turpidity due to re-suspension of sediments after dredging. At the German landfall, this is estimated to last for 72 hrs up to a range of 1 km from the pipeline. *Nord Stream Espoo Report: Key Issue Paper. Seabed Intervention: Works and Anchor Handling*.

217 See 3.5.2 NINE PRINCIPLES OF OCEAN URBANIZATION



[68] Spatial compression at the macro scale.

energy into an infrastructural conduit can be described as *spatial seepage*. The forces required to exert this contraction into a precise path along the sea floor escape full control and are then manifest in slightly unpredictable changes in the direct environment. The space *seeps* horizontally in the form of structural support or protective trenches and concentrically in the form of subtle emissions from the pipeline surface.

Captain Domenico Alferj of the pipe-laying vessel Castoro Sei, owned and operated by the company SAIPEM, describes his experiences on the Nord Stream project:

> "This job was, in many ways, one of a kind. It was like braving a new frontier, paving a new road, or opening up a *new territory.*"[218]

3.7.3 CONTRACTION AT THE MACRO SCALE

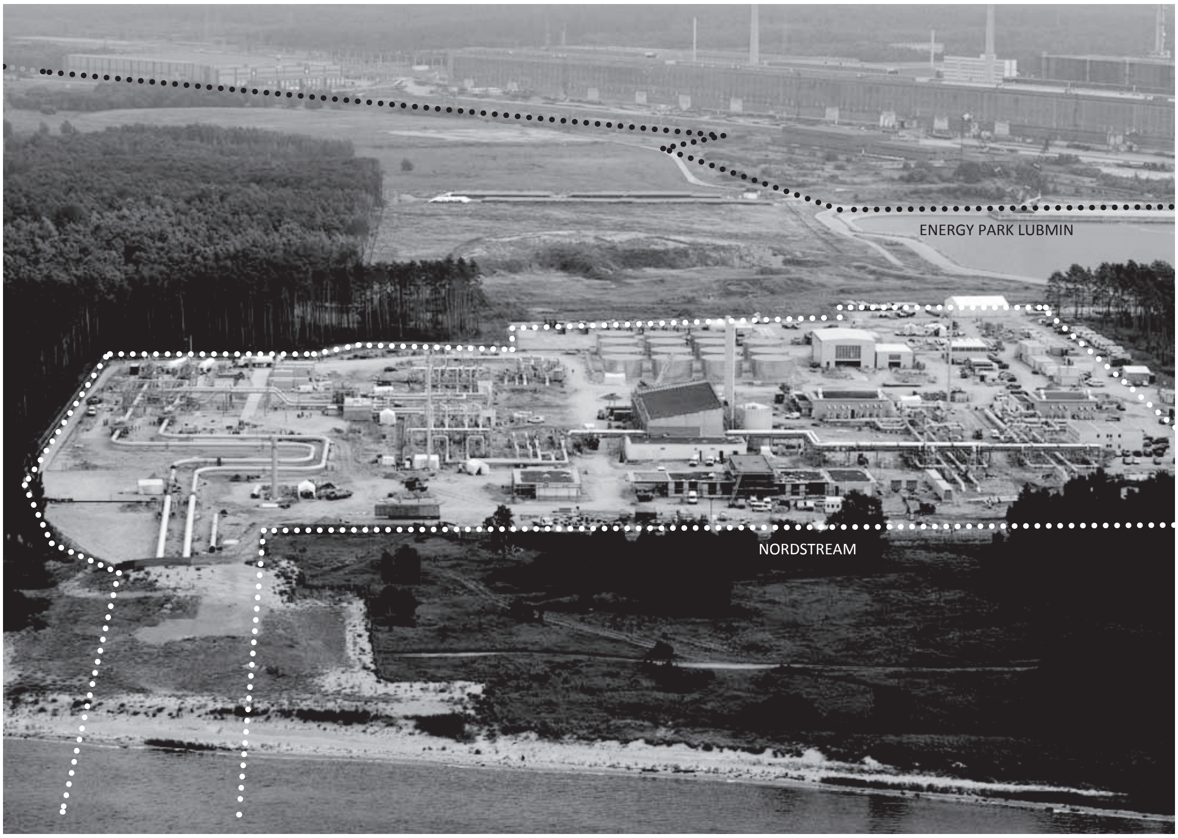
The seafloor as an *unseen* site, offers convenient refuge for energy liaisons and their megastructures. The cementing of one particular such liaison resulted in the Nord Stream project, which in turn required a myriad of pre and post-agreements in order to ensure an effective connection to the pan-European energy landscape. An examination of the full spectrum of spaces produced by these liaisons at the macro-scale, requires an unravelling of structures and processes over time, since these processes have been subject to spatial contraction. As a result, spaces implicated through the establishment of the pipeline's trajectory dissolve and reappear at different sites, in different forms. This approach refers to Rania Ghosn's urge to expose the true geographical dimensions of otherwise mute segments of oil infrastructure:

> "A geographic perspective on energy opens up and materializes the compressed space between the resource hinterland and the metropolis, and by doing that, addresses the political significance of such missing spaces. Once no longer defined by erasure, the space of corporate imaginaries continuously unfolds into a complex re-representation of energy's spatial condition."[219]

The Nord Stream construction process mobilised, developed and eventually demolished a series of special-purpose spaces around the Baltic Sea and further afield, engaging a large international workforce.[220] On the laying vessel, Castoro Sei, for example, around 340 people from 30 different countries were employed for a period of two years of continuous pipe-laying.

The expanded spaces necessary for the execution of such an operation are externalized in relation to the pipeline itself. From these sites, forces are indirectly *compressed* into Nord Stream's slim profile; five marshalling yards for storage of pipe segments ranging in area from 8 – 50 hectares were located in Kotka, Hanko, Slite, Karlskrona and Mukran. Concrete-coating facilities for the pipeline were also built at Kotka and Mukran, the latter employing 150 workers. The port at Mukran was expanded, and a new wharf was built at Slite [68]. At the Russian landfall, a pipe-laying construction and logistics area of 4.5 hectares as well as temporary housing for 150

218 Bodmer, *Secure Energy for Europe*. Chapter 5: Construction & Logistics.
219 Ghosn, *Where Are the Missing Spaces- the Geography of Some Uncommon Interests*.
220 Nord Stream calculates that at the height of construction works, 1000 people were working simultaneously on the pipeline.



[70] German landfall near Lubmin, with the Lubmin Energy Park's 1 km – long machine – building in the background.

[69] Gas Treatment Unit Portovaya Bay, Russia.

workers was established at Portovaya Bay.[221] Within the gas-network system, this space represents a node of exchange and requires a large operational area for the compressor station which prepares the gas for delivery through the pipeline [69].[222]

At Lubmin a similar node of exchange is constructed in order to prepare the gas for delivery through two further network systems; the OPAL pipeline to the Czech Republic, and the NEL pipeline to northern Europe [58].[223] Following the pipeline across Europe, the parallel geographies of network systems become apparent – network nodes such as Rehden do not correspond to urban nodes. Likewise, urban nodes such as London, Paris, Warsaw, Moscow and Madrid, are encircled but not crossed by major pipelines. At Lubmin gas is inspected, treated and warmed by 10° for further transport. The physical expansion of the gas as it is warmed is reflected in the expanded site,[224] where the Nord Stream project consumes around 25 hectares of land and thus emerges from the sea to take on its true dimensions at an industrial scale.

At the Lubmin landfall, this process of expansion is a double phenomenon; the site was chosen because of the existing connection to a high-voltage electricity network. Nord Stream is *grafted* onto an industrial complex which initially served the generation of nuclear power [70]. Lubmin is located close to Greifswald in the ex-GDR and after the Germany's reunification, the decommissioning of the Lubmin/Greifswald nuclear power plant began before it was actually fully completed.[225] The area was then transformed into a site for dismantling work, including the temporary storage of radio-active material in the controversial *Zwischenlager Nord.*[226] The government-owned site managers Energie Werk Nord (ENW) aim to convert the area into a competence centre for energy and technology, including renewables and energy production from gas.[227] Originally, three energy companies planned to build electricity-producing gas power-stations here,

221 Information from the website of the Russian firm RCB – Road City Building, contracted with site-works at Portovaya Bay.
http://www.r-c-b.ru/en/projects/portovaya_bay_the_phase_of_nord_stream/
Accessed 27/03/15.

222 The Portovaya Compressor Station dehydrates the gas to remove condensate or gas hydrates, compresses the gas to the requisite pressure, after which it is subjected to fiscal measurement and fed into Nord Stream.

223 The OPAL (Ostsee-pipeline-anbindungs-leitung) pipeline runs from Lubmin to Brandov in the Czech Republic. The NEL (Nord-europäische Ergasleitung) runs runs 440 km from Lubmin across northern Germany to Rehden, south of Bremen, where the largest gas storage facility in western Europe is located. At Rehden, Nord Stream is then connected to further European gas transportation systems.

224 Expansion is defined as the increase in the volume of a substance. Charles' Law states that gas occupies 1/273.15 more space for each increase in temperature of 1°C.

225 The construction of what was to be the largest of 20 nuclear power stations in the GDR, began in 1967 in collaboration with the USSR. Eight generating units were planned, of which the first 4 began generating electricity in 1973, 1975, 1978 & 1979 respectively. Unit 5 was in the test phase and units 6, 7, & 8 were in an advanced stage of construction when the plant was shut down in 1990. Kakoschke and Maronde, *Seebad Lubmin- Ein Kleinod Am Greifswalder Bodden*.

226 Zwischenlager Nord is a 20,000 m² storage facility built in 1992 for decontaminating and storing nuclear waste from the adjacent plant and a plant at Rheinsberg. Despite heavy local protests, it has also received nuclear waste from other sources in Germany and Castor (Cask for storage and transport of radioactive material) imports from France in 2010 & 2011.

227 The Lubmin Industrial Park boasts an industrial harbour, access to water sources - which was essential for the operation of the nuclear power plant- and further infrastructure such as railway tracks, road access for industrial loads and fire services. Currently 1800 employees work at the park for different energy companies involved in, for example, Rape-oil and Photovoltaics (BP Solar), firms involved in large-scale elements such as wind-turbine shafts and foundations, oil-rig repairs, and cranes. Source: Interview with ENW manager Jürgen Ramthun, 26/07/12.

which would be directly linked to Nord Stream and the high-voltage electricity network. One small power station has been operational since 2013, but the plans for three large projects have largely been abandoned due to lack of investors. This ultimately reflects changes in the energy industry and a move away from dependency on imported Russian gas.[228] Reports also state that the OPAL pipeline has been running at only 50% capacity for the last three years due to delays on an EU decision to grant Russia full access to the pipeline.[229] The network infrastructures which carry gas and electricity flows are themselves rooted and inflexible – mostly representing huge investments and large-scale territorial interventions, they are then subject to political and economic consensus. As they remain unseen, such inefficiencies are seldom visible to the public at large.

Lubmin and Portovaya Bay as sites of expansion represent the necessary twin condition to the pipeline as a site of contraction. In particular at Lubmin, the strategy of grafting new systems to existing infrastructure is an example of the symbiosis of network systems and geographic conditions. Hence network segments such as the Nord Stream pipeline, while crossing vast areas dressed in a single form and dimension, then rely on specific geographic and anthropogenic landscapes in order to effect an energy transfer. The Lubmin Industrial Park is also the planned cable-landing station for a group of offshore windparks to be located between Rügen and Bornholm in the German EEZ. Despite the size of the industrial park – originally the largest nuclear power station in the GDR – it is still largely concealed due to its strategic location close to water and in Germany's most sparsely populated region.[230] The Nord Stream pipeline appears to slot comfortably into a legacy of industrial and military development established in secluded locations on the Baltic Sea- and which continues to exist side by side with the traditional bathing culture of *Seebad Lubmin* just two km away today.[231] Sharp juxtaposition is characteristic of *expansion* in ocean space and will be discussed separately as a typology occupying the ocean surface.[232] In this example, although the expansion described above is an important characteristic of the spatial behaviour of networks, it occurs here *on shore* and is therefore outside the realm of this thesis. In relation to these sites of expansion, the seabed becomes a linear portal connecting markets and supplies. Sites of energy expansion of this type do not occur within ocean space – rather sites of contraction where the ocean environment is solely a silent, neutral conductor, but secures powerful connections which would present greater geographic or political difficulties of passage across land.

228 "EWN Erwägen Rückzug Aus Gaskraftwerksplänen."
229 Lewis, *EU Delays Decision on Russian Access to Opal Gas Pipeline*.
230 Mecklenburg – Vorpommern, the German region with the majority of Baltic Sea coastline, has a population density of 69 inhabitants/km², the lowest in Germany (statistics 2012), and has also one of the weakest economies. The 2013 unemployment rate was 11.35%.
231 Kakoschke and Maronde, *Seebad Lubmin- Ein Kleinod Am Greifswalder Bodden*. Out of a possible 42 locations for the nuclear plant, Lubmin was chosen due to the geological conditions (low earthquake risk), the ready supply of cooling water, and the low population density. (Interview with ENW manager Jürgen Ramthun, 26/07/12.) At a distance of around 4 km from the Industry Park Lubmin, across the Peene river to the island Usedom, lies the Peenemunde Army Research Centre, where the first long-range liquid-propellant rocket – the V-2 – was developed and first launched in 1944. Test launches took place in the Baltic Sea.
232 See 3.7 EXPANSION

3.7.4 SUMMARY CONTRACTION

In conclusion to the above analysis of the Nord Stream offshore pipeline at the micro- and macro- scales, the proposed *contraction* typology in ocean space is defined as follows:

– Linear infrastructural tracts under *contraction* create corridors of urban services characterised by minimal cross-sections over long distances. Hence the true dimensions are not found within ocean space, but spaces on which the network depends are rather externalized to other parts. At the same time the relative dimensions become substantial, since infrastructural elements within a network become part of a much larger whole.

– Once established, the occupation of ocean space through infrastructural corridors leads to the thickening of this function with further connections. Expanded urbanization in the *contraction* mode operates as a series of contained, overlaying linear connections, based on the opening of a new conduit *territory* split between ocean layers.

– Structures and systems under *contraction,* profit from the discretion and low visibility offered by ocean space, both on the seafloor and at their points of exchange on land, which are located in non-urban contexts determined by network logistics.

– Forces subjected to *contraction* and containment in ocean space exert subtle, unexpected effects on their micro-environment either directly through *emissions* or indirectly through *spatial seepage*- the physical transformations effected by the construction process.

– Contraction in ocean space is comparable to contraction on land in so far as pipelines and services are buried and invisible, determined not by topographical spatial logic but by non-national alliances and agreements. The stability of such agreements and hence of the infrastructure itself, oscillates with the political climate:

> "The flow of oil… does not operate in a tabula rasa, but rather is achieved through territorialities. It displaces previous modes of circulation to construct its own geographies of access and control. Redrawing flows, the oil order harnesses social processes in a new geography of places and relations… Energy thus needs space to produce its economic value; and to that end, its infrastructural system organizes political relations at different scales."[233]

The contraction typology exhibits the inherent contradiction in the spatiality of networks; in theory fluid, efficient, topological and flexible, in reality network infrastructure becomes entangled in the solidity of materials, the seasons of politics and the weight of financial markets.

3.8 EXPANSION

INTRODUCTION

The contraction typology as observed in the Nord Stream pipeline transforms through *expansion* at the exchange nodes on land. Contraction and expansion form a twin pair. The second part of this pair is examined here in the context of *ocean space proper*. In the example of shipping movements, the expansion/contraction sequence utilizes the sea surface and unfolds in the opposite direction to the Nord Stream pipeline- it *ex-*

233 Ghosn, *Where Are the Missing Spaces- the Geography of Some Uncommon Interests*.

pands from land to sea. Expansion takes place through a transition from the contained port condition to the continuous but porous ocean surface which can be freely exploited by shipping movements and experienced as a limitless seascape. Maritime transport of both goods and passengers operate as networks, however the sea is thick, viscous and the velocity of sea-going vessels is relatively low. Formed by incremental technological displacement, non-spatial, topological networks can become periodic, interwoven spatial fields in their own right.

3.8.1 NETWORKS, TECHNOLOGY, SEASCAPE

Analysis carried out in the Barents and Baltic Seas revealed specific network relationships in maritime transport in both seas.[234] In the Baltic Sea, shipping activity is funnelled into ports, but otherwise stretches across the sea in a tightly interwoven web. In the Barents Sea, linear paths along the Norwegian and Russian coastline are complimented by the wide-spread movements of fishing vessels covering a broad, dispersed area in the central part of the sea. A third type of trajectory leads to Svalbard- not only as a fishing destination, but also for specialized supply and tourism vessels.The network principle of connecting two endpoints through a non-spatial vector, undergoes mutation in ocean space due to two particularities; movement through the sea requires a displacement of mass and is therefore slower than other contemporary transportation methods on land or in the air, and the open ocean surface subscribes predefined routes only in particular cases, hence the linearity of networks becomes multi-directional to the extent that a distinct type of space is formed.

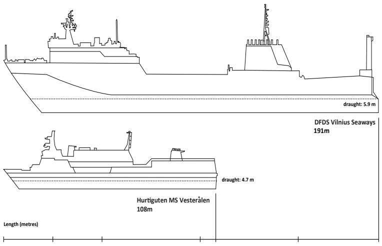
Specific technologies accompanying the maritime transport industry are largely geared towards achieving scale advantages and integrating ocean transport into coordinated world-wide logistics,[235] making maritime transport the backbone supporting international trade and globalization.[236] A jump in physical size of ships and port facilities accompanied these developments, reaching a maximum of 13,500 – 15,000 TEU[237] called the “suezmax”, in the “Emma” class introduced by Maersk Lines in the mid – 2000s.[238] The lock size in the Panama Canal determines size of ships passing through this route (Panamax), which previous to the current expansions under construction, was 33.53 × 320.04 m with a depth of 12.56 m. The New Panamax capacity of 55 wide × 427 long × 18.3 m deep is to be achieved by 2016 through the construction of new locks. Ports are also directly affected by these developments of scale, since they are pressurized to acommodate ever larger vessels. Ports represent the technological interface between the specialized logistical systems of land and sea.

Shipping provides access to the inherent seascape where the ocean’s particular spatial qualities can be experienced in a similar way to the landscape image of Jackson’s *landscape two.*[239] At the same time, shipping activities participate in the production of the transport seascape more

234 See 3.3.3 URBANIZATION (BARENTS SEA) and in 3.4.3 URBANIZATION (BALTIC SEA)
235 See 2 LITERATURE REVIEW (INTRODUCTION)
236 Asariotis et al., *Review of Maritime Transport 2008: Report by UNCTAD Secretariat*.
237 TEU= twenty feet-equivalent container units. A vessel carrying 12,500 TEU is around 396m in length.
238 In 2006, Maersk Lines launched *Emma Maersk* – an E-class container ship 397 × 56m with a 16 m draft.
239 See 2.2 SEASCAPE

[71] Hurtigruten ship MS Vesterålen, Honningsvåg, Barents Sea 17/02/12. Outlying islands are visible

[72] Vilnius Seaways passing the Bay of Gdansk, Baltic Sea 09/04/13



[73] Scale comparison.

aligned to *seascape three*. The frequencies and trajectories of shipping movements, the vessels themselves and the sea surface together combine to create a synthetic seascape of organic and inorganic parts.

Expansion occurs wherever ships are moving out into the open sea and therefore in both the Barents and the Baltic Seas. In the Barents Sea, the Hurtigruten postal ship serves a crucial infrastructural function for the small urban settlements along the Barents Sea coastline and also accommodates a large number of tourists. Empirical research was carried out in the Baltic Sea on the Ro-Ro/Passenger ship *Vilnius Seaways* from Sassnitz in Germany to Klaipeda in Lithuania [72 – 73].[240] Both vessels serve a combination of needs for passengers and goods. While a passage on the Hurtigruten formed part of this research, and this coastal route participates in a form of extended urbanization, it is not considered to be representative of *expansion* in this thesis, since it does not cross the open sea [71].[241] This examination aims to gain a clearer understanding of the contradictory status of ocean space *while moving through it* – what is the intermediary space between destinations and in what ways does shipping contribute to extended urbanization in the case-study seas?

Firstly, the port will be discussed as site of containment, control and exchange with the city and the landscape, using the example of Klaipeda. Expansion is then investigated on the open sea, in this case the East Gotland Basin, and placed in reference to Deleuze and Guattari's "smooth space."

3.8.2 CONTAINMENT : THE PORT OF KLAIPEDA

Ports have mostly been historically located at naturally sheltered harbours or river mouths. The concentration of activities at ports- the site of land-sea connections – is paralleled by sensitive ecological systems in the littoral zone. Sharp juxtapositions occur between these two realms, which are required to co-exist. The port is examined here as a point of departure, but will not be treated in detail since they are also outside the offshore focus of this thesis.

Ports are the sites of transfer where shipping space contracts and the space of goods and exchange expands. Historical port-cities are faced with the challenge of expansion within restricted urban contexts, often leading to a separation of port and urban facilities. Ports are highly managed and regulated zones. Technological upgrading is required to accommodate ever-larger ships and to manage the transfer-interface of goods. Ports which have developed parallel to historical city sites, such as many around the Baltic Sea, are in tight competition and are under pressure to provide the optimum services, prices and spatial arrangements. A thriving *cityport,* as defined by port researchers Hoyle and Pinder, depends firstly on stimulus from the water side, with port development and urban development then becoming highly interdependent.[242] Eventually the growth of both of these systems becomes difficult to accommodate spatially and to administer polit-

240 Research crossing from Sassnitz (Germany) to Klaipeda (Lithuania) in the *Vilnius Seaway* from 08 – 09/04/2013. Vilnius Seaways is 191 × 28 m with a 5.9 m draught. It sails under the Lithuanian flag and has a gross tonnage capacity of 22,341 tonnes. Ro-Ro = roll on-roll off, refering to cargo with wheels, such as trucks, cars and train-carriages.

241 Barents Sea study trip 12-22.02.12, including a Hurtigruten passage from Tromsø to Vardø, 16-18.02.12. The Hurtigruten ship *MS. Vesterålen* is 108 × 16.5 m, draft 4.7 m, with capacity for 510 passengers, 35 cars and a gross tonnage of 6261 tonnes.

242 Hoyle and Pinder, *Cityport Industrialization and Regional Development*.

[74] Pan-European corridors.

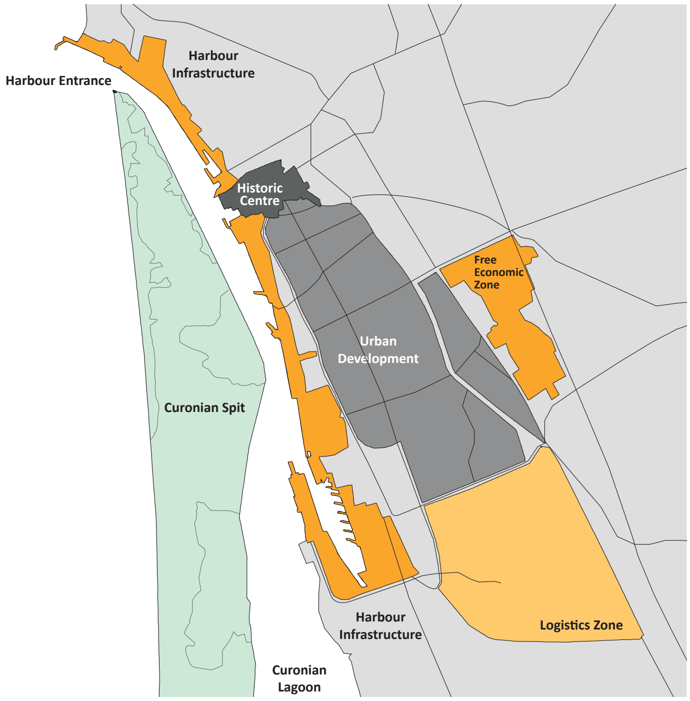
ically, since urban authorities and port authorities often compete. This leads to specialization and a spatial separation of port functions from traditional urban functions.[243]

In the case of the Lithuanian port city of Klaipeda, the site was originally established as a castle called Memelburg by the Teutonic Knights in 1252, however its strategic position at the mouth of the Neman River, and its year-round ice-free port, meant that the economic influence and importance of the port overtook the castle in terms of its influence on the town's economy and development. The Hanseatic League used the port adjacent to the castle and by 1525 it was exporting wheat for neighbouring Lithuania. In the 18th century it was a major exporter of timber to English traders. Today the port of Klaipeda accounts for 4.5% of Lithuania's GDP and according to the port authorities, generates up to 18% of the GDP including related functions.[244]

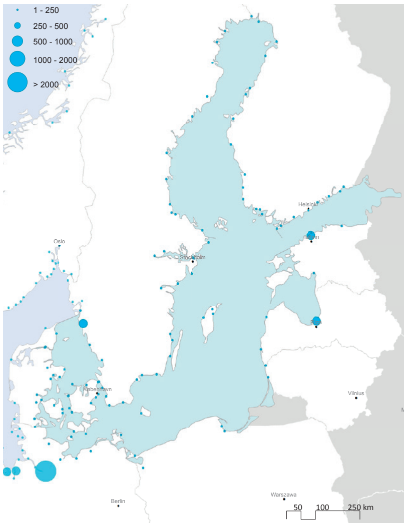
Ports link maritime and terrestrial transport systems [74]. The scale of ocean-sized elements is transferred to land, resulting in strong juxtapositions of scale and an accumulation of areas for storage, handling and exchange facilities. In Klaipeda, the Port stretches along the banks of the Nema River leading into the Curonian Lagoon [75], adjacent to the town, which has also seen parallel growth originating in the historic town centre, developing with the port along the river axis. Expansion areas for the port itself have been achieved by reclaiming quays, nudging into the adjacent urban tissue, and expansion of lager and storage areas at the southern end of the harbour, beyond the city's urban border. However the port area is spatially constrained. The *Baltic Logistics Centre* has been established to the south of the port adjacent to the port railway hub with an area of 600 hectares, the largest of its kind in Europe. The logistics centre is the destination of the Pan-European Corridor IX, which links Greece to Klaipeda, passing Odessa, Kiev, Minsk & Vilnius [74].[245] Currently, feasibility studies to extend the port are being carried out, with one option being to develop an artificial island outside the port entrance in the Baltic proper. From the coast, Klaipeda's physical profile is dominated by port infrastructure [76]. The port's cargo capacity is 60 million tonnes and of the town's 157,000 residents, 23,000 work in port-related activities.[246] Klaipeda is one of many ports with similar capacity around the Baltic Sea rim showing an annual increase in traffic of up to 10%. [247–248] In 2014 the cargo handling turnover was 36.4 million tonnes. Lithuania has one of the highest numbers of Baltic employees in maritime transport and associated sectors, along with Denmark.[249] The port of Klaipeda is still operating as a cityport, with port and urban activities and economies intrinsically linked.

Port constructions such as breakwaters, quays and seafloor channels optimize the protection offered by natural harbours and ultimately create a water's edge highly articulated through technology. At port entrances

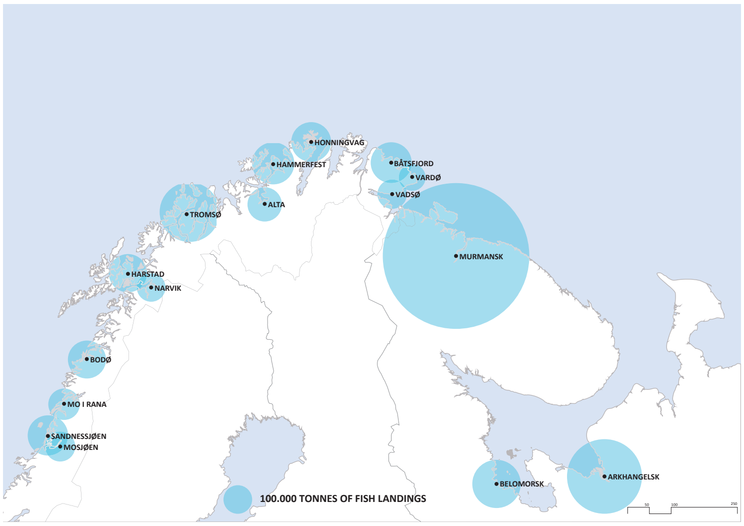
243 Ibid.
244 Klaipėda State Seaport Authority, *Port of Klaipėda: Discover a Proven Way*.
245 From Illichivisk by Odessa (Ukraine), the corridor offers the eservice of the Viking container train which delivers goods over the 1700 km to Klaipeda in 52 hours. 44,100 TEU s were transported by the Viking in 2014.
246 Klaipėda State Seaport Authority, "Port of Klaipėda: Discover a Proven Way." equal to 14% of all residents – the % of working population is therefore higher.
247 Less than 250 million tonnes in 2009, whereas Riga and Tallinn were over 250 million tonnes. Data from Russian ports is not included in the EU statistics – In 2009 the Port of St Petersburg handled almost double the cargo of Riga.
248 ESaTDOR, *Baltic Sea Regional Profile*.
249 Ibid.



[75] Klaipeda – city/port.



[77] Total shipping at Baltic Sea Ports in 2008 (Mt).



[78] Mean fish landings at Barents Sea ports.

[76] General cargo terminal, Klaipeda port.

[79] Curonian spit.

large ships already enter a predefined channel leading to specialized zones and quays and dredging works are progressively expanded to cope with increased ship sizes, loads and draughts.[250]

The juxtaposition of port infrastructure to urban systems is mirrored in the juxtaposition of ports to water systems. Many ports, despite their industrial scale and function, are located directly adjacent to delicate coastal ecosystems. The Barents and Baltic Seas are not characterized by large urban coastal centres, rather they both host a chain of centres comparable in size, even if the Baltic port cities are larger by comparison [77 – 78].[251] The intensification and concentration of maritime activities at ports is therefore often in stark contrast to the site of ecological exchange between land- and seascape. Sensitive ecosystems and habitats compete for space with maritime transport functions. At sites where the shipping traffic meets land, these different functions must overlap and coexist. Klaipeda port is located in extreme adjacency to the Curonian Spit UNESCO world heritage site. This site frames the south entrance to the harbour and effectively limits port expansion [79]. The lagoon itself, of which the port marks its Baltic Sea outlet, is also a Natura 2000 Habitat site. Migrating birds on the East Atlantic Flyway pass here in their millions and the lagoon is also one of the most productive waters in Northern and Easter Europe with 50 species of fish including carp, salmon, sea-tout, pike, pike-perch and perch.[252]

3.8.3 THE OPEN SEA
THE HORIZON

On leaving protected ports, vessels enter the space of the sea. The *open sea* has no fixed definition, but is generally understood to mean either politically – outside territorial waters and therefore 12 nautical miles offshore, or visually – not enclosed and out of the sight of land.[253] While the intersections of boundaries within the Barents and the Baltic Seas have been documented, these remain highly abstract and are not represented in the the visual experience of the sea.[254] Instead, the open sea provides the possibility to experience space itself 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 its environment, transmitting information on scale and distance.[255] It is the ultimate boundary of the horizon itself which, like a horizontal curtain, enables objects and landmarks to slip behind it:

“A shifting line where perception trails off”.[256]

The word horizon originates from the Greek verb to divide *horizö* and boundary, landmark *oros*. An object’s height and distance from the viewer determines the moment of its disappearance over the horizon, but from the

250 The Port of Klaipeda plans to upgrade to *Post-Panamax* type ships (365 m long, 52 m wide and 16.4 m draught), which means dredging to the depth of -17m from its current depth of -15.5 which accommodates ships with a 15m draught. (*Port of Klaipeda- Discover the Proven Way*)

251 St Petersburg is the largest Baltic port city with a population of 5 million, followed by Stockholm (2.2 million), Copenhagen (1.9 million), Helsinki (1.4 million), Riga (696,000), Tallinn (543,000) and Gdansk (462,000).

252 *Pearls of the Baltic Sea. Networking for Life: Special Nature in a Special Sea*.

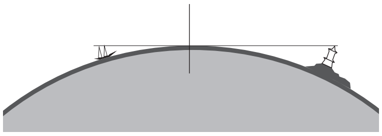
253 http://dictionary.reference.com/browse/open+sea

254 See 3.3 - 3.4, Spatial Characteristics of the Barents and the Baltic Seas.

255 Howard and Rogers, *Perceiving in Depth*. p 122

256 Maleuvre, *The horizon*.

[80] Horizon, Eastern Gotland Basin, Baltic Sea.



[81] Distance to the geometrical horizon.

natural human viewpoint, the horizon is visible at a distance of just ca. 5 km [80 – 81]. This means that it is the horizon itself, which continually "opens" the space of the sea and actively contributes to the process of *expansion.* Due to this enigmatic role of implying an opening through ultimate closure, the horizon has been of great cultural and spiritual importance throughout history – "it has been the line between the known and the unknown"[257] and therefore intrinsically linked to human mortality.

The laterally unbounded quality of the sea characterizes the open seascape*,* which has also been thematised by important artists.[258] The open sea also implies a condition of unimpeded flows and of interconnecting ecological systems. Habitats of some marine life-forms can cover vast areas, which are traversed in seasonal patterns. These are scales which defy planning, yet the inherent importance of such spaces has been recognised and attempts to register such a category of "open space" within ocean planning vocabulary for the German EEZs in the North and Baltic Seas:

> "In addition to regions economically used, the spatial planning also safeguards open spaces in the sense of largely unspoiled and undisturbed habitats and landscapes as a prerequisite for ecological regulation as well as for 'landscape experience' and for basic research."[259]

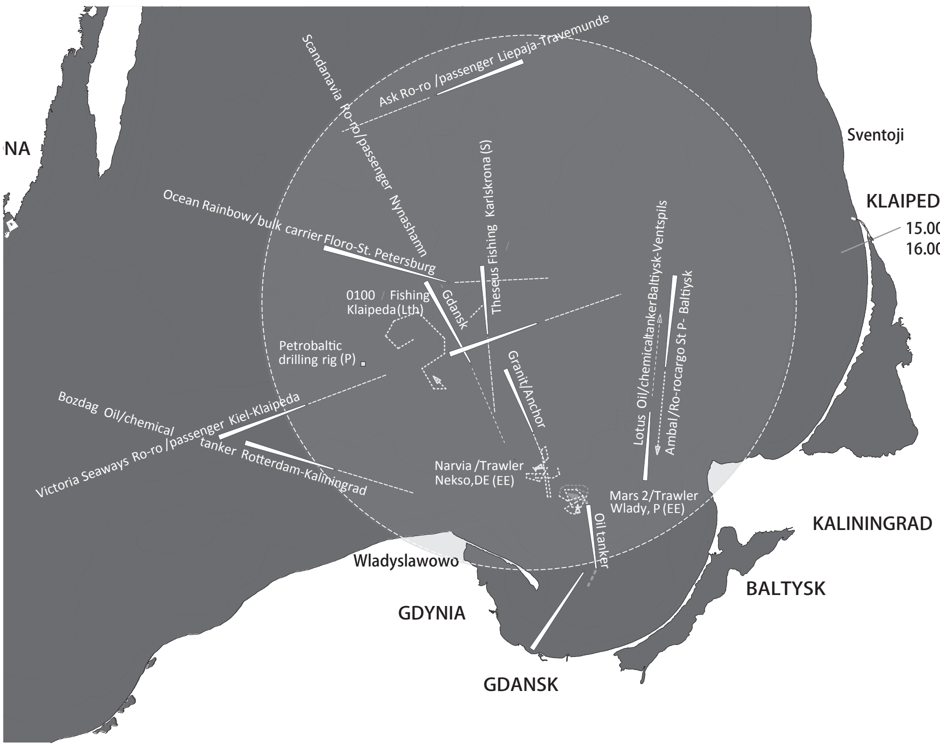
The open seascape is a resource which defies definition but which we wish to preserve as a *common* between interconnected urban regions.

SHIPPING PATTERNS

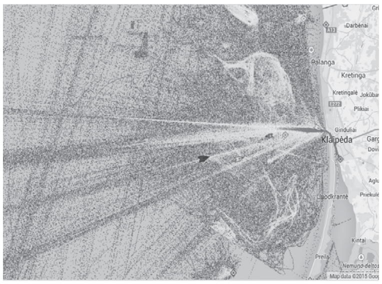
In the Baltic Sea, the short shipping paths do not lose sight of land, however the crossing from Sassnitz to Klaipeda passes through one of the sea's most expansive parts and therefore particular spatial attributes can be observed [82 – 83]. The Ro-Ro ship Vilnius Seaways travels at a speed of 17 knots, roughly equal to a land speed of 31.5 km/h.[260] The travelling time from the port of Sassnitz to Klaipeda is 17 hours [82]. This velocity means that, rather than being represented solely by an immaterial linear trajectory, vessels occupy ocean space for considerable periods of time and therefore exert influence on the overall spatial constellation for a perceptible period. This pace of displacement through water appears as a gliding, continuous state since the passage is uninterrupted. In order to capture their physical presence at this velocity, a study was made of vessels within a one hour radius of the *Vilnius* in the widest part of the Basin. Vessels present within this radius are documented through a one-hour period, which is the time taken to travel around 31.5 km. Their physical presence is accompanied by an acoustic field and water displacement which leaves accompanying visible traces [83]. The result is an an X-ray showing an irregular, multidirectional field of space-claiming lines and crossings. Through this lens, temporary intensities come into relief, which would then shift and assemble in a different configuration. The open sea enables the emergence of a *field*, which

257 Ibid.
258 See 2.2.6 SEASCAPE TWO
259 German Federal Agency for nature Conservation (BfN), *Spatial Planning in the German Exclusive Economic Zone of the North and the Baltic Seas – Nature Conservation Objectives and Principles.*
260 The knot = 1 nautical mile/hour (1.852 km/hr). For practical purposes, it is the equivalent of 1 minute of latitude. The knot gives the speed of vessels relative to the fluids in which they travel

[82] Scale in the Eastern Gotland Basin, Baltic Sea. Path of Vilnius Seaways, 08 – 09/04/13.



[83] 1-hour field.



[84] Shipping movements, Klaipeda 05/04/15, 19.45.

is *charged* with latent potential and activated by ongoing trajectories. The concept of a field charged with history, memories, intentions and spatial practices, is derived from researchers investigating mental maps and spatial perception as a particular aspect of Stan Allen's *Field Conditions:*[261]

> "Fields themselves, however, are not commonly described as iconic – their expansive nature exists as a temporal quality across time and space... the notion of a field charged with identity, structure, and meaning, creates new potential for the perception and navigation of the city."[262]

The sea replaces the texture of the city here, but the importance of navigation and perception are common to both contexts. I argue that shipping vessels in the open sea exploit a space of expansion, which results in an explicit multi-directional, viscous, slow, irregular and periodic field of intensities.

The sea is a site of negotiation between controlled, recommended routes, and multi-directional movement. Apart from the channelled deep-water and recommended routes, which have been established by the IMO to minimize the risk of collision in heavily trafficked areas, navigation on the open sea is unrestricted, and therefore represents a particular and unique type of spatial configuration, distinct from land. Regular shipping routes appear in the density record of ships in the Klaipeda area [84]. The main routes to Karlskrona, Kiel, Gdynia (Poland), Rostock and the Danish Straits are clearly visible, while a multitude of single paths also fill the field, including fishing boats remaining within the Lithuanian EEZ. These paths confirm the findings of the time-space study [83], and intersect to create an irregular, organic web of surface activity.

3.8.4 SMOOTH SPACE

Out at sea, space expands to a point where visual references to artefacts such as lighthouses, or coastlines themselves, dissolve. Enclosure and boundaries are not the determining spatial force. Direction is determined by invisibles such as the wind, currents and electronic navigation systems.

A conceptual approach to this kind of space is offered by Deleuze and Guattar's thinking on smooth (nomad) and striated (sedentary) space.[263] For Deleuze and Guattari, the ocean's seeming lack of visible structure, direction and enclosure, suggests rhizomic space - open, smooth and undefined. The rhizome attributes of non – heirarchical and non-directional quality and behaviour define what they call "smooth space" which makes the sea "the smooth space par excellence."[264] The smoothness of this space refers to its isotropic nature and its surface texture, which while appearing homogeneous, is at the same time capable of accommodating multiple irregularities. It also refers to the space's power of de-territorialisation and its directional property, which, like a vector, is always changing. Smooth space resists closing off and allocation. In smooth space one "distributes oneself in open space, according to frequencies and in the course of one's crossings".[265] Equating smooth space with nomad space, implies a position relative to its opposite spatial system; the State, or striated space. This counter-space is

261 Allen, *Points + Lines*. For a more detailed discussion on this text. See 3.8 ASSEMBLAGE
262 Lueder and Wall, *The Iconic and the Charged Field.*
263 Deleuze and Guattari, *A Thousand Plateaus*.
264 Ibid. p 479
265 Ibid. p 481

geometrically determined and controlled, it operates by occupying territory, not by *negotiating* it. In the case of the sea, maritime space-originally inherently *nomad* in essence – begins to be striated through the geometries and calculations of western civilization. The arduous search for a method to perfect the calculation of longitude at sea is an example of this type of *striation*, which itself was already embedded in an elaborate context of rival institutions aiming to more accurately control movements in ocean space.[266] Wealth and power was at stake – and many voyages across the Atlantic had already taken place by the time the Longitude prize was awarded to English watch-maker John Harrison in 1773.[267]

Nomad forms of navigation, on the other hand are based on sensing the sea. Polynesian navigation is an enlightening example of the myriad senses utilized to read the subtle nuances of sea space, and of the sense of the space itself, which is not based on delineation, rather on orientation within an ever-changing set of relationships. In this sense, the idea of a point-a place in time, is not determined by lines, but rather by these relationships. Illustrating this point in his paper *This Territory was not Empty: Pacific Possibilities*, Matt Matsuda describes a conception of navigation held by Caroline Islanders called *etak* in which boats remain stationary and islands move.[268] Arguably the world's best navigators, specialist knowledge of the ocean enabled Polynesian cultures to orientate guided by astronomy, currents, the direction of the waves, cloud formations and sightings of particular birds.[269]

Deleuze and Guattari describe one of the essential differences between smooth and striated space as the inverse relation between the point and the line:

> "In the case of the striated, the line is between two points, while in the smooth, the point is between two lines."[270]

A point sets itself in an open relation to the space around, which is full of potential possibilities, even if some of these possibilities have a deterritorializing effect. The line, in contrast, defines itself through two fixed points.
The smooth space of Deleuze and Guattari's sea has been discussed by many scholars and researchers. Kellar Easterling argues that the smooth sea has a hard edge in that it serves as a refuge for not only extra-territorial acts such as piracy, but also extra-national organizations claiming space in a "slushy zone of segregated logics:"

> "These new seas and the boundaries between them are arguably some of the most politicized and conflicted places on earth, all laying simultaneous claim to oil-drilling rights or protective zones of security. The United Nation's new Laws of the Sea (1982) thicken the extended and overlapping boundaries at the edges of nations, or in the tangle of archipelagos. These waters are slushy, violent, conflicted, dangerous, and they are, once again, clogged with traffic."[271]

266 Sobel, *Longitude*.
267 Merchant ships, whaling ships, warships & pirate ships used the method of dead-reckoning to navigate, but were restricted to using narrow, safe passages, since the method was inaccurate. By the end of 17th century almost 300 ships/year were ailing regularly between the British Isles & West Indies. (Sobel, *Longitude*)
268 Matsuda, *This Territory Was Not Empty*.
269 Howe, *Vaka Moana: Voyages of the Ancestors: The Discovery and Settlement of the Pacific*.
270 Deleuze and Guattari, *A Thousand Plateaus*. p 480
271 Easterling, *Enduring Innocence*.

The spatial analysis of the Baltic Sea revealed a series of fragmented, overlaying and competing spaces, which would seem to verify Easterling's argument. In the case of shipping movements in the Baltic Sea as described above [14], both smooth and striated space are evident; smooth space in the non-directional movement and occupation by some vessels, and striated in the frequent, controlled trajectories of vessels following a pre-defined route. Deleuze and Guattari also stress that these conditions are not mutually exclusive, but rather exist only in mixture:

> "Smooth space is constantly being translated, transversed into a striated space, striated space is constantly being reversed, returned to a smooth space."[274]

However, it is characteristic of ocean space that these conditions exist side by side, the *slushy*, contested operations nested within grey legal zones and the expansion of the surface condition offering a plane of movement and a wide horizon, screens conditions at five-kilometre distance.

3.8.5 SUMMARY EXPANSION

Through the analysis of shipping trajectories in the open sea, the proposed expansion typology can be defined as follows:

– Expansion is characterised by the open space of the sea which is created when visual landmarks drop behind the horizon- the horizon itself remains the single form of spatial articulation, resulting in a highly abstract space devoid of relative scale or objects. Expansion refers to the dynamics of this process, whereas the *open sea* is a resulting spatial condition.

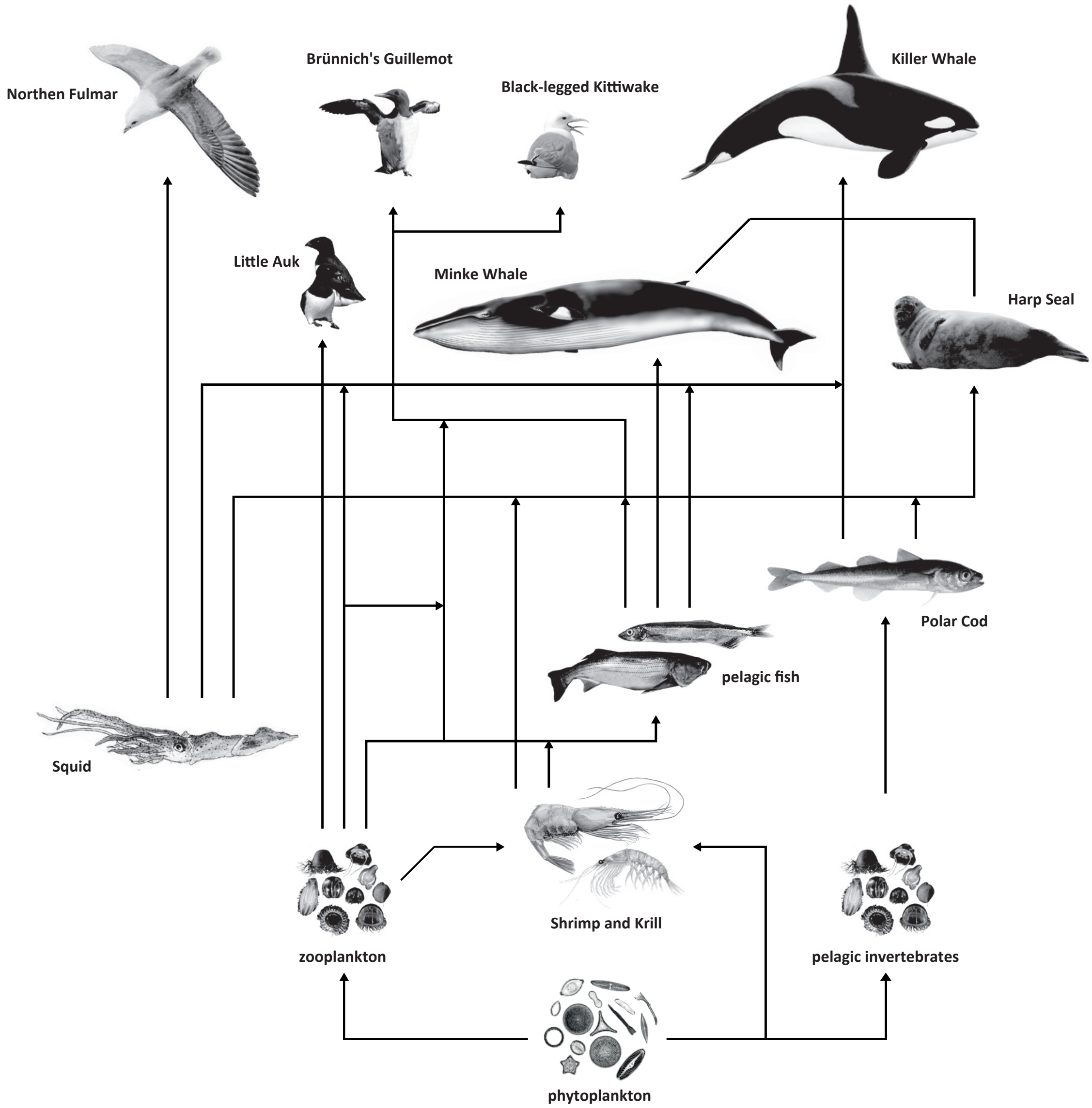
– Visually, the sea surface will remain open, despite abstract coordinates which enclose or define territorial segments. This lack of signs of enclosure or indication of direction endows the open sea with non-hierarchical, isotropic qualities, which in turn enable the engagement with a multidirectional spatial system generated from points rather than lines:

– Shipping movements, which when documented, reveal an irregular, organic, multidirectional occupation of space. Together such trajectories can create a loosely interwoven field charged with periodic intensities.

– The geographical configuration of the Baltic Sea and the relatively even distribution of comparably-sized ports forms the basis of a dense network of maritime connections which *expand* systems of exchange into new configurations as well as reinforcing existing flows across the Baltic.

– Expansion has been recognised as an important *inherent* quality of ocean space and processes have been set in motion which aim to define and protect this quality in legislative terms for planning purposes.

274 Deleuze and Guattari, *A Thousand Plateaus*. p 474.



[84] Barents Sea Food-web.

3.9 ASSEMBLAGE

INTRODUCTION

One of the central arguments of this thesis is that the inherent spatial characteristics of the ocean interact with, and determine the specific manifestations of urbanization in ocean space. What are the principles of this *inherent* space? How are the seascape, the ecological systems and organic networks organized spatially and temporally? Industries based on natural resources such as fishing, also indirectly rely on the primary phytoplankton production. Where and when do these domains of diverse form and materiality combine to produce periodic intensities? Which specific form do these *intensities* take and is this knowledge potentially of relevance to the planning or protection of important ocean zones?

One of the urban formats manifest in the Barents Sea has been identified as "the loose, flexible mesh of activities oscillating with the extreme seasonal changes in the region and tied to the seascape resources."[274] A deeper understanding of this shifting mesh in terms of its inherent spatial system is therefore the objective of this investigation.

3.9.1 SEASCAPE, NETWORKS, ECOLOGY

The topographical seascape forms a fundamental basis for the definition of ocean territory.[275] Spatial analysis carried out in previous chapters has revealed a complex, dynamic, inter-scalar seascape determined by topography, flora and fauna, geological formations, water flows and life-forms. It is therefore a shifting, fluid volume with singular internal spatial properties. Together, the spaces within the water column and the biological networks that they host, form the ocean's ecological system.

Parallel to landscape, seascape has been defined in relation to urbanization.[276] A seascape is produced through habitual interaction – it is shaped, modified, cultivated and harvested. Like landscape, the seascape is synthetic, whereas the natural world is described by James Corner as "unmediated environment."[277] Therefore further precision is necessary to resolve this contradiction. I argue that if a seascape in its *natural* form is equivalent to the unmediated environment, then this form can be called the *inherent* seascape. Is is comparable to the control situation in a scientific experiment. In this way, spatial properties can be examined in their own terms, using their own vocabulary and the potential relevance of findings can then assessed from a neutral standpoint. The objective in this case, is to derive spatial understanding from an ocean format, and not the reverse procedure of imposing urban formats on the ocean.

Networks are individual components linked together in some way, therefore patterns of connections in any system can be represented as a network.[278] The oceans and the atmosphere are nonlinear dynamic systems.[279] Hence they are infinitely more sophisticated than a transportation network. However scientists have discovered shared *topological* properties between some complex biological networks and networks such as the inter-

274 See 3.3 BARENTS SEA : SPATIAL CHARACTERISTICS
275 See 1. 9 OCEAN TERRITORY : A PROPOSED DEFINITION
276 See 2.2 SEASCAPE
277 Corner, *Recovering Landscape*.
278 Newman, *Networks*.
279 De Landa, *A Thousand Years of Nonlinear History*.

[85.a] Formation of the polar front: currents and bathymetry net.[280] Manuel de Landa argues that such open systems co-exist in multiple forms of varying complexity and can switch from one stable state to another, which is known as bifurcation:

> "Attractors and bifurcations are features of any system in which the dynamics are not only far from equilibrium but also non-linear, that is, in which there are strong mutual interactions (or feedback) between components."[281]

For de Landa, it is through non-linear dynamics that human progress throughout history can be understood in a holistic manner, however he also argues that this approach has largely been overlooked by classical theories such as Darwin's theory of evolution, which generally promote the outcome of equilibrium.[282] Network theory is interested in particular aspects of such complex systems; the connections (edges) between parts (nodes), and therefore systems are reduced to the necessary levels of abstraction and simplification in order to focus on the behavior of the system in these terms. An oceanic food web is an example of a biological network where energy flows in the direction of prey to predator. The network in this case comprises of organisms, which occupy a position in the sequence, called a trophic level, and the connections between them are represented by the flow of energy [84].

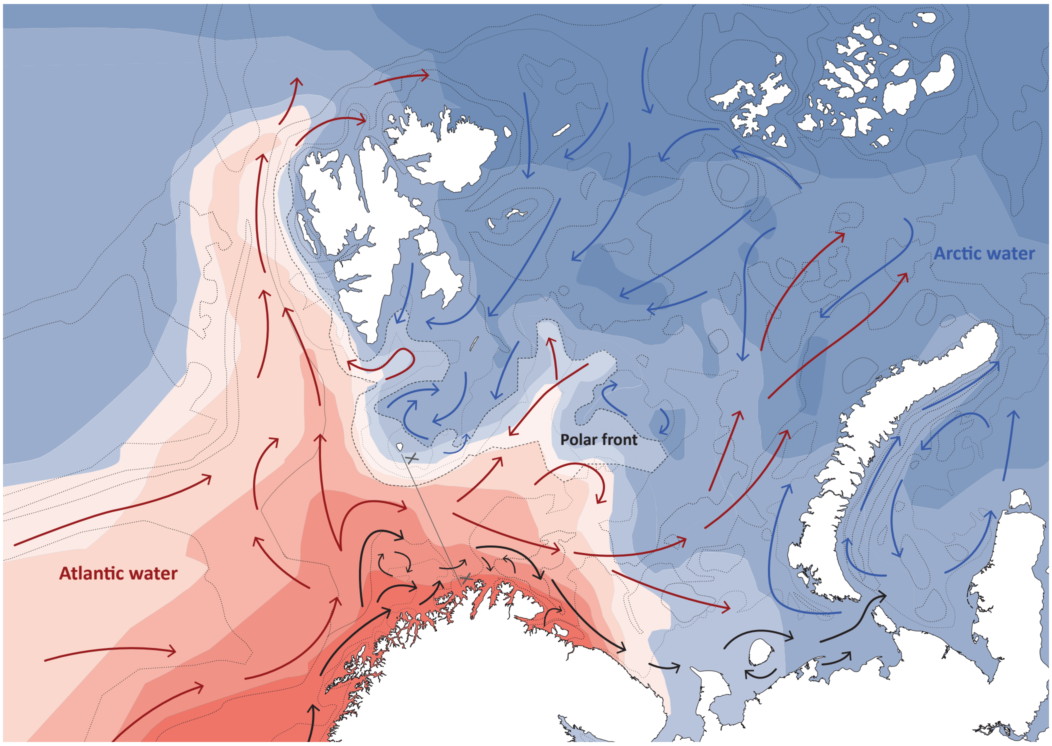
Non-linear, dynamic, ecological systems such as oceans are complex systems made up of multiple networks, hence networks and ecology are intrinsically linked. A complex system is characterized by emergent qualities which are greater than the sum of its parts and adaptability to external constraints, which means that the system must be open.[283] The key to adaptability is the system's feed-back mechanism; any dynamic complex system, if it is able to do so, will try to organize its complexity so as to optimize energy flow.[284]
Ecology is the relationship between living organisms and their surroundings, and therefore an ecological system has a spatial dimension, which the study of networks does not.

> "An ecosystem is an entity that includes a collection of organisms and the surroundings in which they live and feed."[285]

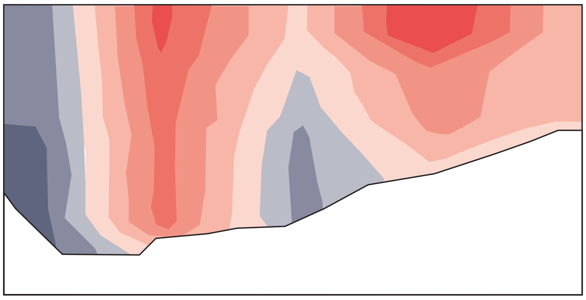
In ecology, these spaces are called habitats. The Barents Sea is ecologically stable and intact, therefore it serves as an appropriate basis from which to examine the spatial dimensions of an ecological system, even in a simplified manner.

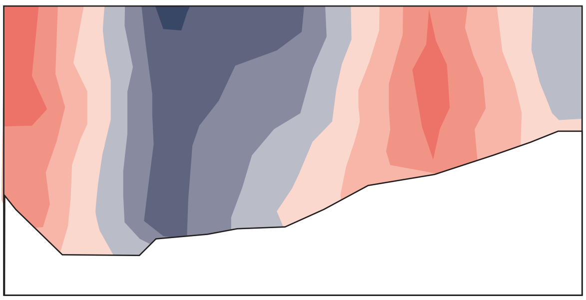
The summary of the Barents Sea oceanography revealed a complex system of interchanges where a series of phenomena intensify around particular space/time combinations, hence they are not simply geographically located, rather determined by a set of conditions such as currents, temperature, salinity and bathymetry.[286] Seasonal zones of intensity emerge,

280 The topological properties of a network are how its elements are arranged into a structure. See 2.1 NETWORKS.
281 De Landa, *A Thousand Years of Nonlinear History*. p 14
282 The idea of "the survival of the fittest," on which Darwinism is based, is a form of equilibrium, an optimal design or, in the case of thermodynamics, optimal distribution of energy. In the 1960s this theory was proved to be true for closed systems only, by Ilya Prigogine. Open systems, on the other hand may be pushed far from equilibrium with intense flows of energy in or out, and with a far greater number and type of possible outcomes. Ibid.
283 Nikos A. Salingaros, *Principles of Urban Structure*. p 231
284 Ibid. p 232
285 Sakshaug, Johnsen, and Kovacs, *Ecosystem Barents Sea*.
286 See 3.3 BARENTS SEA: SPATIAL CHARACTERISTICS



[85.b] Formation of the polar front: currents and water-masses





[86] Ingoing (Atlantic water) and outgoing (Arctic water) water-masses at XX registered 23.01.10 (above) and 27.01.10

created by the hydrographic, topographic and atmospheric interactions. In order to understand these spatial and temporal dimensions more fully, two events will be examined and represented in greater detail; the polar front and the marginal ice edge.

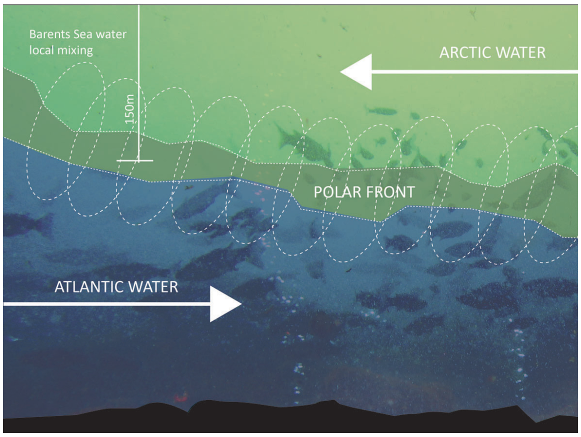
3.9.2 POLAR FRONT

A front is defined as "the horizontal boundary between two watermasses where hydrographic characteristics change abruptly across a narrow transition zone."[287] The name *front*, was given to colliding warm and cold air masses by Norwegian meteorologist Vilhelm Bjerknes, "just as masses of troops collide at war."[288] In the Barents Sea, the polar front is a "broad meandering convergence system."[289] This is the transition zone between two types of water, the Arctic water, which is colder but less dense, and the Atlantic water, which is warmer but saltier and therefore of a higher density. While this is a permanent feature of the Barents Sea, it is not geographically fixed, rather adjusts according to its defining parameters; a combination of bathymetry, currents and temperature. Warm Atlantic water is transported northwards towards the Barents Sea by the Norwegian Atlantic current, which runs along the break in the continental shelf. This water continues both northward, along the western Svalbard coast, and eastwards into the Barents Sea, where it also follows two branches- one along the northern Norwegian and Russian coastline, and one moving north-eastwards into Hopendypet (Hope Island Deep) [85.a – 85.b]. Cold Arctic Water enters the Barents Sea from the north, in the channels between Svalbard and Franz Josef Land, and Franz Josef Land and Novaya Zemlya. The former current flows southwards towards the Spitzbergen Bank, where it is joined by the latter, which flows westwards across the Barents Sea.

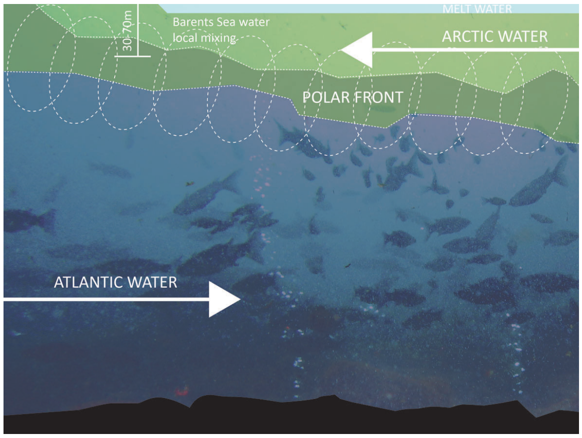
A watermass is "a given set in the temp-salinity (TS) space"[290], therefore watermasses can be clearly distinguished from one-another [86]. At the Polar Front, where they converge, the Atlantic currents are submerged under the Arctic water, and continue at medium-to-bottom depth [87].[291] In autumn and winter this depth is at around 150 m. Polar Front water is produced locally at this depth through mixing of the two waters. In summer these waters are topped with a layer of melt water up to a depth of 5 – 20 m. A transition layer develops between the melt water and the core of Arctic water below, which is located at between 30 and 70 m below the surface [88].

The bathymetry of the western Barents Sea is marked by the Spitzbergen Bank and trenches to the north and south. These trenches direct the currents, and therefore the polar front is stable and clearly identifiable in plan as well as section in this area. In the south-eastern part of the Barents Sea, the currents spread out broadly and the polar front is not easily identifiable. Due to vertical water-mixing, the polar front is an area rich in nutrients and high in primary production. During the winter, Barents Sea capelin feed here and it is also an important foraging area for seabirds. For this reason the WWF nominate the Polar Front as a priority conservation

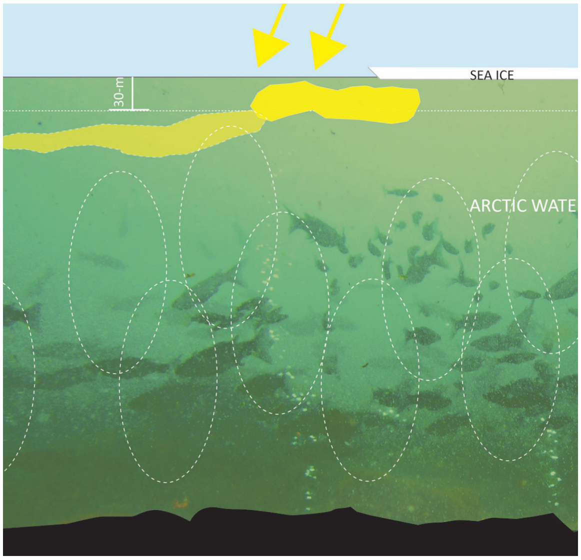
287 Leppäranta and Myrberg, *Physical Oceanography of the Baltic Sea*. p 61
288 Stewart, *Introduction to Physical Oceanography*.
289 *The Barents Sea Ecoregion*.
290 Leppäranta and Myrberg, *Physical Oceanography of the Baltic Sea*.
291 Sakshaug, Jihnsen and Kovacs, *Ecosystem Barents Sea*



[87] Location of the Polar front in winter.



[88] Location of the Polar front in summer.



89] Ice edge during phytoplankton bloom.

[90] The marginal Ice edge relative to polar front: normal and cold winters

area for plankton and ice-edge organisms.[292] Both in plan and section, the polar front is a zone of transition, where different water-masses *converge.* At the same time it is a site of the *emergence* of a particular zone in its own right made up of Polar Front water. Emergence takes place through the interactions of the different parts.

This water has physical mass, spatial presence and is moving:

> "A watermass is body of water with a common formation history, having its origin in a physical region of the ocean. Just as air masses in the atmosphere, water masses are physical entities with a measurable volume and therefore occupy a finite volume in the ocean. In their formation region they have exclusive occupation of a particular part of the ocean. Elsewhere they share the ocean with other water masses with which they mix."[293]

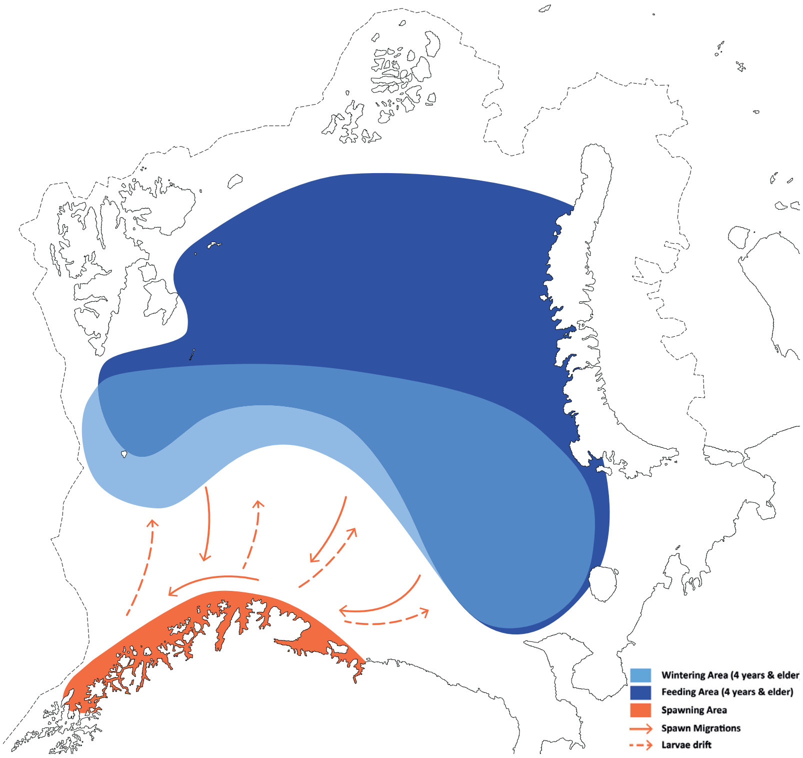
Water-masses are also described as having a *core.*[294] This is the most extreme value of a given attribute, for example salinity, as a function of depth. These cores are clearly visible in [86]. A water-mass seen from this perspective, begins to take on spatial properties we normally associate with solids; volume, density and a core. At the same time it has a history of movement and is essentially fluid, capable of convergence, convection and diffusion.

3.9.3 THE MARGINAL ICE EDGE

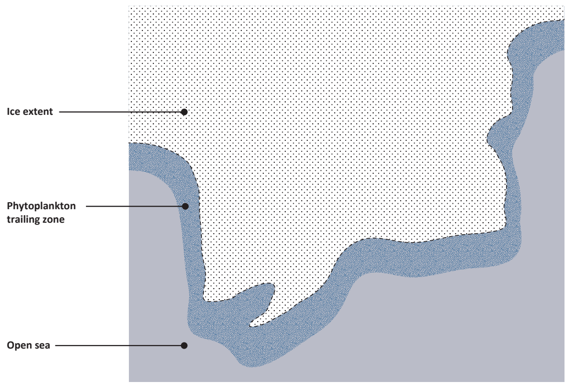
The marginal ice edge is the limit of ice-formation in the Barents Sea. In spring and summer, it is the site of high phytoplankton production, which sets off a chain of influential biological events involving many species. The "ice-edge effect", which explains the high primary production, is a combination of the nutrient-rich water as a result of autumn and winter mixing, spring sunlight penetrating the upper water layer, and the seasonal stratification of the water itself. Due to the formation of melt water which has a lower salinity than Arctic water, a pycnocline[295] forms at a depth of around 5 metres and increases in depth as the summer progresses. This stabilizes and separates the top layer from mixing with deeper water. Under these conditions, and in contact with the spring sunlight, the phytoplankton bloom takes place, beginning close to the ice edge [89]. The ice-edge is normally located north of the polar front, but if the winter has been extremely cold, ice will form on the Atlantic surface water south of the polar font. This ice melts rapidly as the Atlantic water is warmer than Arctic water [90].

Zooplankton occupy the second trophic level and tend to drift with the prevailing current. Most common zooplankton are herbivores feeding on the phytoplankton, therefore they provide a link to the pelagic carnivores.[296] There are numerous different species, but zooplankton are generally characterized by "life-history strategies" adapted to the short period of abundant food supply – the phytoplankton bloom.[297] Many species conserve energy during the winter periods of limited food supply by migrating to deep water and entering a semi-dormant state. In spring they return to

292 *The Barents Sea Ecoregion*. p 89
293 Tomczak, *Some Historical, Theoretical and Applied Aspects of Quantitative Water Mass Analysis.*
294 Sakshaug, Johnsen and Kovacs, *Ecosystem Barents Sea*. "During the summer, the core is situated at 30 – 70m depth." *Arctic Water*. p.40
295 Pycnocline: a thin vertical boundary between two vertical layers of differing density.
296 Pelagic: belonging to the free water masses. *Ecosystem Barents Sea*.
297 Sakshaug, Johnsen, and Kovacs, *Ecosystem Barents Sea*. p 215



91] Capelin yearly distribution map.



[92] Trailing zone of phytoplankton behind the ice edge.

the surface to reproduce and feed, timing their reproduction just ahead of the bloom so two generations can concurrently profit from the food supply during one season. Zooplankton are also imported into the Barents Sea by currents from the Norwegian Sea between March and August, when they reside in the upper 200 m of the water column.

Capelin is one of the two predominant commercial species of fish in the Barents Sea along with cod, both of which occupy the next trophic level. Capelin winter along and directly to the south of the polar front. They feed on zooplankton in spring as they migrate towards their feeding areas further north and east [91]. The zooplankton C. glacialis is an important food for the capelin, found along the eastern coast of Svalbard, where the capelin arrive around mid-August. Mature zooplankton are consumed first, meaning that the population depletion leaves food available for the immature members. In January and February the Barents Sea capelin begin migrating to their coastal breeding grounds along particular migration routes which change from year to year, attracting predatory cod en route and the Barents Sea fishing fleet in their wake. Migrating capelin move in dense schools, some consisting of several hundred tonnes of fish.[298] The chemical and biological reactions taking place at the ice edge trigger the movement of a range of species and a sequence of periodic agglommerations moving with the ice edge as it retreats. The phytoplankton bloom, for example, forms a broad 20 – 50 km "trailing" zone of maximum density behind the ice edge [92].

3.9.4 SPATIAL IMPLICATIONS

Internal spatial changes in the Barents Sea are marked by vertical *boundary layers*, or a *transition zone,* which is also a space in its own right. The ocean does not have single, lineal boundaries. Some of these spaces are broad, such as the 20 – 50 km – wide *trailing zone* following the receding ice-front and some are narrow, such as temporal pycnoclines appearing between the Arctic water and Atlantic water during spring.

Since the natural world is not geometrical, the spatial boundaries created by its mechanisms are asymmetrical and organic in form. However, they also obey precise oceanographic principles grounded in physics and chemistry. While the space of the Polar Front is geographically relatively well-defined, the Marginal Ice Edge will differ in location and composition from season to season according to wind levels and temperature. The cyclic sequence of events which unfolds, however, is regular in its order, protagonists and interchanges, even if the quantitative and temporal parameters fluctuate. The Barents Sea ecosystem is forced to continually adapt to these changes.[299]

A MORPHOLOGY OF OSCILLATING MARGINS

The spatial phenomena analysed here within the Barents Sea can be seen as displaying a morphology of oscillating margins, in that spatial entities develop from a well-defined *core*, which will be discernible by maximum density, through increasing degrees of diffusion until they are dissolved. In the spaces outside the core, mixing with other entities occurs in three dimensions. These layers and interactions change over time according to well-defined thresholds, but the principles will generally remain constant.

298 Sakshaug, Johnsen, and Kovacs, *Ecosystem Barents Sea*. p 380
299 Scientists have noted a seven-year cycle of fluctuations. *Ecosystem Barents Sea.*

Spaces and events in the Barents Sea are large-scale and wide-spread. In this sea much research has been carried out in order to locate and map the seasonal movements of species. Adopting the principle of margins, it is possible to identify *core* and *periphery* areas of importance. Biological space has, in fact, already been mapped and areas such as the polar front classed as a priority area for primary production. While the spatial characteristics of oscillation and broad threshold zones pose new challenges for mapping, the most important challenge is conceptual- adapting planning procedure to such principles of ocean spatiality.

3.9.5. FIELDS

To bring such organic spatial compositions into the realm of urban discussion, comparable models are needed. Stan Allen's *Field Conditions* and *Assemblages* as defined by Gilles Deleuze will be used for this purpose. Stan Allen's seminal essay *Field Conditions* describes a new way of organizing and conceptualizing space, based on the *many* as opposed to the *one* and on the *field* as opposed to the *object:*

> "A field condition could be any formal or spatial matrix capable of unifying diverse elements while respecting the identity of each. Field configurations are loosely bound aggregates characterized by porosity and local interconnectivity. Overall shape & extent are highly fluid and less important than the internal relationships of parts which determine the behaviour of the field."[300]

Allen refers to mathematical field theory, non-linear dynamics and to computer simulations of evolutionary change, but explores architectural space, art and music looking for traits of the condition he describes above. For architecture, this can mean seriality and repetition, but not hierarchy. Repetition must be carried out in such a way as not to dominate successive development, but so as to leave space for unplanned local connections.

Examples offered by Allen include Le Corbusier's hospital project for Venice – a series of self-contained units organized horizontally and according to interactions with local micro-situations. The additive, non-directional, non-hierarchical approach marks this project as a type of field. This is an architecture "not invested in durability, stability and certainty but an architecture that leaves space for the uncertainty of the real."[301] In this sense, architecture must partake in an open, non-predetermined system. Each part is an entity which is capable of establishing links, therefore a field is a meshwork of multiple links at the local scale, irrespective of the whole. Peaks, intensities or *vortexes*, will then form as a reaction to local conditions and not due to an overriding formal idea. This seems closely aligned to complex organic systems of organisation capable of *emergence* and *adabtability*, such as ecosystems. Allen makes the connection to natural systems of organization such as a flock of birds in movement, which produce an organized field without a central system of organization.[302]

Field conditions as proposed by Allen are fundamentally a horizontal phenomenon, a redefinition of the relationship between fig-

300 Allen, *Points + Lines*.
301 Ibid.
302 Intelligence theorist Craig Reynolds reonstructed bird behaviour in flight through computer simulation, where the behaviour of each individual followed 3 simple rules, which referred to the individual boid's immediate environment. These local rules enabled Reynolds to simulate flock behaviour.

ure and ground in that the figure can emerge from the ground itself. Yet the "moments of intensity, as peaks or valleys within a continuous field" he describes, could equally be applied to ocean space. The intensities we have observed at the ice-edge, for example, are three-dimensional, yet they adhere to some of the field principles. The spaces established by organisms such as phytoplankton effectively emerge from the *background*, while still remaining an integral part of it. Interrelations between parts of the ecosystem are its determining features. A school of fish or a bloom of phytoplankton adhere to many of the field principles, however in the larger picture, they are also directional, influenced by the sea's internal currents and external wind forces. A *Field* as a *condition*, however, while full of potential for ensuing possibilities, remains systematic and static in that its dynamics will be reflected by those *occupying* the field, which are separate from the field itself.

3.9.6 ASSEMBLAGE

The WWF use the term assemblage in their definition of an ecoregion to refer to interconnected groups of species; *(Ecoregion):*

> "Large units of land or water containing a geographically distinct assemblage of natural communities sharing a large majority of their species, dynamics, and environmental conditions." [303]

Assemblage here intends the collecting, gathering of diverse entities which then form a loose group, but also the interrelations between these entities and the spatial context determined by environmental conditions. In an ecoregion, the spatial context is large, and can be expected to contain many such specific assemblages.

In the context of this discussion, the idea of assemblage will be examined in terms of *periodic intensities,* which creates a conceptual link the theory of assemblage as extrapolated by Gilles Deleuze. The polar front and the marginal ice-edge are spaces formed by an assemblage of influences, forces and material elements from different categories. At the marginal ice-edge, for example, the energy of sunlight, the materiality of ice and phytoplankton life-forms create an assemblage through their interactions, which then sets off a wide-ranging chain of events. The space accommodating this assemblage is also one such contributing element.

Since these spaces and events are periodic, Deleuze's ideas of territorialisation and de – territorialization offer a way of incorporating such seasonal dynamics into a conceptual framework. For Deleuze, an assemblage is formed by sets of relationships between objects, ideas and processes of different categories:

> "An assemblage, in its multiplicity, necessarily acts on semiotic flows, material flows, and social flows simultaneously... There is no longer a tripartite division between a field of reality (the world) and a field of representation (the book) and a field of subjectivity (the author). Rather, an assemblage establishes connections between certain multiplicities drawn from each of these orders, so that a book has no sequel nor the world as its object nor one or several authors as its subject.[304]

303 *The Barents Sea Ecoregion*. p 23
304 Deleuze and Guattari, *A Thousand Plateaus*. p 23

He describes the nature of an assemblage using two axes:

– A horizontal axis which covers the range from *content* in the form of physical bodies, to *expression,* for example in the form of statements and laws regarding these physical bodies.

– A vertical axis which marks the extent of territorialisation, which has a stabilizing effect, or "the cutting edge of deterritorialization," which destabilizes.[305]

Assemblages are made up of heterogeneous components which are not exclusively dependant on the relationship represented within the assemblage, rather they are "self-subsistent and articulated by relations of exteriority."[306]

Manuel de Landa has gathered together the dispersed strands of Deleuze's theory of assemblages and clarified certain aspects.[307] For de Landa, the ability of an assemblage to link the the micro and the macro scales, and to "cut across the nature-culture divide" are two critical potentials of the theory. In simple terms he explains the difference between "mere" aggregates and assemblages:

"(an aggregate) a whole without properties that are more than the sum of its parts. (assemblages)… wholes whose properties emerge from the interactions between parts."[308] In an assemblage, "the whole cannot be reduced to a sum of the parts, because it reflects the components capacities and cannot be reduced to their properties".[309]

3.9.7 SUMMARY ASSEMBLAGE

The analysis of two periodic interactions in the Barents Sea has revealed spatial properties which can be localized both geographically and temporally, and therefore could potentially influence planning strategies tuned to inherent ocean dynamics. The two examples analysed; the polar front and the marginal ice edge, have both been recognised by the WWF and the Ministry for the Environment as valuable and vulnerable areas, and have been spatially localized within strategic maps.[310] From these examples, the Assemblage typology can be defined as follows:

– An assemblage includes different types of independent, but inter-related materials, forces and processes, which are not defined solely by the assemblage itself, therefore an asssemblge is more than the sum of its parts.

– An assemblage is open, adaptive and emergent.

– Spatial properties within an assemblage have a morphology of margins oscillating within thresholds. Boundaries between states or entities are spatial rather than linear and volumes are formed with recognisable cores and progressive peripheral gradients. This property of diffusion enables different entities to intersect and overlap.

305 Ibid. p 88
306 De Landa, *A New Philosophy of Society*. p 20. Relations of exteriority refers to the fact that they are not dependant on their internal relations within an assemblage and that the whole does not form an *organic unity*. This is in contrast to *relations of interiority* within which the component parts are determined by the relations they have to the whole and cannot exist in the same form outside of these constituent relations.
307 Ibid.
308 Ibid. p 5
309 Ibid. p 11
310 Ministry for the Environment Priority Areas: s.3.3 BARENTS SEA – SPATIAL CHARACTERISTICS. WWF map of priority areas for biodiversity preservation: s. 3.9 CONFLUENCE

– Within the cycle of determinants that form an assemblage, conditions, times and locations are determined according to organic precision – the assemblage morphology is distinguished by high periodic interrelatedness to other groups and spaces. Therefore it also has potential to be understood as a new type of planning tool. This would mean that spaces and materials intersect in certain combinations at certain times, creating a temporary stabilized and territorialized intensity.

3.10 CONFLUENCE

INTRODUCTION

The Barents Sea, as well as being Europe's last clean intact marine ecosystem,[311] holds an estimated 30% of the world's gas and 25% of the world's oil reserves below the seabed. The second urban format to emerge from the analysis of the Barents Sea's spatial characteristics is dominated by the *strategic geometries* of the hydrocarbon industry.[312] These geometries are constructed representations of urbanizing forces at work in the Barents Sea. The collaborations between international energy consortiums and the continuous investment in research and technology culminate in dispersed nodes of material infrastructure through which these combined forces flow. Offshore material manifestations of the oil and gas industry seem slender and fragile compared to the strategic geometries within which they are embedded. These geometries create a loose but precise mesh of coordinates over a vast area of the Barents Sea and construct a solid foundation for potential exploration and extraction activities.

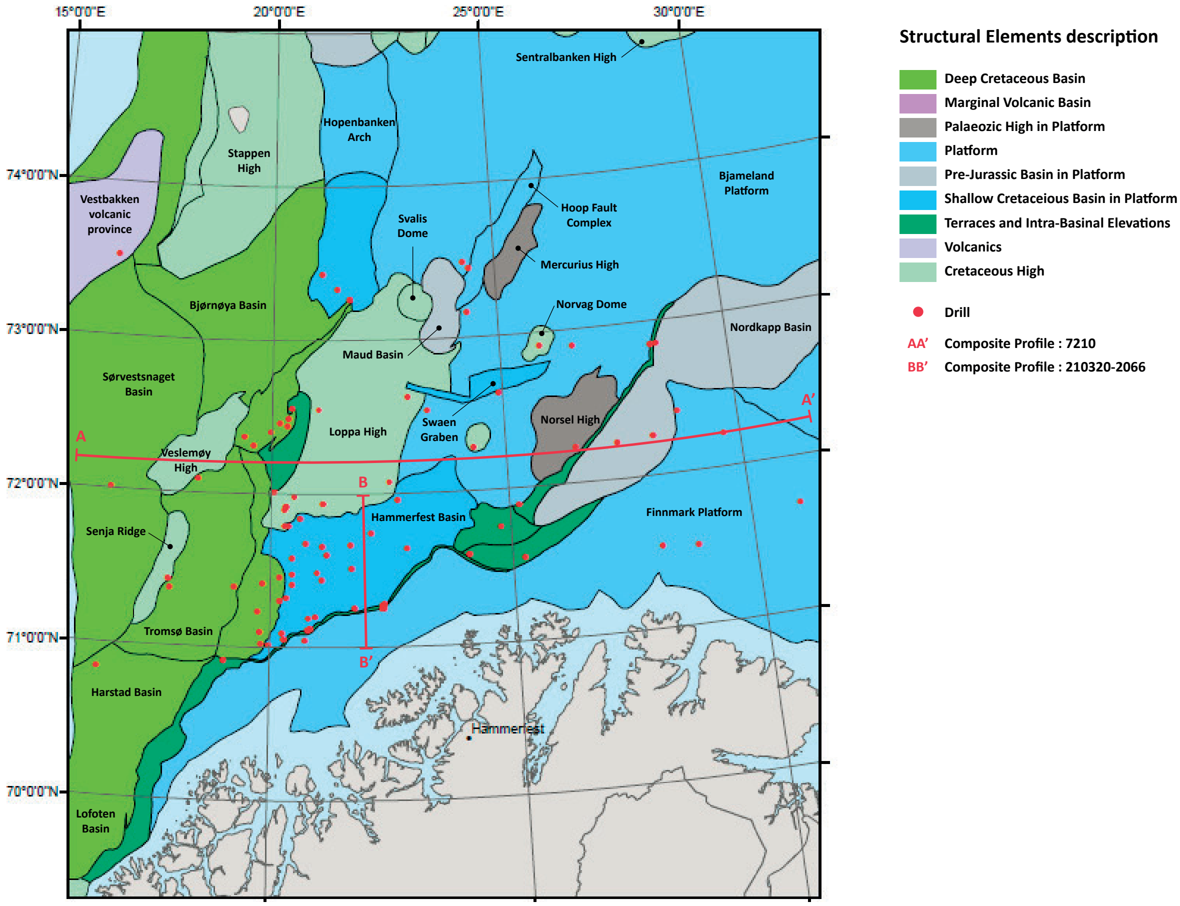
The extraction of fossil fuel is dependent on the connection to seascape resources. Technology is employed to locate these resources geographically and to connect the physical drilling site to the geometric matrix. This process is one way of *scaping* the sea in preparation for production. The results of this process, however, are not as tangible as, for example, a ploughed field, rather they remain highly abstract; data input becomes output in the form of maps which create the basis for systems of knowledge. In turn the knowledge-basis becomes a valuable resource in itself and is able to contribute to the management of the Barents Sea ecosystem. The knowledge-base bears witness to the particular alliance between environmental protection and exploitation hosted by the Barents Sea.

Through this process of knowledge-building, the relationship between production and protection comes full circle. Both join forces to manage a hyper-environment rich in both hydrocarbons and ecological importance. This arrangement, and the interactions between *s*eascape, technology, and ecology which shape it, will be investigated at the Norwegian offshore hydrocarbon "neighbourhood" of Snøhvit.

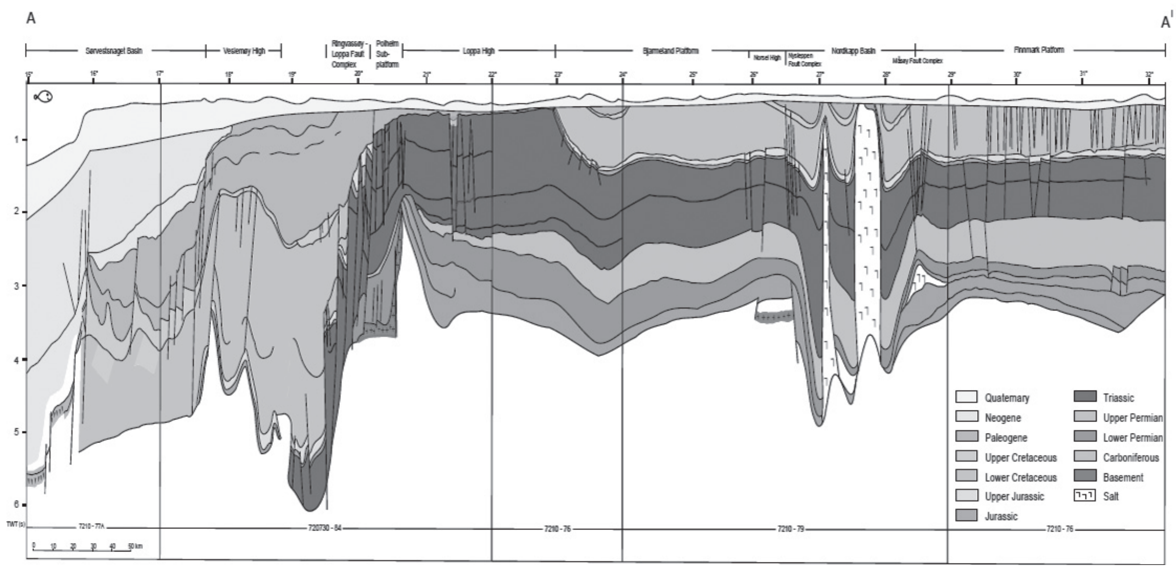
3.10.1 SEASCAPE, TECHNOLOGY, ECOLOGY

From the perspective of offshore oil and gas, the ocean floor is a porous surface containing the release valves for energy-wells. Through its permeable surface, access is gained to deposits located between 2500 and 5000 metres deeper. As a result, this working "field" in the Barents Sea has been drilled with approximately 100 exploration wells since the beginning of

311 The Barents Sea Ecoregion.
312 See 3.3 BARENTS SEA – SPATIAL CHARACTERISTICS



[93] Exploration wells drilled in the south western Barents Sea (as of 25.11.2013). Structural elements and location of transect AA'.



[94] Geological transect AA'.

exploration activities in 1980 [93].[313] The seascape therefore becomes significant as a series of deep geological formations. It is a seascape *constructed* through scientific exploration and representation. Rania Ghosn makes this point in her contribution to *The Petropolis of Tomorrow*:

> "The verticality of the environment, no less than its horizontality, is produced through the intertwined practices of scientific fieldwork and political authority."[314]

At the same time as the ancient underwater crust is revealed in its richness and complexity, the surface seascape is (re)constructed as a regular grid for the same purpose [95].[315] Petroleum and gas extraction normally require a connection between these two surfaces – a compression of the intermediate space through linear infrastructure much in the same way as the Nord Stream pipeline compresses ocean space between two "landings".[316] However, the Snøhvit field uses an extraction system located directly on the seabed. Gas is then transported through a 145 km-long seafloor pipeline to the Melkøa Island processing plant near Hammerfest.

Specialized scanning and mapping technologies result in a new type of "urbanized" territory in the Barents Sea, which is closely aligned to the establishment of environmental parameters for the same territory. In the subsequent hydrocarbon production phases, infrastructure is erected to serve the extraction process and to tie it into international production and distribution networks. The precision with which seabed scanning is undertaken therefore represents only one initial step in the technological chain of the hydrocarbon industry. Following discovery in commercial quantities, extraction mechanisms are installed and in the case of Snøhvit, the CO_2 produced during processing is re-injected back into adjacent geological formations. Through these extreme extensions, technology enables the excess "products" of urbanization to be stored in depths reaching 2500 m below the seabed.[317]

The Norwegian government initiated the interdisciplinary Mareano programme for mapping of the seabed in 2006 with expertise from the areas of hydrography, geology, biology and chemistry, which all and reveal important information about the Barents Sea marine ecosystems. The particular areas of study were selected in 2006 "because they were of interest for the oil and gas industry and had also been identified as particularly valuable and vulnerable" [96].[318] Seemingly peripheral and as a *bycatch* to hydrocarbon activities, valuable environmental data on the Barents Sea is collected throughout the phases of hydrocarbon exploration. In practice, this data is collated and shared between government departments with a particular interest in enabling petroleum activities to expand. The Mareano programme also brings together additional data from the Norwegian Defense Research Establish-

313 *CO_2 Storage Atlas Norwegian Continental Shelf*. Wildcats – an oil or gas-well drilled in an area not known to be productive have yielded around 35 discoveries.

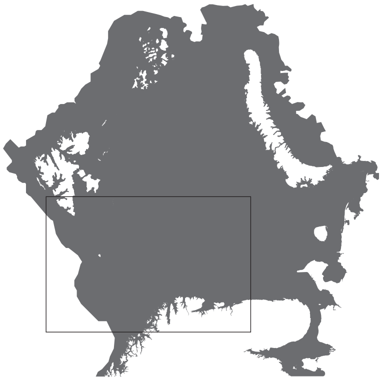
314 Ghosn, *The Expansion of the Extractive Territory*.

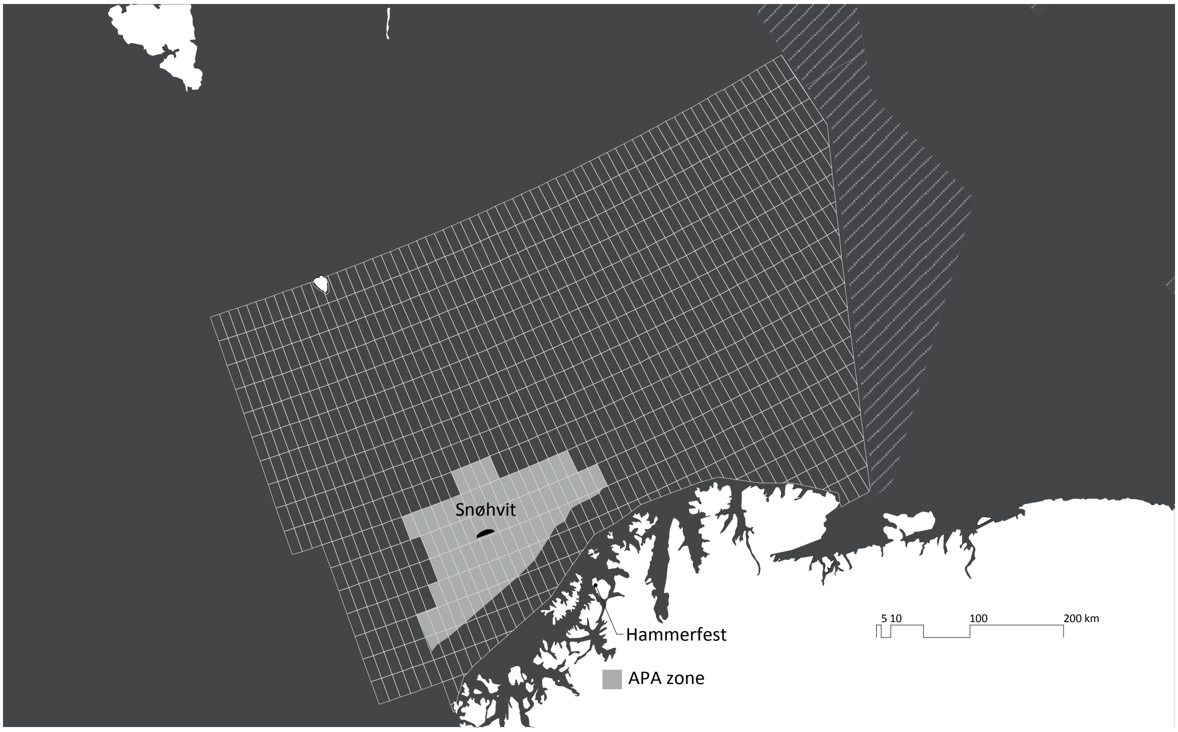
315 See 3.3 BARENTS SEA: SPATIAL CHARACTERISTICS.
The Norwegian Petroleum Directorate has established a structural grid of blocks measuring 35 × 50 km and extending from the Norwegian coastline to Bear Island.

316 See 3.7 CONTRACTION

317 http://www.statoil.com/en/TechnologyInnovation/NewEnergy/Co2CaptureStorage/Pages/Snohvit.aspx
Accessed 16/04/15.

318 Royal Norwegian Ministry of the Environment, *Meld. St. 10. Report to the Storting (white paper) First Update of the Integrated Management Plan for the Marine Environment of the Barents Sea – Lofoten Area*. p 6





[95] Exploration grid in the Norwegian EEZ- units 20 x 50 km. The location of Snøhvit is shown inside the Awards in Predefined Areas (APA) zone

ment and the Norwegian Petroleum Directorate.[319]

Ecology is defined as the study of the living conditions of organisms with each other and their surroundings, organic as well as inorganic.[320] In the Barents Sea, this necessarily includes the consideration of culturally-based relationships established around natural resources, including Sami traditions, the fishing industry, and the well-being of the population. The offshore petroleum and gas industries create value, generate employment and are seen as contributing to the general development of the northern region as a whole. Since their beginnings in the 1970s in Norway, these industries have developed into their own specific *ecology* and are already deeply-rooted in Norwegian territorial logic.[321]

Urban ecology – a process which integrates natural features, infrastructure and architecture so seamlessly as to result in a complete merger and where elements can hardly be distinguished from one another – is in my view best presented by Rainer Banham's *Los Angeles: The Architecture of Four Ecologies.*[322] Banham describes how within the diverse ecologies of *Surfurbia*, the *Foothills*, the *Plains of Id*, and *Autopia*, "the mechanisms, natural and human, that have made those ecologies support a way of life" can be identified.[323] In Norway, evidence of the *petroleum ecology* is readily available in the Integrated Management Plan for the Marine Environment of the Barents Sea-Lofoten Area;

> "In assessing the framework for petroleum activities in the Barents Sea and the waters off the Lofoten Islands, the Government has taken into account the importance of these areas in environmental and fisheries terms and their potential importance in terms of petroleum resources. On the basis of this assessment, the Government will maintain oil and gas exploration activities, and will give the oil industry access to areas of potential interest within an environmentally sound framework."[324]

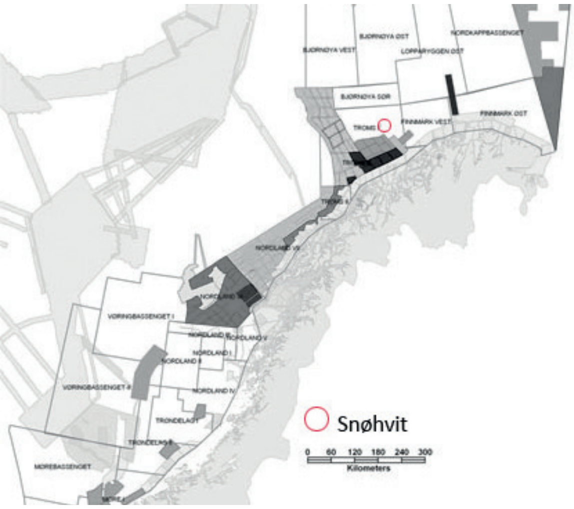
3.10.2 TERRITORIAL CONTEXT

PHYSICAL OCEANOGRAPHY

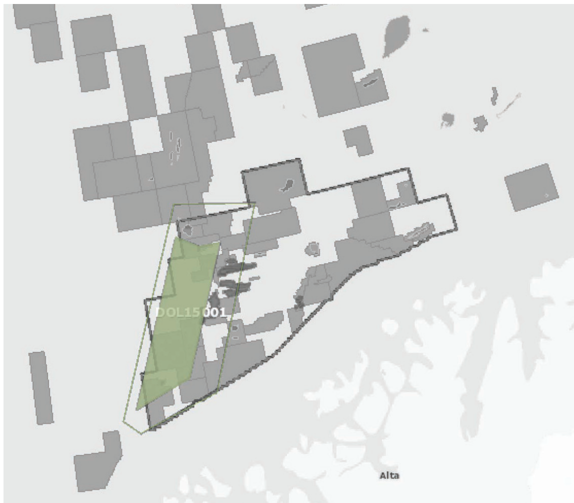
The Snøhvit gasfield is the first offshore Barents Sea production site within the Norwegian EEZ and has been on stream since 2007. Its neighbour and successor, the Goliat oilfield is due to be completed later in 2015 and is located 50 km south-east of Snøhvit. Both of these fields are located within the Hammerfest Basin, a geological formation defined by fault complexes on each side [93]. Hydrocarbons are located in sandstone formations from the Lower to Middle Jurassic period [94].[325]

The Mareano programme scans the seabed at depths less than 1000 m using am EM710 echo-sounder, and an EM300 at greater depths. The sonic pulse issued by an echo-sounder can provide detailed information about

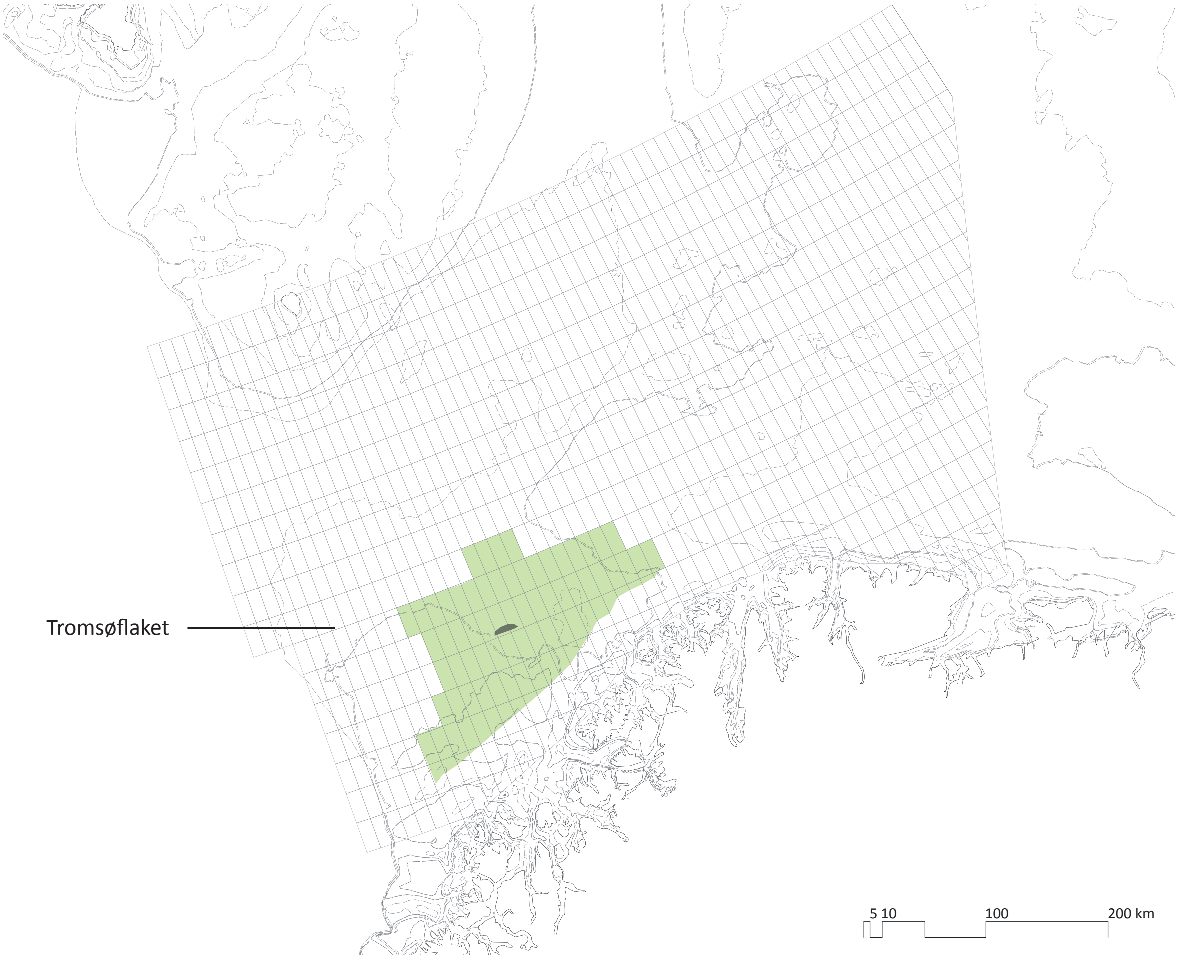
319 http://www.mareano.no/en/about_mareano
320 See 2.4 ECOLOGY
321 Oil was first discovered in commercial quantities at Ekofisk in the Norwegian North Sea in 1969.
322 Banham, *Los Angeles*.
323 Ibid. p 235
324 Royal Norwegian Ministry of the Environment, *Meld. St. 10. Report to the Storting (white paper) First Update of the Integrated Management Plan for the Marine Environment of the Barents Sea – Lofoten Area*. p 135
325 The Jurassic geological period is dated between 201 – 145 million years ago. Formations of this period were first recognised in the Jura mountains by Alexander von Humbolt in 1795.



[96] Areas where depth surveys have been carried out as part of the MAREANO programme to 2012.



[97] Ongoing seismic surveys (green) and current licensing areas.



[98] Tromsøflaket bathymetry

[99] Echo-sounder.

[100] Seismic surveys, Norwegian Petroleum Directorate.

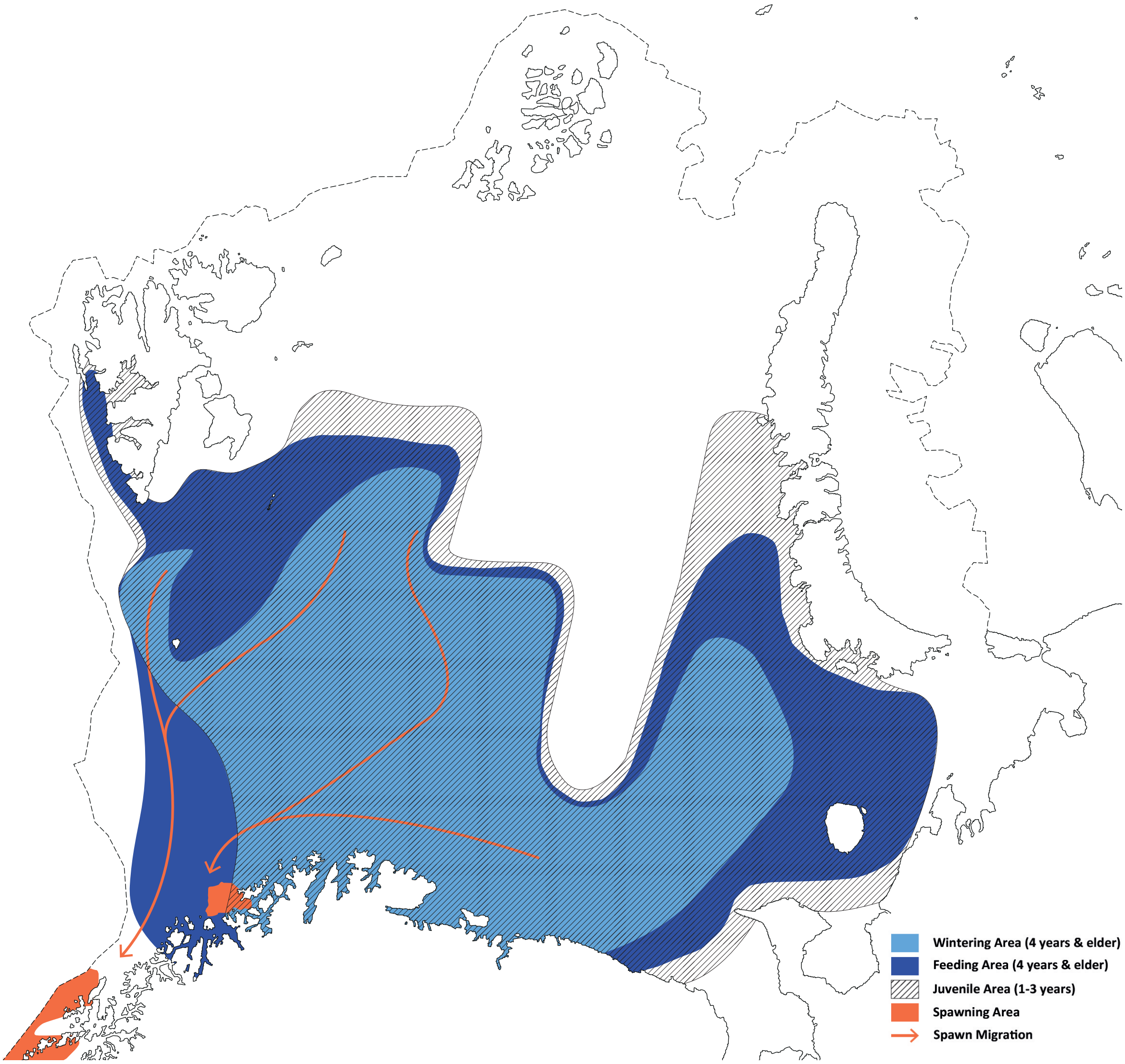
the seabed features such as coral reefs, ripple marks and also about the water column. The Echo-sounders normally measure 60° on either side of the vertical, therefore the measured path is around 3.5 x the water depth [99].[326]

Between 2005 and 2014, an area 131,000 km^2 had been scanned in the Barents Sea [96]. Despite the restricted number of operational wells, activity is high. The Norwegian Petroleum Directorate carry out continuous seismic surveys in the Barents Sea and have accumulated large amounts of data [100]. Surveying for hydrocarbons is undertaken by seismic surveys, which involve letting off small explosions and sending shockwaves into the sub-surface. These have a negative impact on fish populations, resulting in adult fish leaving the area, and a lethal effect on fish larvae at close range. The Environmental Management Plan has restricted drilling in sensitive coastal areas in summer when cod and other fish are spawning, but surveying requires a “precautionary approach” only. Local Lofoten residents and fishermen recently complained to the government about seismic “shooting” being carried out by the Norwegian Petroleum Directorate along the cod migration route between Tromsøflaket and Lofoten.[327] Effects of the seismic tests are not well known, and for the local fishing community, this activity presents a real risk of reduced stocks in an area traditionally dominated by fishing, and not hydrocarbons. The area beside Tromsøflaket is clearly earmarked for ongoing seismic surveys by the Petroleum Directorate [97], and therefore also for further petroleum exploration.

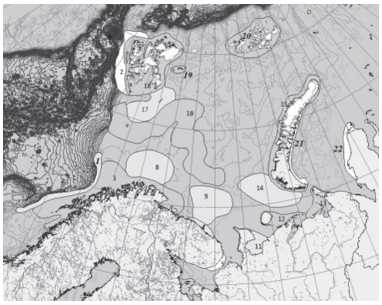
LIFE-FORMS

The Snøhvit fields are located adjacent to, and partly within, an important environmental area – the Tromsøflaket (Tromsø Bank), a small bank extending off the north-western Norwegian coast with water depths ranging from a minimum of 160 metres to a maximum of 350 metres in the Ingøydjupet glacial trough [98]. Tromsøflaket is market by iceberg ploughmarks and moraine ridges, has a wide range of habitat types, and therefore also a high biodiversity, but it is best known for the many different species of sea-floor sponges. This bank lies along the migration path of the cod, historically the most important fish resource taken from the Barents Sea.”[328] Cod winter in the southern, ice-free part of the Barents Sea and begin their migration to the coastal spawning areas around western Finnmark, Troms and Lofoten in January, where spawning is most intense around March [101]. Each female can produce up to 5 million pelagic eggs, which are then transported northwards into the Barents Sea by the currents.[329] At the Tromsøflaket, the interaction of currents with the bathymetry causes particular eddies to form, which hold back up to 90% of the flow of cod larvae arriving in the two summer months of June and July.[330] These larvae provide food for large quantities of seabirds- after breeding on Bjørnøya, Guillemots gather here in late summer to prepare for their migration. Tromsøflaket is also an area of high primary production and therefore important for wintering seabirds. The WWF has nominated this zone of coastal currents as particularly valuable within in the following categories; seabirds, plankton production, fish,

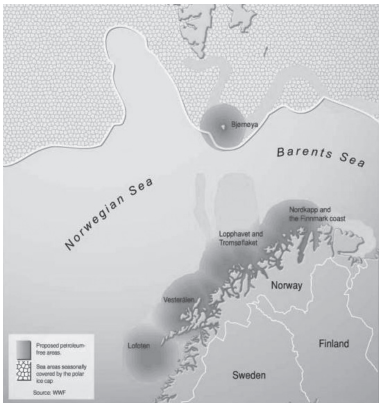
326 http://www.mareano.no/en/topics/bathymetric_mapping accessed 17.04.15
327 Benjaminsen, *Seismikkskytingen Er Avsluttet I Barentshavet*. (Seismic has been concluded in the Barents Sea)
328 Sakshaug, Johnsen, and Kovacs, *Ecosystem Barents Sea*. p 384
329 *Pelagic* – of the open sea. The eggs are not attached to plants or substrate.
330 *The Barents Sea Ecoregion*.



[101] Cod in the Barents Sea, annual distribution



[102] Priority areas for biodiversity preservation, Barents Sea (WWF)



[103] Proposed petroleum-free areas (grid-Arendal).

and biodiversity of benthic organisms (the richest in the ecoregion). Therefore it has been awarded very high priority status by the WWF's biodiversity assessment, and proposed as a petroleum-free area. The maps prepared by the WWF and the grid-Arendal programme trace a broader profile of protection at Tromsøflaket than the Norwegian Ministry of the Environment [10 – 11].

Although Norway has protected almost 17% of its land area,[331] very few marine protected areas have as yet actually been nominated. The Barents Sea Management Plan states that the establishment of marine protected areas is a priority.[332] But rather than protecting large areas, the Norwegian Environmental Agency follow an *integrated, ecosystem-based management* approach, where, based on a sound knowledge of the condition of the environment, different activities can co-exist as long as periodic restrictions are respected when necessary.[333] Production involving ocean resources includes fishing, hydrocarbons, tourism and newer industries such as bioprospecting and mineral extraction, all of which are recognised by the environmental agency as contributing to *value creation* in the Barents Sea-Lofoton area. Examples of protective management measures which are taken in consultation with the respective authorities, are the periodic closing of particular areas for fishing or reduction of quotas, and bans on bottom trawling in important coral-reef areas. Regarding the close proximity of hydrocarbon activities and vulnerable coastal spawning areas, restrictions are placed on drilling during the summer months only.[334] This collaboration demonstrates a convergence of interests in maintaining both a productive sea and an intact marine environment, since several of the industries named above also depend on the latter.

URBANIZATION

Snøhvit is a combination of seven production licenses distributed across three fields; Snøhvit, Albatross & Askeladd with a total of 20 wells, nine of which are located at the Snøhvit field itself, including eight for production and one well for re-injecting CO_2. From Snøhvit, a 680 mm diameter gas pipeline transports the gas condensate to the Melkøa Island processing plant near Hammerfest, accompanied by two chemical pipelines; one for transporting the CO_2 back to the field, and an "umbilical" pipeline supplying chemicals necessary for extraction [103 – 104]. The gas condensate extracted at Snøhvit has a 5 – 8 % concentration of CO_2, which is above the export limit to the EU.[335] The processing plant at Melkøa Island removes the CO_2 and liquefies the gas by cooling it to -163°C . From Melkøa, the LNG is then transported by ship to further destinations.

The artist's visualizations of the seafloor situation at Snøhvit portray a flat, uniform surface fitted with multiple connections but devoid of any territorial elements such as topography or the licensing grid, and hence also devoid of any reference to "site" [105]. The layout resembles a net-

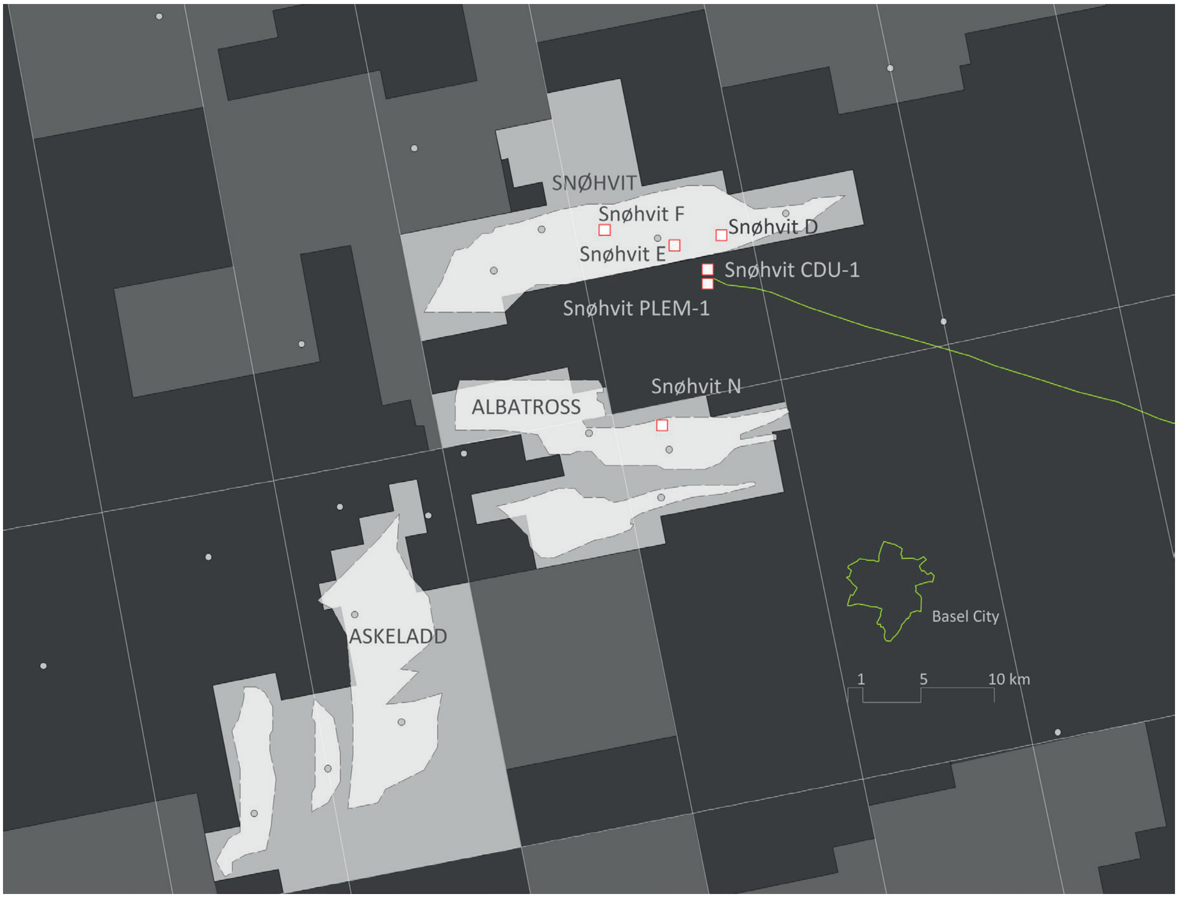
331 State of Norway, info-site managed by the Norwegian Environment Agency. http://www.environment.no/Topics/Biological-diversity/Protected-areas/#A Accessed 20/04/15

332 "Under the Convention on Biological Diversity, a target has been set for at least 10 % of coastal and marine areas to be protected by 2020". Integrated Management Plan for for the Marine Environment of the Barents Sea-Lofoten Area. p 134

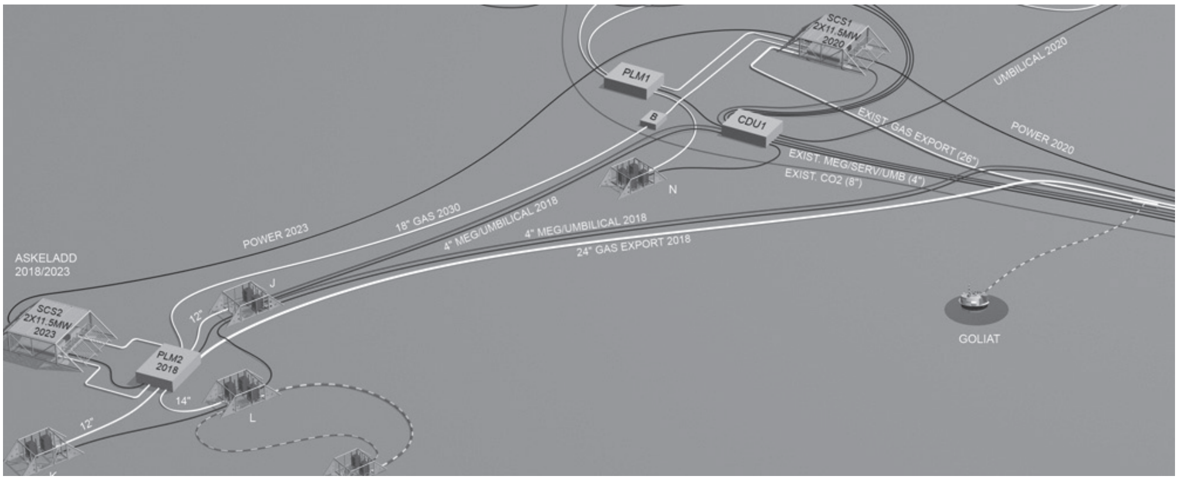
333 See 4.2 MARINE SPATIAL PLANNING IN THE BARENTS SEA

334 See 3.3 [15] "Framework for petroleum activities."

335 Max concentration of CO_2= 2.5%



[104] Snøhvit field showing position of production templates (E, D, N), the sub-sea distribution structure (CDU-1) the pipeline end manifold (PLEM-1) and the gas-injection well (F).



[105] Schematic layout of Snøhvit seafloor installations (artists impression).

work diagram. The geological structure over 2000 m below and the abstract licensing block coordinates are separate systems of placement each with their own distinct spatial logic. These two systems are overlaid with a third, network logic of the piping-layout sandwiched in-between. The relationships between all three are coordinated by technology. The Snøhvit installations are conceptually dislocated from territorial reference points and yet occupy a total area roughly equal to the size of the City of Los Angeles.[336] The number of overlaying systems and relative proximity of wells, also endow this configuration with an unfamiliar type of density which can only be perceived by piecing together different layers of specialist information, and never from the surface of the sea. Individually, a 68 cm diameter pipeline is of a negligible dimension within the scale of the Barents Sea, however the installations require multiple pipelines, which together thicken into linear cords circulating around the template of the ocean floor.

Offshore fields offer the oil and gas industry the advantage of remoteness and autonomy, since they are out of the public eye. The state-of-the-art installations at the Snøhvit field take this condition one step further, where infrastructure is relocated to a deep, silent, impenetrable, albeit "common" seafloor site, to which only true specialists have access.

3.10.3 CONFLUENCE OF ENVIRONMENTAL AND TECHNICAL SYSTEMS

Confluence signifies the flowing together or uniting, originally in the sense of two rivers or streams.[337] While certain aspects of the alliance discussed here can be compared to other typologies; the grid (Interpenetration) or the linear infrastructure (Contraction), the technological marriage of environmental and hydrocarbon interests is an extreme format that brings a new dimension of extended urbanization into the foreground.

Until recently Science and Technology Studies (STS) has largely overlooked the relationship between technology and the environment, but mounting research interest in enviro-technical systems is turning this topic into a field of enquiry in its own right. Such an approach looks at the intersections between science, government and environmental management, and "the ways that humans and non-humans are assembled into durable socio-technical networks."[338] Environmental projects on a grand scale, such as the construction of the Canal du Midi in the 17th century[339], or the (re) construction of the river Rhone[340], re-emerge from an enviro-technical analysis as "deep entanglements – or, confluences – of infrastructure design, environmental engineering, and nation building."[341]

It is in reference to this concept that this enviro-technic typology is called *confluence*. Hydrocarbons are already an integral part of the Barents Sea ecology. Strategic geometries stretch over the sea surface and sub-sea geologies regulate the emergence of template systems on the seafloor. Sites of extraction nudge against boundaries of environmental vulnerability and the oil and gas industry must avoid drilling during the summer

336 The area of the City of Los Angeles is 1,302 km^2, with a max width & length of ca 40 km. The Snøhvit ensemble is discontinuous and forms a parallelogram rather than a square, but the total length & width are both around 40 km.
337 *Oxford Concise Dictionary*, 6th edition.
338 Research profile Prof Patrick Caroll, University of California, Davis, currently researching *California Delta: The Engineered Heart of a Modern State Formation*. Funded by the NSF.
339 Mukerji, *Impossible Engineering*.
340 Pritchard, *Confluence*.
341 Rowland and Passoth, *Infrastructure and the State in Science and Technology Studies*.

spawning season. Fishing and exploration activities – both vital economic sectors for northern Norway – must co-exist temporally and spatially. The Ministry of the Environment argues that it is through a technologically produced knowledge-base that a balance is to be achieved. The form of extended urbanization applied to the Snøhvit field matches the extreme nature of the environment within which it is inserted; it has gone sub-surface in answer to continuing development pressure combined with the extreme environmental challenges of temperature, light and depth. Direct underwater systems eliminate the effects of seasonal surface fluctuations caused by ice, storms or waves and new technologies effectively reduce on-site structures and personnel to a minimum.[342] The imperceptibility and remoteness of offshore energy operations under the control of powerful corporations, has been articulated by critics and artists.[343] Seafloor operations represent a further degree of decoupling extractive activities from the public realm. Through remotely-controlled extraction sites devoid of human presence, the oil and gas industry, in direct collaboration with the Norwegian Ministry for the Environment, open up the Barents Sea as a new productive territory.

This territory is produced through data-synthesizing maps, which are themselves sites of information density. Hence the territory becomes structured around the digital coordination of different strata- both physical and virtual, which emerge in a collated form to compete with other maps, pathways and spatial claims. I argue that the collective territory is *constructed* through these activities, and while its form cannot yet be compared to a coherent (historical) artefact such as a canal spanning the Mediterranean and the Atlantic, its spatial configuration emerges as the *confluence* of environmental and technological "natures". The resulting *new nature* – an organic/ non-organic hybrid of mutual interdependencies is a product of the Anthropocene.[344] The Barents Sea, as an increasingly hybrid environment, requires "ecosystem" management and depends on a technological knowledge-base to carry this out.

3.10.4 SUMMARY CONFLUENCE

The Barents Sea's strategic petroleum geometries remain a dormant tablet ready for the activation of fields within the system's coordinates. They form an invisible infrastructure, yet are none the less real for this abstraction. The grid is the result of years of systematic surveying activities, data-gathering and analysis to prepare the territory for exploitation. I argue that its dimensions of around 269,000 km² and its regular layout are evidence that the forces of the petroleum industry have been channelled into a format of extended urbanisation. The geometry is reinforced by laws and licenses which then unleash exploration activity in true physical terms. It is difficult to imagine a clearer example of "striation" of the sea as in-

342 In the Barents Sea, conditions of light, wind and temperature are more extreme in the atmosphere than in the body of water itself the water temperature, for example remains relatively unchanged all year. (Atlantic water 3.5 – 6° and Arctic Water between 0 and -1.5°, seawater freezes at -1.9°C). *Ecosystem Barents Sea*.

343 See 2.3.2 TECHNOLOGY AND URBANITY

344 See 2.4.3 21ST CENTURY – THE ANTHROPOCENE

tended by Deleuze and Guattari.[345] The post-licensing formations however, are disconnected and messy – almost random and organic compared to the orthogonal spatial "order" of the grid, which is a classical system for the allotment and distribution of territory. Rania Ghosn succinctly explains the reason for this:

> "As the locational logic of resources is geologic rather than geographic, extractive industries often operated in areas isolated from the power of the central authority and previously unconnected to networks of communication, transport, and labour."[346]

The particular case of the Barents Sea, where ground has been prepared, but further development is slow to take off, demonstrates the dynamics of the *confluence* typology. The mechanisms of extraction operate within a transitory, nomad system. Imports or out-sourcing of skills, technology, machinery and expertise follow the discoveries and create artificial *seasons* of activity. Seasonal adaptability is a special northern skill, and a prerequisite to surviving Nordic life.[347]

Environmental factors are also an integral and critical part of the hydrocarbon equation in the Barents Sea. In *confluence*, the exploitation of resources presupposes engagement with powerful natural forces parallel to those which have formed the resource itself. Hence the local situation poses an enormous challenge and depending on external influences, such as the market price or political opinion, the flow of hydrocarbon production may remain limited by its own partner in the enviro-technical ensemble- the contingent, erratic, unpredictable ocean itself. However confluence is resourceful and will readily adapt its form and constellation to changing conditions.

Through the insights gained by an analysis of the Snøhvit gasfield in its context, the proposed *Confluence* typology can be defined as follows:

– A condition of merger where seemingly divergent interests combine forces.

– Confluence steers flows, hence such a merger is a periodic alliance of parallel interests and can subsequently be realigned.

– Offshore, confluence does not result in megastructures, rather a conceptual or regulatory framework for development.

– Confluence builds a powerful consensus of interests, activates financial resources, and potentially presides over vast area of space, even if its built manifestations do not reveal the scale of influence it exerts.

– Confluence can be considered a "natural" phenomena in the sense that it is a result of interactions concerning environmental resources and in the case of the Barents Sea, is part of the well-established oil and gas ecology.

The convergence and overlapping of these two areas of interest is a signal of their necessary co-existence in the Anthropocene. Norwegian society is wealthy, technologically well-developed and has gained much valuable experience in offshore industries. Therefore the ecologically intact Barents Sea

345 "It is the difference between a smooth (vectorial, projective or topological) space and a striated (metric) space: in the first case "space is occupied without counting" and in the second case "space is counted in order to be occupied" Deleuze and Guattari, *A Thousand Plateaus*. p 361, referring to two kinds of space-time in music after Pierre Boulez. See also 3.7 EXPANSION for a fuller discussion on striated space.

346 Ghosn, *The Expansion of the Extractive Territory.* p 236

347 Gugger, Couling and Blanchard, *Barents Lessons.* Territorial Constitution 4 Humans and Seasons.

Title	INTERPENETRATION	CONTRACTION	EXPANSION	ASSEMBLAGE	CONFLUENCE
Influence of topics	Seascape Technology Ecology	Networks Seascape Technology	Networks Seascape Technology	Networks Seascape Ecology	Seascape Technology Ecology
Exemplary location	Baltic Sea > Belt Sea	Baltic Sea > Arkona Basin - Gulf of Finland	Baltic Sea > Klaipeda-Eastern Gotland Basin	Barents Sea > Polar Front / Marginal Ice Edge	Barents Sea > Hammerfest Basin
Structures	72 wind turbines, transformer, cables	Nord Stream pipeline 1224 km x 2 x 1.2m	Ports, Ro-Ro vessel (198 x 28m x 5.9m draught)	----	Exploration grid, 269,000 km^2 Snøhvit gas extraction field 1,300 km^2
Description	Large-scale loosely-arranged fixtures, important ecological site and high frequencies of adjacent urban activity.	Extreme spatial fluctuation, concentration of forces, effects at micro & macro scales	Continuously opening ocean surface, effect of the horizon, interwoven vectors form a field	Loose, changing densities & intensities which create far-ranging spatial conditions inherent to the ocean	Alliance between environment and petroleum, manifest through technological knowledge-building systems.
References	architettura radicale; Superstudio, Archizoom	Rania Ghosn, Erik Swyngedouw	Deleuze & Guattari, nomad/smooth space	Stan Allen: Field Conditions, Giles Deleuze & Manuel de Landa, Assemblage	Sara Pritchard: Confluence. Envirotechnical approach

106: Comparative table of all Typologies will also be managed within this framework, which itself has been largely dependant on the oil and gas industry.

3.11 SUMMARY TYPOLOGIES

The five typologies and their properties are summarized in the comparative table [106]. Seascape is common to each typology, and since seascape has manifold dimensions, it can be concluded from this table, that each intervention or spatial phenomenon in the ocean is linked to a form of seascape. The contradictions of scale are also evident in the table; physical structures are thin and precise, however the area of influence is large. The typologies are characterized by loose, fluctuating, periodic and widely-dispersed spaces- this is in contrast to “familiar” urban conditions which are associated with concentration. These spaces therefore determine the type of urbanity at the core of this investigation.

Have the typologies contributed to a clearer understanding of general socio-spatial processes?

Results of research carried out by Floridi in the area of Globalization, in particular in reference to Information and Communication Technologies, reveals several close parallels to these typologies. Floridi’s “six key transformations characterising the processes of globalization”[348] are described as follows;

Contraction: acceleration has shortened the time required for any interaction- life is more condensed and takes place in a contracted physical space.
Expansion- the new digital environment is constantly expanding
Porosity- between physical and virtual space
Hybridization- the digital is spilling over and merging with the analogue
Synchronization- accidental, temporary synchronization of otherwise chaotic trends, which cannot be attributed to masterminded organization.
Correlation- the lack of distinction between what is local or what is remote-global often means not everywhere but actually delocalized.

While these transformations are specific to Floridi’s model of globalization, and the meanings differ from the characteristics defined by operations in ocean space, questions of correlation or disjunction between the two groups arise. *Porosity* shares certain properties with Interpenetration and *Synchronization* with Confluence. *Correlation* can be easily imagined as a further typology in ocean space. Contraction at the Nord Stream pipeline is also about condensing energy and securing connections in order to contract distance. The pipeline’s connection to the pan-european energy grid illuminates the global dimensions of the energy sector.

Some typological mechanisms identified in ocean space are therefore clearly related to processes of globalization. This validates their relevance and merits further study.

348 Floridi, “Global Information Ethics: The Importance of Being Environmentally Earnest.”

4 RELEVANCE TO PLANNING

INTRODUCTION

The spatial analysis of the Barents and Baltic Seas presents the ocean as a rich terrain of dispersed fragments of urbanization, thick cords of infrastructure securing selected connections and abstract fields of intended activities. These fixtures or coordinates are reliant on seasons of high primary production and subsea geological formations and are entangled with seabed forests, reefs, trenches, banks and vast areas of wintering, breeding or migrating birds. The scale is dispersed and densities periodic. However in some cases, the physical space of the ocean is almost completely consumed and geographical limits are now matched by forms of extended urbanization such as the size and manoeuvering capacity of maritime vessels.

The inherent space of the ocean offers urbanizing opportunities as a continuous surface, as an airspace outside inhabited areas, as a deep concealed space, as a potentially latent, open space and as an abstract territory bound by non-visual coordinates. Specific forms of urbanization have colonized these spaces and taken hold there. Parallel to this, ocean ecosystems continue their cycle in interaction with anthropogenic factors, creating periodic spaces of high productivity and consolidating traditional routes and pathways. The assemblage typology shoes that these organic systems themselves possess spatial properties which I argue can be more relevant for ocean planning than a geometrical petroleum grid.

Large parts of both the Barents and the Baltic Seas have become sites of production, sometimes directly competing with other uses and causing “habitat displacement.” This competition and resulting disputes led the UN to develop UNCLOS and define national boundaries offshore. The formation of an extended national territory in the form of an Exclusive Economic Zone unleashed further planning efforts to organize this space. But an ambiguous zone was also created; despite coastal nations not having ownership rights to the space as a *commons*, their right to the exploitation of resources within this zone plus the international right to unimpeded shipping, cable-and pipeline-laying, quickly dominated planning objectives in the EEZ and established economic priorities as its foremost function.

The following section examines these planning mechanisms more closely;

– Firstly, the origins and definitions of Marine Spatial Planning are described. Examples of particular international cases then paint a broad picture of its diversity.

– Secondly, the conceptual shift to spatial planning is discussed within EU policy and in comparison to urban design and urban strategy.

– Thirdly, current planning measures in the Barents and Baltic Seas are summarized, including an evaluation of these measures against the typologies proposed in Part 3.

In conclusion, the investigation of the *design* potentials of the ecosystem-approach is recommended rather than the current emphasis on *planning* potentials. Design potentials then provide the basis for what could become the *Ocean Project.*

4.1 STATE OF THE ART – MARINE SPATIAL PLANNING

The United Nations Convention on the Law of the Sea (UNCLOS) is the definitive international legal instrument regulating ocean space. It came into force in 1994 after being opened for signature at the third United

Nations Convention on the Law of the Sea in Jamaica in 1984. The United Nations continues to support the management and spatial coordination of this newly defined realm. The Marine Spatial Planning (MSP) initiative to coordinate ocean use in the interests of sustainable management, is led by UNESCO and supported by their Intergovernmental Oceanographic Commission (IOC). Objectives of several of UNESCO's ocean programmes, such as Man and Biosphere (MAB) and the Coastal Areas and Small Islands Programme overlap with, and stand to gain from, the overall objectives of MSP. The programme is sponsored by Foundations with an agenda in marine conservation,[1] as well as NGOs, European Agencies and government departments. At the beginning of this doctoral research, the international MSP database provided by UNESCO IOC contained only a handful of examples, but this has expanded to 41 ocean management initiatives over 21 countries, including two projects in China.[2] New legislation in Germany, the UK and Belgium has unleashed recent planning activity and European funding instruments have encouraged pilot programmes in new member countries such as Latvia, Lithuania, Estonia and Poland. UNESCO's efforts to promote MSP continue with international conferences and the compilation of a guide for practical implementation.[3] While national EEZs provide the current framework for ocean planning, the understanding of the relevance of trans-national planning is also gaining in importance.

Marine Spatial Planning is defined by the UNESCO IOC as:

> "A public process of analyzing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic, and social objectives that usually have been specified through a political process."[4]

MSP aims at an approach that is integrative, participatory, strategic, adaptive and *ecosystem-based*, to ensure a balanced co-existence between human activities and healthy ocean ecosystems. The ecosystem approach represents a departure from the traditional sectorial approach in the ocean, since the latter has not been able to deal with the cumulative effects of human activities. This approach is defined as:

> "A strategy for integrated management of land, water, and living resources that promotes conservation and sustainable use in an equitable way… the ecosystem approach requires a comprehensive analysis of all dimensions of environmental problems, based on the application of appropriate scientific methods. The essential processes, functions and interactions among organisms and their environment are the guiding parameters for the approach, including humans as an integral component of ecosystems."[5]

For UNESCO, Marine Spatial Planning is one way of achieving an ecosystem approach to planning and management, since it aims to consider marine ecosystems from both a spatial and a temporal perspective. However, once human activities are included in the equation, MSP must also consider many more uses and stakeholders. While being widely accepted in theory, the appli-

1 The Gordon & Betty Moore Foundation, the David & Lucille Packard Foundation
2 http://www.unesco-ioc-marinesp.be/msp_around_the_world. Initial research phase: 2011.
3 Dahl, Marine Spatial Planning. A Step-by-Step Approach toward Ecosystem-Based Management.
4 Annu*al Report 2006*. p 57
5 Ibid. p 57

cation of the ecosystem approach and its effectiveness, still remains unclear.

In this thesis, ocean space has been approached from the perspective of interactions between ocean systems and human interventions. An *ecosystem approach* sounds like a radical new form of planning, where the ecology of the ocean is understood as an integrated system including anthropogenic influences. This approach would potentially be highly adapted to ocean time and space. Ecosystems are complex systems which respond to changing internal conditions and which have emergent structures.

> "A complex system cannot be completely separated into fully independent modules."[6]

Thus the use of MSP as a tool requires consideration of the following question; How can planning methods adapt to ecosystems and their emergent, non-linear, open-ended properties?

4.1.1 AN OVERVIEW OF MARINE SPATIAL PLANNING

Examples of marine spatial planning are not all aligned to what could be expected under an *ecosystem approach* and vary considerably according to the geographic and political context and to the history of spatial definition within that context. In preparation for a pilot project in the UK, a review of Marine Spatial Planning initiatives and experiences was conducted by the study group for the Department for Environment, Food and Rural Affairs (Defra) in 2005. The management plans for ten international marine areas located in Australia, New Zealand, Fiji, Canada, the Wadden Sea (Netherlands, Denmark and Germany), the Philippines and Florida were analysed.[7] From the review, the common characteristics of MSP could be discerned:

– Management plans were driven by objectives and priorities.

– Most plans had been initiated through the objective of environmental protection, not production.

– The process of forming a consensus was achieved through intensive consultation which aimed to break down the sectorial approach.

– Implementation of the plans remained unclear in many cases.

– The definition of boundaries at sea placed a greater emphasis on ecosystem components (than boundaries on land).

Three aspects of these examples will be explained more fully; Participation, Conservation and Implementation.

PARTICIPATION

The process of producing a plan for marine space is marked by different steps, which are in turn supported by environmental assessments, nature protection plans and subsequent revisions. Consultation with a broad range of stakeholders is critical to the ambitions of MSP. The example of the *Marine Planning Partnership for the Pacific North Coast (MaPP)* of Canada, provides an insight into the dynamics of stakeholder participation. Canada was the first country in the world to pass comprehensive legislation for ocean management with the Oceans Act of 1997. The Canadian Pacific North Coast is characterized by a relatively unspoiled marine environment, important fishing tourism industries, indigenous communities (First Nations) and oil and gas interests. After six years of preparation and 1.5 years of the actual plan-

6 Nikos A. Salingaros, Principles of Urban Structure.
7 MSPP Consortium 2005a Marine Spatial Planning Pilot Literature Review, DEFRA.

[1] Marine Bioregional Plans, Australia.

ning process, the Canadian government's Dept. of Fisheries and Oceans "re-aligned" the process. Essentially the government was not prepared to resolve the conflicts caused by, and pressures applied by the oil, gas and associated shipping interests through such a process, which involved consultation with opposing parties such as the First Nations. The First Nations subsequently withdrew from the process. As a result two plans have been developed for the same area; activities and uses deemed to be under federal government jurisdiction are covered by the Pacific North Coast Integrated Management Area Plan (draft 2013), whereas the province of British Columbia in collaboration with the First Nations, have produced a management plan through the Marine Planning Partnership for the Canadian Pacific North Coast.[8]

CONSERVATION

The history of many *bounded* ocean spaces is related to environmental protection, which precedes the idea to "plan", but not the idea to "manage." Therefore many examples of MSP originate in marine reserves or protected areas, which are subsequently incorporated into a strategy for a broader area. Australia's recent and ongoing establishment of six "Marine Bioregional Plans" for 7 million km^2 of ocean from the 3 nm coastline to 200 nm limit of the EEZ, is an example of such a process [1].[9] The plans include networks of marine parks, as well as existing protected areas. Within this broad framework, particular local zones for fishing and tourism or important marine habitats are handled in more detail and controlled through a permit process. This example recognizes the vast scale of Australia's ocean systems which are driven by warm ocean currents and intersected by whale migration and within which more specific zones are embedded. Therefore the scale of a marine protected area, for example, is relative to both a larger, more comprehensive scale, and a smaller scale of local activities.

IMPLEMENTATION

As in the Canadian case described above, ocean planning is linked to government policy and in several cases is preceded by Acts of Parliament; for example the Australian *Environment Protection and Biodiversity Conservation Act* 1999, the German *Federal Spatial Planning Act*, 2004 and the UK *Marine and Coastal Access Act* 2009. The Acts themselves are also preceded by assessments and pilot studies. While the spatial plans are regulatory and enforceable in the UK and Germany, integrated plans resulting from diverse initiatives in Canada have not moved forward towards official governmental approval or implementation. In many other international cases, integrated management "plans" are advisory only, but serve as a valuable information platform and a reference for further decision-making, since data from many sectors comes together in one coordinated format. This is the case in Norway. Overall, knowledge about the marine environment lags behind that of the terrestrial environment. The geographical location of "knowledge gaps" is in itself seen as a worthwhile outcome of some MSP projects and means that further research, analysis and information-gathering can be optimised and focused on areas of greater conflict or environmental sensitivity. These

8 Ministry of Forests, Lands and Natural Resource Operations, British Columbia, *First Nations and Province Complete Marine Plans*.

9 The parks have been established in 2012. See Appendix; Marine Spatial Planning and http://www.environment.gov.au/topics/marine/marine-bioregional-plans/about

examples show that MSP is a process which emerges in a specific form according to the territorial context. Here, the interactions between the different determining aspects of ocean territory come into focus; the bio-territory, the geo-physical territory and the socio-economic territory. Seldom do these three territorial aspects co-exist in equal terms in ocean planning, rather the unbalanced interrelations between them may be the cause of outright political conflict.

4.1.2 MARINE SPATIAL PLANNING : A CLOSER EXAMINATION

For architects and urban designers, developing a comprehensive project requires a thorough examination of the existing environmental, social and economic conditions as well as the sustainable allocation of the spatial and temporal distribution of human activities. Many projects also involve intensive public consultation and the consideration of requirements from different and potentially conflicting sectors. Referring to the definition of the ecosystem approach at the beginning of this chapter, it would seem that architects and urban designers are already working close to this concept, apart from the detailed levels of analysis regarding the natural ecosystems which however, could easily be integrated into the architectural programme. The examples of MSP discussed show little evidence of architectural input, therefore which other ways can the ecosystem approach be achieved? A deeper examination is required regarding this emerging planning field, which will be approached according to its three components; Marine, Spatial and Planning.

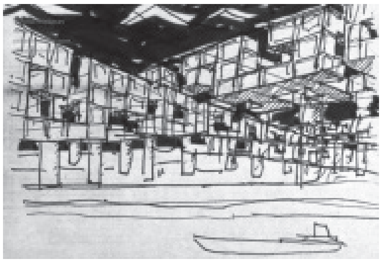
MARINE

Related to the sea or ocean[10]; of, found in, produced by the sea; of shipping or naval matters. In science, marine usually refers to salt water environments, but in engineering for example, it may refer to any navigable body of water. The noun marine has a military meaning as a navy or a member of a navy such as the United States Marine Corps. Hence it is interesting to note that marine is infused with notions of control, navigation and the military.

SPATIAL

Relating to the position, area and size of things[11]; of and relating to space and the relationship of objects within it.[12] The first usage of spatial is recorded in the mid-19th century, originating from the Latin spatium meaning 'space.'[13] The mid-19th century is marked by the "second" industrial revolution within which the refinement of the steam engine, the internal combustion engine, electric power lines and the assembly line transformed the western world, initiating "modern urban life" and the first spurt of significant urban growth since the Medieval period.[14–15] According to researchers investigating the relationship between technological, economic and social developments in European cities, it was also in this period that material, institutional, professional and political networks and transnational govern-

10 Cambridge online dictionary.
11 http://dictionary.cambridge.org/dictionary/british/spatial Accessed 04/05/15.
12 http://www.merriam-webster.com/dictionary/spatial Accessed 04/05/15.
13 http://www.oxforddictionaries.com/definition/english/spatial Accessed 04/05/15.
14 Hård, *Urban Machinery*.
15 De Landa, *A Thousand Years of Nonlinear History*.



[2] Ville spatiale at eye level, with a waterfront. Source: www.yonafriedman.nl (Courtesy of Marianne Homiridis).

ance strategies emerged.[16] The appearance of the term spatial coincides with these new transformations of urban scale and technology.

"Ville Spatiale" was the name given by Yona Friedman to his visionary sketetal mega-structure which hovered over the existing land- and cityscape, providing a flexible infrastructure for all possible living and working spaces [2].[17] This was the founding idea for the "Groupe d'Etudes d'Architecture" (GEAM), which also included Constant (Nieuwenhuys) and Frei Otto. The "spatial city" was part of their proposal to build 100 new cities of three million inhabitants in response to what they saw was the need for urban expansion vertically, eliminating horizontal sprawl.[18]

In the contemporary planning context, the use of this term is understood to stem from European planning policy, in particular the European Spatial Development Perspective (the ESDP) from 1999.[19–20] Preliminary work in this direction on the part of the EU, however, dates back to the *European Regional/Spatial Planning Charter* adopted in May 1993, which defined, "for the first time, the major Europe-wide objectives that should underlie policies for spatial planning, improvement of the quality of life, and the organisation of human activities in the physical space of Europe."[21] In the EDSP, spatial encompasses the larger, more heterogeneous realm of the European territory. It can be applied to cross-border situations between regions, between land and sea, and between nations. The plan includes development perspectives for infrastructure, agriculture, research & development, environment, economic and social cohesion. It recognizes the relevance of particular spatial typologies, such as urban areas, with regard to these categories and therefore begins to use them as a framework.[22] The plan also promotes "the development of polycentric and balanced urban systems and strengthening the partnership between urban and rural areas."[23]

In the UK, the use of *spatial* in relation to planning effectively replaces the term *land-use planning*:

> "Spatial planning goes beyond traditional land-use planning to bring together and integrate policies for the development and use of land with other policies and programmes which influence the nature of places and how they function."[24]

In German, the Federal Spatial Planning Act, 2004 is based on the previous Act of 18 August 1997, but the term "Raumordnung" (spatial planning) is used in both cases.[25] Also the traditional French term "l'aménagement du territoire" describes the scope and intentions of spatial planning. Therefore

16 Hård, *Urban Machinery*.
17 Yona Friedman, *L'architecture mobile*.
18 Mallgrave and Goodman, *An Introduction to Architectural Theory 1968 to the Present*.
19 *ESDP European Spatial Development Perspective. Towards Balanced and Sustainable Development of the Territory of the European Union*.
20 Hillier, *The Ashgate Research Companion to Planning Theory*.
21 CEMAT, *European Regional/spatial Planning Charter. Torremolinos Charter*.
22 Commission on Spatial Development, *ESDP European Spatial Development Perspective. Towards Balanced and Sustainable Development of the Territory of the European Union*. p 16
23 Ibid. p 11
24 Office of the Deputy Prime Minister, *Planning Policy Statement 11: Regional Spatial Strategies*. 2004
25 BGBl. I S. 2081, 2102 (Bundesgesetzblatt Jahrgang 1997 Teil 1 Nr. 59, seite 2081 18/08/1997), Gesetz zur Aenderung des Baugesetz buchs und zur Neuregelung des Rechts der Raumordnung (Bau- und Raumordnungsgesetz 1998 – BauROG) / BGBl I s 2986 (Bundesgesetzblatt Jahrgang 2008 Teil 1 Nr. 65, seite 2986. 22/12/2008), Gesetz zur Neufassung des Raumordnungsgesetzes und zur Aenderung anderer Vorschriften (GeROG).

it can be concluded that the introduction of the word “spatial” was necessary only in the English language, due to the particular planning traditions inscribed within the term “land-use planning”. Yona Freidman’s project however, refers to a conceptual shift outside the realms of planning legislation, where “spatiale” implies the definition and occupation of a new spatial realm, not anchored in *la terre*.

Spatial planning encompasses urban planning and more – it is capable of crossing borders previously determined by scales of administrative units and therefore can potentially recognize new and unfamiliar modes of urbanization. Both in theory and practice, spatial planning can be understood as an “attempt to cope with complexity and uncertainty through imagination and experimentation.”[26] Based on the *spatial turn* in EU planning policy as described above, I argue that the pairing of the term “spatial” with planning echoes an urban condition within which the dichotomies of urban and rural are dissolved, where urban relationships stretch across national boundaries, and in particular, within which an urban extension from land and sea can be conceptually embedded. A further ambition of the EU in this planning context, is to move from an economic, to an environmental and social union:

> “The EU will therefore gradually develop, in line with safeguarding regional diversity, from an Economic Union into an Environmental Union and into a Social Union.”[27]

Hence for the EU, “spatial” is first and foremost an economic dimension.

PLANNING

To plan involves both a representation, such as a plan, and a method- a way of arriving (to plan).[28] Planning carried out by any discipline involves a leap into the future and therefore a strategy for dealing with mutable unknowns:

> “The twin hazards of uncertainty and disagreement form an essential context for planning’s ambitions of shaping the future.”[29]

Despite this “open” definition of planning, the history of the planning profession is associated with hierarchy, a predominantly two-dimensional plane of reference, fixed master-plans and with the progression towards a predetermined goal. Modern urban planning has evolved from resolving problems associated with the industrial revolution and extreme urban growth, to the Garden City movement from visionaries such as Ebenezer Howard, to post-war modernism and a 1960’s systems view of planning, to the public demand for more participation and loss of planning credibility, to the current pluralization of planning processes where the role of planning can be described as providing “a resource for democratic and informed decision-making.”[30]

Design, on the other hand is a cognitive process within which the definition of the “problem” evolves concurrently to the possible solutions, of which a number will be produced in parallel. Hence there is no pre-determined set of solutions. Research on the design process carried out

26 Hillier, *The Ashgate Research Companion to Planning Theory*.
27 Commission on Spatial Development, *ESDP European Spatial Development Perspective. Towards Balanced and Sustainable Development of the Territory of the European Union*. (1999) p. 10
28 Hall and Tewdwr-Jones, *Urban and Regional Planning*.
29 Myers, *Symposium*.
30 Hall and Tewdwr-Jones, *Urban and Regional Planning*.

by Nigel Cross, confirms that problems and solutions are kept fluid until they are identified jointly through the articulation of a concept- a creative leap, or a "bridge" between the two.[31] Historically, the disciplines of architecture and planning were split in the 1960s. Planning went on to address land-use patterns and socio-economic issues at the macro-level, while architecture concerned itself with the scale of buildings.[32] However if design follows a relatively undetermined methodology to approach complex problems – in the realms of science design problems have been called "unstructured" or "wicked"[33] – this process can potentially be applied to any scale or problem.

Urban design is characterized by the simultaneous attention to different scales, to the public and private realms, to the three-dimensional articulation of space and by its responsibility towards collective space. Urban design involves multiple interested and affected parties as well as a heterogeneous range of different spatial typologies- both built and unbuilt. The design process is dynamic- a range of solutions evolves towards a differentiated result within which critical areas will be developed in a higher resolution – ensuring the optimal interaction of the parts- and lower resolution areas remain available for further input. An urban design is not completely determined, but will aim to physically mould, shape and construct space and consider the material and aesthetic qualities of this construction.

An urban strategy, on the other hand remains more abstract, setting up programmes and parameters which enable change and development. Originally a military concept, strategy is a way of mobilizing a range of forces to achieve maximum support of a particular policy, whether in peace or war. An urban strategy is less concerned with the physical materiality of the context and is itself not a process, rather a set of guiding principles which could be achieved in a number of different ways. If a large-scale context is deemed impossible to design due to the complexities of its inter-scalar dimensions, strategy provides a way of remaining open-ended while at the same time determining a direction, potential steps and methods. A certain dynamic is retained. Individual *plans*, or *designs* can be embedded within a strategy. This non-deterministic nature of strategy can inform planning:

> "Only a kind of strategic planning open to transformative practices is suited to cope with the continuing and unabatedpace of change driven by the structural developments and challenges in our western society."[34]

Geographer Jean Hillier argues that planning can be approached from Giles Deleuze's post-structuralist perspective.[35] Strategic planning would then be more closely aligned to strategic *navigation* between fluid concepts which are always in a state of "becoming" but which may not be harmonious. Strategic *navigation* is experimental, pragmatic, yet still in contact with reality. Using the parallel of Deleuze and Guattari's "planes", Hillier argues for a double conceptualization of planning, in which the "plane of immanence" represents a broad, conceptual background over which local, short-term plans and projects are layered. The latter are "planes of organization." The plane of immanence describes potentials, is open-ended and subject to

31 Cross, *Designerly Ways of Knowing*.
32 Gosling and Maitland, *Concepts of urban design*.
33 Loveridge, *Process Bifurcation and the Digital Chain in Architecture*. p. 90
34 Albrechts, *Enhancing Creativity and Action Orientation in Planning.*
35 Hillier, *Strategic Navigation in an Ocean of Theoretical and Practice Complexity*.

transformation. It can also describe “visions of a longer-term future” in the form of relatively abstract concepts such as “sustainability.” Instead of *forecasting*, Hillier advocates the use of *foresighting* – a speculative act meaning different alternatives can be explored as scenarios.

Mapping is a way to identify such possibilities. Deleuze and Guattari and Corner describe the map as made to “unfold potential”, and unlike a “tracing” does not merely reproduce the known.[36–37] A true map, then functions as “both an analogue and an abstraction… first disclosing, then staging the conditions for the emergence of new realities”.[38] According to Hillier, strategic navigation as a process thus “requests strategic planners to diagram and engage the virtual events immanent within their worlds”.[39]

4.1.3 SUMMARY MARINE SPATIAL PLANNING

In this section the differences between planning, design, urban design and urban strategy have been discussed. Marine Spatial Planning aims to determine parameters of use and therefore reduce conflicts, but also aims to remain open-ended, processual and to take all integrated spatial and temporal aspects of ocean ecosystems into account. I argue that parts of the MSP ambition relate to planning in the traditional sense, and parts adhere more clearly to the process of design. Strategy has a chance to connect these two; strategy can provide a framework and a series of objectives which can then be implemented through *design* in heterogeneous ways. Plurality in design can refer to different time-cycles, divergent interests and specific environmental conditions.

An examination of the origins and use of the term *spatial* reveal its association with emerging forms of urbanity and new realms of occupation. Marine Spatial Planning is a young discipline born out of the necessity to manage extended urbanization across the land-sea divide. This is but one of the emerging territorial relationships being tackled by EU policies under the term *spatial*, which is applied to accommodate different forms of urban extension.

4.2 MARINE SPATIAL PLANNING IN THE BARENTS SEA

The Management Plan for the Barents Sea- Lofoten Area is an example of Marine Spatial Planning which aims to adopt ecosystem-based management, and as such has been praised by UNESCO:

> “the management plan for the Barents Sea-Lofoten area is a ground-breaking effort, putting the concept of an integrated, ecosystem-based management regime into practice for the first time.”[40]

The aim of the plan is to “provide a foundation for the co-existence between industries and measures for addressing principle challenges related to pollution and the maintenance of biodiversity.”[41]

This kind of management aims at a holistic view guided by the scale of the ecosystem itself and the understanding that all aspects of an ocean system are interrelated. Therefore single acts of parliament governing sectorial areas must be considered in relation to one another and the cumulative effects as-

36 Deleuze and Guattari, A Thousand Plateaus.
37 Corner, *The Agency of Mapping: Speculation, Critique and Invention*.
38 Ibid. p 216
39 Hillier, *Strategic Navigation in an Ocean of Theoretical and Practice Complexity.*
40 http://www.unesco-ioc-marinesp.be/msp_around_the_world/norway_barents_sea
41 Sakshaug, Johnsen, and Kovacs, Ecosystem Barents Sea. p 21

[3] Particularly valuable and vulnerable areas in the Barents Sea-Lofoton area.

sessed. This means that judgment can be discretionary and the precautionary principle is often the basis for decisions.[42] The single acts set out guidelines, which then must be balanced with the importance of other acts.[43] The management plan is advisory only, and avoids defining strict actions, but serves as a point of reference from which other legislation should be developed. It "clarifies the overall framework and encourages closer coordination and clear priorities for management of the Barents Sea-Lofoten area. It increases predictability and facilitates coexistence between different industries."[44]

Management measures are aimed to increase the resilience of the ecosystem. The plan identifies particularly valuable and vulnerable areas in terms of biodiversity and biological production where "special caution is required"[3] Regarding benthic fauna, birds, fishing (managed by the Directorate of Fisheries), long-range pollution, climate change and ocean acidification, the measures adopted by the plan revolve around mapping, monitoring and improving knowledge. This is also the case for understanding cumulative effects, where new information on biodiversity pressures and impacts of human activity makes it possible to "evaluate the targeted measures for conservation and sustainable use of ecosystems."[45] Decisions are made on the basis of scientific knowledge and evidence – hence the establishment of a knowledge base is of critical importance. The government states it will establish marine protected areas. The prohibition of coastline trawling and the establishment of trawl-free zones and "flexible" areas, where fishing is regulated during specific periods, are managed by the Directorate of Fisheries.

The framework for petroleum activities describes the most specific measures in the plan and restrictions in the vulnerable areas are defined as follows; a limit of new coastal petroleum activities out to 35 km from the baseline and no drilling out to 65 km from March to August in Finnmark & Tromsøflaket (fish-spawning and migration). More surveying is planned before new blocks are opened in the north-east Norwegian Sea and impact assessments in the previously disputed area along the Russian border where production licenses can potentially be granted.[46] The oil and gas industry must comply with a zero discharges policy from their operations.[47] Throughout the plan, emphasis is placed on "value creation for Norwegian society." This applies to all productive areas; fisheries, agriculture, marine transport, petroleum, tourism, renewable energy and bioprospecting. In particular, the oil and gas industry is given high importance in this regard, and the

42 In the absence of sufficient knowledge, decisions are based on the Precautionary principle – the opposite of being innocent until proven guilty. If there is a doubt that an activity will cause environmental damage, but not enough scientific evidence to prove this, the precautionary principle states that this lack of evidence is not grounds to carry out the activity, rather it shall be prevented. This principle can be made more restrictive in combination with the "polluter pays" principle, as in the case of the OSPAR Convention (The Convention for the Protection of the Marine Environment of the North-East Atlantic). The precautionary principle is applied to environmental contexts, being first used internationally in the 1982 World Charter for Nature at the United Nations Assembly. The 2006 UN resolution on sustainable fisheries (A/RES/61/105) calls on nations to protect vulnerable marine ecosystems from destructive fishing practices fish stocks according to the precautionary principle.

43 Relevant Acts include; the Nature Diversity Act, the Marine Resources act, the Pollution Control Act, the Petroleum Act, the Offshore Energy Act.

44 Royal Norwegian Ministry of the Environment, *Meld. St. 10. Report to the Storting (white paper) First Update of the Integrated Management Plan for the Marine Environment of the Barents Sea-Lofoten Area*. p 133

45 Ibid. p 19

46 See THESIS INTRODUCTION [7], Exploration Licensing areas, Norwegian continental shelf.

47 From the white paper 1977.

authorities emphasise “the importance of co-existence with other industries, particularly the fisheries industry.”[48] The plan aims to establish an integrated Norwegian-Russian monitoring programme regarding climate change, and assist in developing a Russian management plan. Monitoring is intended only at the bio-physical level, and not at the level of the performance of the management plan itself, but the plan is due for revision in 2020.

For ease of comparison, a summary of the facts relating to the plan are laid out at the end of this section, alongside those of the Spatial Plan for the German EEZ in the Baltic Sea [7].

4.2.1 SUMMARY: PLANNING IN THE BARENTS SEA

The management plan for the Barents Sea cannot be understood as a stand-alone document. The plan is a statement of intentions. It is an overview which refers to different threads of legislation from other sectorial governing bodies. These are highly interrelated, and each situation is regarded case by case before decisions and restrictions are made. It relies on the utmost cooperation between sectors. Much trust is placed in technology; surveying, monitoring and improving the understanding of the ocean and its dynamics, pressures and threats. The “management” of the ocean is to be achieved through technology, hence this system is cost-intensive and relies on a high level of scientific and managerial coordination. The extent of this established collaborative culture is expressed in the sharing of knowledge and systems of control between the Ministry of the Environment and the Petroleum Directorate as discussed in the “Confluence” typology.

The plan has also been praised as being a model of *ecosystem-based* management. At the beginning of this chapter, the following question was formulated:

HOW CAN PLANNING METHODS ADAPT TO ECOSYSTEMS AND THEIR EMERGENT, NON-LINEAR, OPEN-ENDED PROPERTIES?

As most marine spatial plans, the plan for the Barents Sea is based around the national boundaries of the Norwegian EEZ. In the Barents Sea, national borders do not correspond to biological or topographical ocean boundaries and the ecosystem operates across this artificial divide. The Russian-Norwegian political divide is then reflected in many domains of extreme discrepancy, of which economy, health, and nuclear waste are just some examples.[49] While the long-standing Russian-Norwegian cooperation in the domain of fishing has been almost exemplary in the Barents Sea[50] and the first collaborative Russian-Norwegian Environmental Report was issued in 2014,[51] a management method based on the ecosystem must by definition intensify these efforts to cross the border. Therefore the reliance on Norwegian technological systems to achieve ecosystem-based management will have only a limited effect. This is a criticism and a challenge for planning cultures as a whole when addressing the “management” of ocean systems. Since the plan is advisory only, it can be described as open-ended. Consultation was mainly carried out with the major industries and other ministries,

48 Royal Norwegian Ministry of the Environment, “Meld. St. 10. Report to the Storting (white paper)First Update of the Integrated Management Plan for the Marine Environment of the Barents Sea - Lofoten Area.” p 80.
49 Gugger, Couling, and Blanchard, *Barents Lessons. Teaching and Research in Architecture*.
50 Hønneland, *Making Fishery Agreements Work*.
51 *Joint Norwegian-Russian Environmental Status Report on the Barents Sea Ecosystem, IMR – PINRO Reports*.

however considerable expertise (26 directorates and institutions) has been drawn into the plan.

Regarding the articulation of spatial and temporal parameters, which are a further feature of the ecosystem-approach, the plan is still rudimentary. While illustrating the valuable and vulnerable areas, the plan does not articulate how these areas are to be treated, apart from, for example a ban on fishing within 20 nautical miles of the Bjørnøya baseline and a ban on new petroleum activities within parts of the particularly valuable and vulnerable areas. Compared to a plan prepared by the WWF identifying priority areas for conservation,[52] the polar front and marginal ice edge are presented in a minimal, schematic way, which does not represent the state-of-the-art in available scientific research. In general, attention is focused on areas of petroleum interest – an area which extends as far as the marginal ice-edge.

4.2.2 CONFLUENCE AND ASSEMBLAGE

The level of confluence apparent in the management plan, raises the question of the *open* character of the plan towards other factors and the consideration of their relative importance. The environmental/petroleum confluence emanates closure. However, as discussed, the Barents Sea is already an established petroleum ecology and hence the confluence typology exerts an overriding influence over the complete Norwegian part of the sea.

However, the interrelations of periodic environmental factors should be more fully represented in an "ecosystem-based" management plan. Seasonal flows of bird, fish and animal life should be integrated into its strategy. These are directly related to dynamic environmental conditions such as wind, currents, ice formation, bathymetry and food supply. Geometries and boundaries for these ecosystems are organic – they are determined by topographical features and natural events. Therefore the challenge remains to combine fixtures and licensing blocks associated with fossil fuel extraction and natural ecosystems into a unified form of representation over time.

The Assemblage principle offers a possible approach; if the licensing grid element were to be eliminated and the petroleum industry loosened from this administrative anchor, the single, diverse elements and sites comprising the extraction process could be brought into relation through an assemblage configuration. Geological formations containing hydrocarbons are themselves organic in form and dispersed irregularly through the Hammerfest Basin. A representation which highlights this arrangement, rather than a systematic spatial system over the entire Norwegian part of the sea as far as the ice-edge, would allow for other assemblages to co-exist and intersect in space and time.

While production is still limited in volume and geographical location in the Barents Sea, this activity could be understood more as a series of points, rather than an expansive gridded and *bounded* area. If the map constructs the territory, a map demonstrating the assembled elements of gas extraction would in fact be more organic, and enable a more fruitful dialogue and exchange with the sweeping, large-scale seasonal spaces developing in the Barents Sea. Such a differentiated map would represent a more balanced range of forces, would reduce the force of the grid and hence would construct a new imagination of the sea and its interactions.

52 See 3.10 CONFLUENCE [10 – 11]

4.3 MARINE SPATIAL PLANNING IN THE BALTIC SEA

4.3.1 EVOLUTION

Spatial Planning in the Baltic Sea has been supported by the EU through the programmes BaltCoast[53] PlanCoast[54] and BaltSeaPlan.[55] This sequence of programmes also describes the evolution of marine spatial planning in the region.

The BaltCoast programme was conceived as an instrument to address the ecologically sensitive coastal zone, which is also important for tourism, infrastructure and urban expansion. Integrated Coastal Zone Management (ICZM) originates from an EU Council resolution adopted in 1992 – a follow-up from the UN Earth Summit in Rio de Janeiro, which urged coastal states to set up such programmes. The BaltCoast project developed recommendations for ICMZ, but also recognized the need for the integration of offshore areas, for which it then developed recommendations. In 2005, the German state Mecklenburg-Vorpommern was the first EU state to integrate their coastal zone into a territorial development plan; the "Landesraumentwicklungsprogram." This zone covers the eastern part of Germany's Baltic coastline out to the 12 nm territorial limit.

Mecklenburg-Vorpommern then took the lead in the PlanCoast project, which aimed to develop methods for integrated coastal and ocean planning in three European seas; the Baltic Sea, the Black Sea and the Adriatic Sea. The project introduced Integrated Marine Spatial Planning (IMSP), which had been advocated in the Green paper of the European Commission, as a new instrument to achieve this goal:

> "Integrated Maritime Spatial Planning combines the tools and procedures of terrestrial spatial planning with the principles of Integrated Coastal Zone Management (ICZM). IMSP views coasts and seas as constituent parts of an integrated system, both in terms of ecology and socioeconomic factors. Through intensive stakeholder involvement and the use of Geographic Information Systems (GIS), IMSP extends terrestrial spatial planning and principles of ICZM to the open sea."[56]

Mecklenburg-Vorpommern pioneered the use of GIS to develop electronic planning registers which were then made freely available to other professional users and to the public. A pilot plan for the Western Gulf of Gdansk was developed as part of the PlanCoast project. Poland was one of the few EU countries to introduce legislation for Marine Spatial Planning with the 2003 Act for the Maritime Areas of Poland, however at this stage the draft plan has not been taken further.

BaltSeaPlan continued this evolution to develop 8 pilot planning

53 BaltCoast (2002 – 2006)INTERREG III B BSR project budget: 3 Mio €, 17 sub-projects implemented by 22 national, regional and local authorities plus two scientific institutes and one non-governmental organisation from 8 BSR countries; Germany, Poland, Sweden, Lithuania, Latvia, Finland, Estonia, Russia (Kaliningrad). Lead: VASAB.

54 The PlanCoast (2006 – 2008) INTERREG IIIB CADSES project budget: 2 Mio €, 16 partners from Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Germany, Italy, Montenegro, Poland, Romania, Slovenia and the Ukraine. Lead Partner: the Ministry of Transport, Building and Regional Development of Mecklenburg-Vorpommern(Germany).

55 BaltSeaPlan (2009 – 12), ERDF (Europen Region Development Fund) Baltic Sea Region programme. Project budget 3,7 Mio €, 8 pilot projects for marine spatial planning in the Baltic Sea. Lead: BSH, Federal Maritime and Hydrographic Agency, Germany.

56 Schultz-Zehden, Gee, and Scibior, PlanCoast. Handbook on Integrated Marine Spatial Planning.

projects: the Danish Straights/T-Route (DK), the Pomeranian Bight/Arkona Basin (DE/DK/SE/PL), the Western Gulf of Gdansk (PL), the Middle Bank (SE/PL), the Lithuanian Coast (LT), the Western Coast of Latvia (LV), Pärnu Bay (EE), Hiiumaa and Saaremaa Islands (EE). These projects were mostly structured around national EEZs, but the Pomeranian Bight/Arkona Basin and the Middle Bank pilot plans addressed the challenge of trans-national ocean zones [4]. These zones are characterised by bathymetrical features such as shallow banks which are of high importance for birds, of interest for the development of windfarms, and which are traversed by national borders and shipping routes [5].

One of the most interesting exercises of the BaltSeaPlan project was the development of the BaltSeaPlan Vision 2030 document, prepared by all 14 partners.[57] The potentials of energy, maritime transport, fishing and the environment were considered in a coherent way throughout the whole Baltic Sea. The project fully exploits the conceptual freedom of the vision method and proposes the following:

– To establish a network of Marine Protected Areas which focus on the spatial dimension of species – this will ensure habitat connectivity and protection over different life stages or paths.

– To declare the Baltic Sea an emission control area (NOx, Sox) for shipping and to define areas to be avoided by ships.

– The full integration of fishing activities into the spatial plan, the protection of fish spawning and nursery areas, the establishment of blue corridors to connect habitats, monitoring and control of fish stocks to ensure sustainable catch-levels, and the establishment of sustainable aquaculture and sea-ranching.[58]

– A Pan-Baltic super grid which coordinates energy requirements around the Baltic, differentiating between import or export between Baltic states depending on renewable energy resources. Offshore wind potential is realized, co-use of windfarms encouraged and seabed infrastructure bundled in linear corridors.

– A Territorial Impact Assessment as well as the (statutory) Environmental Impact Assessment (EIA) should be made to ensure that the socio-economic effects of projects are also assessed.

– To designate areas based on the non-static principle – adaptation to changing conditions is required and measures are revised regularly- a timeframe of 5 – 10 years is proposed.

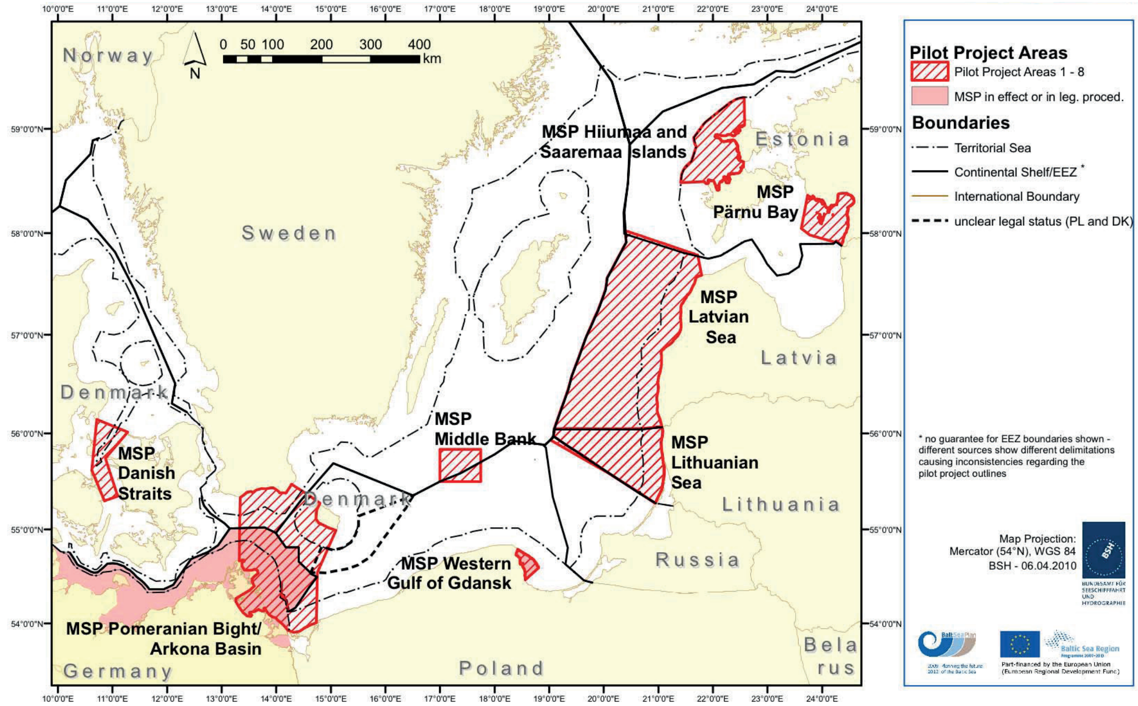
– To set up both a formal body for endorsing pan-Baltic MSP with Ministers responsible for spatial planning in each country, plus a technical body to facilitate the trans-national process.

– To organize space around the concepts of linear elements- infrastructure, shipping corridors and blue corridors, and "patches" – which are priority areas for a particular use- for example windfarms, fish spawning areas or conservation. The different layers of the ocean mean that corridors are overlaid and are able to cross in a fluid manner.

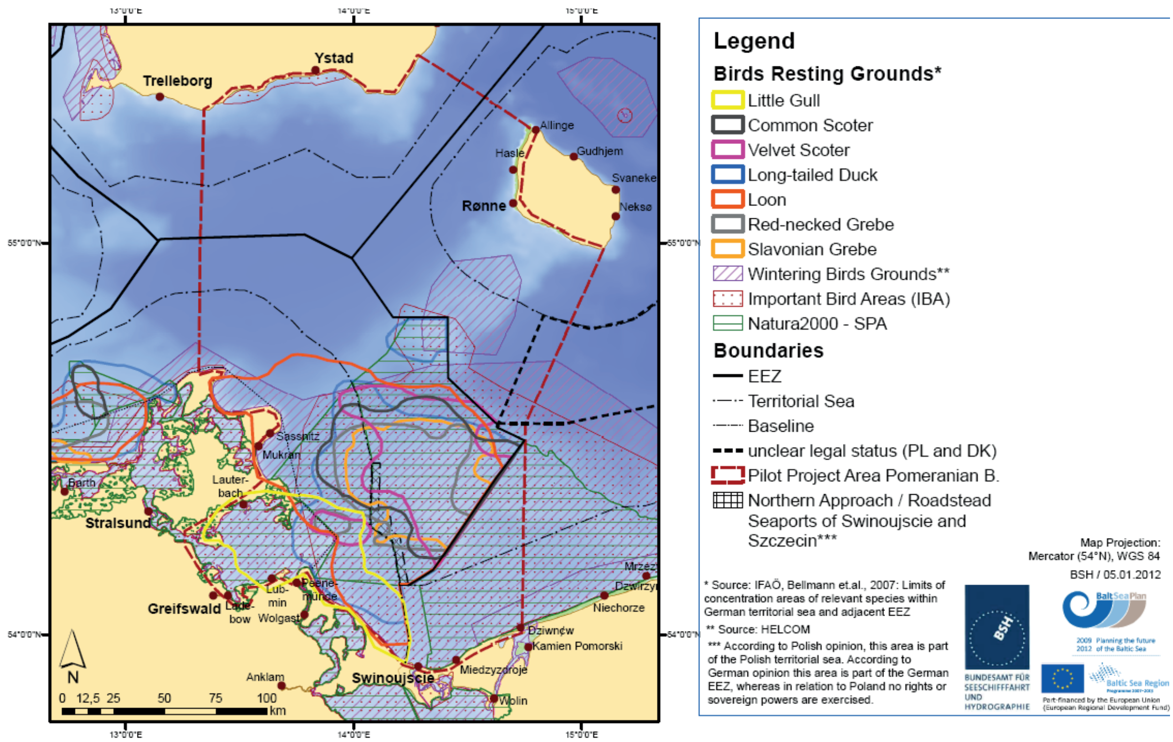
Vision 2030 demonstrates the potential of trans-national think-

57 Gee, Heinrichs, and Kannen, Vision 2030. Towards the Sustainable Planning of the Baltic Sea Space.

58 Sea-ranching is a Japanese principle within which migrant fish-species are conditioned to a sound before feeding as young hatchlings in a net. They are freed to the open sea to mature , but when returning to the original site to spawn, fish responding to the horn sound are captured.



[4] Overview of Marine Spatial planning Pilot Areas under the BaltSeaPlan programme.



[5] Bird habitats, wintering grounds and conservation areas, Pomeranian Bight/Arkona Basin.

ing and coordination. It also offers a comprehensive new image of the Baltic Sea at the conceptual level. Pilot plans in Poland, Latvia, Lithuania, and Estonia developed through BaltSeaPlan will serve as a basis for establishing official plans and work is continuing. Sweden also created a new government agency – the Agency for Marine and Water Management – in 2011, which is to be responsible for ocean planning. A preliminary report delivered in 2014 is to serve as the "knowledge base".

In the Baltic Sea to date, only the German authorities have issued definitive marine spatial plans. For this reason the German spatial plan will be examined in closer detail.

4.3.2 SPATIAL PLAN FOR THE GERMAN EEZ, BALTIC SEA

The early start to the planning process in Germany was due to guaranteed subsidies for electricity generated by wind-power, called feed-in tariffs, which were introduced in 1990. Although in Germany the move offshore was not immediate, the "Federal Government Strategy for the Use of Wind Energy at Sea," released in January 2002, defined a target of 3000 MW of installed wind energy by 2010 and 30,000 MW by 2030. The Federal Maritime and Hydographic Agency (BSH) received a flood of applications for the installation of offshore windpower triggered by these incentives, and began the preliminary work on a marine spatial plan in 2002.

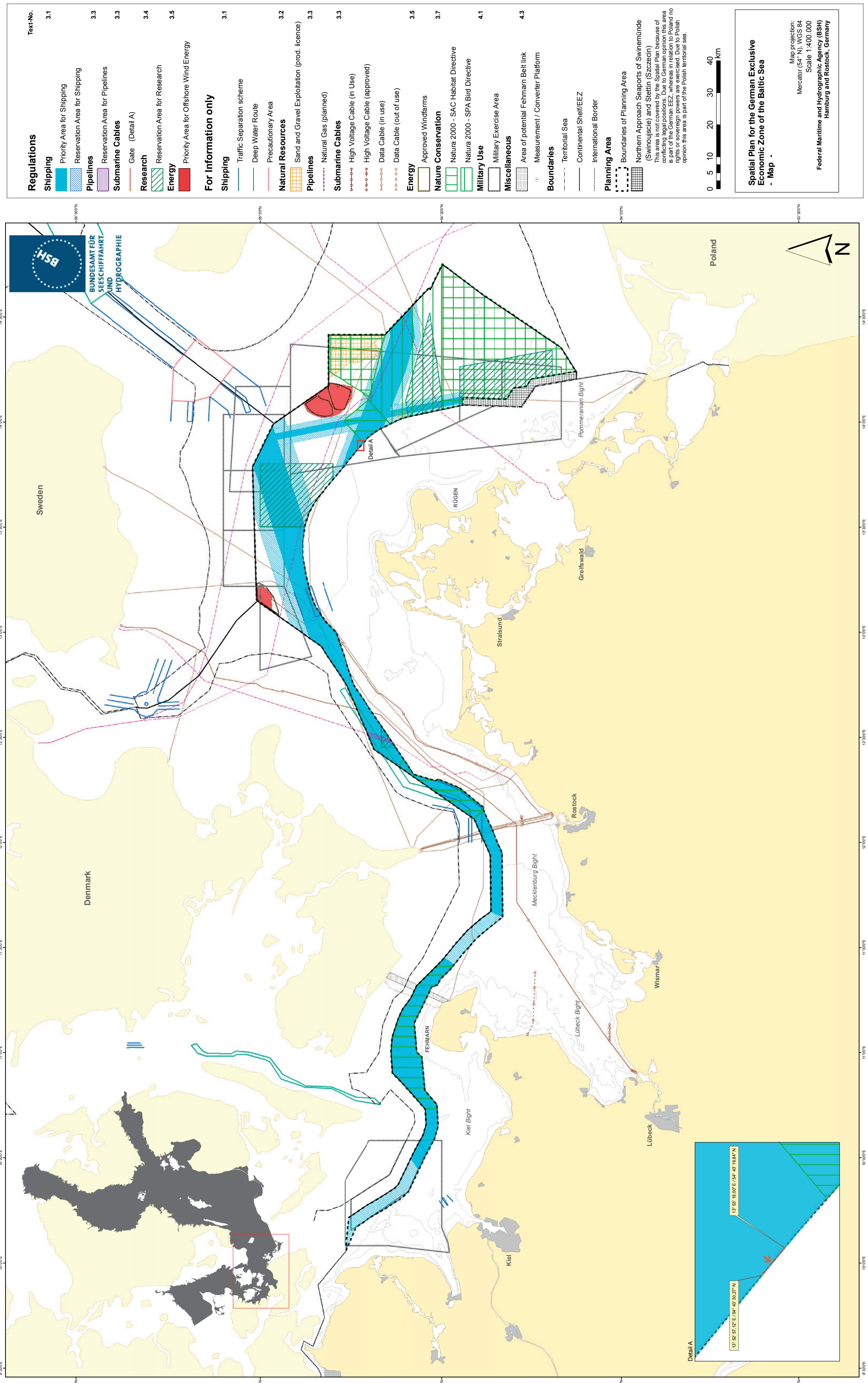
The 2007 *Integrated Programme for Energy and Climate Protection*[59] aimed for 30% renewable energy production in Germany by 2020. This was further specified for offshore wind in the 2008 National Strategy for the Seas, where an offshore installation of 20.000 – 25.000 MW by 2025-2030 was seen as a "realistic" objective, and which would equal 15% of the current electricity consumption.[60] By December 2013, the installed wind energy capacity in Germany had reached 34,179 MW, of which 521 MW was offshore.[61] This total does not include several offshore parks had been completed but were not yet connected to the electricity network and new installations for which the foundations had already been built. At this time renewables already contributed a total of 24.7% to the national energy consumption. The 2014 Renewable Energy Act upgrades the objectives, stating that 80% of Germany's energy consumption should come from renewables by 2050, with 40 – 45% by 2025 and 55 – 60% by 2035.[62] Within this political context, wind energy development is a priority for Germany's marine spatial plan in the Baltic Sea [6]. A second priority specified in the plan is the securing and strengthening of safe and unimpeded shipping routes, since cargo volume handled in German ports is expected to double by 2025 and shipping is an important economic sector for Germany. The third priority recognized in the plan is the natural environment, for which the precautionary principle is recommended. The environmental impact of any measures is an important consideration which runs through all aspects of the plan. The Environmental Assessment of the plan as a whole, concluded that the spa-

59 Integrierte Energie-und Klimaschutzprogramm (IEKP), own translation. http://www.bmub.bund.de/themen/klima-energie/klimaschutz/klima-klimaschutz-download/artikel/das-integrierte-energie-und-klimaschutzprogramm-iekp/?tx_ttnews[backPid]=3033

60 www.clearingstelle-eeg.de/files/private/active/0/bundesregierung_meeresstrategie_2008.pdf Accessed 08/05/15.

61 Berkhout, Görg, and al, Windenergie Report Deutschland, 2013.

62 http://www.gesetze-im-internet.de/eeg_2014/__1.html Accessed 08/05/15.



[6] Marine Spatial Plan for the German Exclusive Economic Zone of the Baltic Sea.

tial plan would have a positive effect on the environment since activities will be concentrated and coordinated.[63] This plan designates 3 types of zones:

– *Priority areas* where one use (for example, shipping, pipelines) is granted priority over all other spatially significant uses.

– *Reservation areas* where one use is given special consideration in a comparative evaluation with other spatially significant planning tasks, measures and projects.

– *Marine protected areas* where measures are applicable for the reduction of impacts (e.g., through pollution) on the marine environment.

Priority areas as well as adjacent reservation areas have been established for shipping. Priority shipping areas are the major east-west T and H shipping routes as determined by the IMO, routes extending existing IMO traffic separation schemes, and the Świnoujście-Ystad ferry route. According to UNCLOS, shipping enjoys a special status and freedom of maritime transport should be guaranteed, therefore shipping is also possible anywhere outside of these designated areas.

Two priority areas have been established for wind energy; Kriegers Flak directly on the German/Swedish/Danish maritime border, and West of Adlergrund, on the German/Polish marine border. The combined area amounts to 130 km^2. The plan stipulates that the maximum height of the turbine hub is 125 m when this is visible from the coast or islands. Dismantling of turbines at the termination of the permit (25 years) is mandatory unless more environmental damage would be caused by dismantling than by leaving structures in place. Windparks must be compact and make economical use of ocean space.

In the Kriegers Flak priority area, currently two windparks are planned for the German EEZ; Baltic II which is waiting connection to the network, and Baltic Power, which has submitted the consent application. This area is a cluster adjacent to a reserved area in the Danish (Kriegers Flak K2-K3-concept/early planning) and Swedish EEZs (Kriegers Flak II- consent authorized). In the West of Adlergrund priority area, 11 projects are registered, three of which have received planning consent.

Reservation areas have been designated for pipelines and marine research. The areas marked for conservation under Natura 2000[64] are protected under nature conservation law – they are included in the plan for information and orientation only and comprise about 56% of the area. Responsibility for applying legislation to EU Natura 2000 sites lies with the state, however protection does not mean full exclusion of human activities. Germany had already proposed 10 Natura 2000 sites to the EU by 2007 and plans for the management of these sites are currently being prepared. In addition, the Helcom initiative to establish Baltic Special Protected Areas throughout the sea also requires a management plan for each area. In the German EEZ, plans are currently being prepared for an area adjacent to the south-western Polish border.

The marine spatial plan states that designations for fisheries are not possible due to the EU's regulatory responsibility for fishing policies

63 BSH:Federal Maritime and Hydrographic Agency, *Umweltbericht Zum Raumordnungsplan für die Deutsche Ausschließliche Wirtschaftszone (AWZ) in der Ostsee*.

64 Systems of ecologically valuable conservation areas comprising SAC (Special areas of conservation) under the Habitats directive, and SPA (special protected areas) under the EU Birds Directive.

and also to the difficulty in spatially definable fishing grounds. Therefore, no area designations have been made for fisheries. In a similar manner, areas for military use are not covered by the legislation, or by UNCLOS, but military interests are deemed to represent the interests of the public and therefore they are included in the plan for information. Permit applications such as those for windfarms, must take this activity into account.

4.3.3 SUMMARY: PLANNING IN THE BALTIC SEA

The Spatial Plan for the German Exclusive Economic Zone of the Baltic Sea is a regulatory document. Its framework reinforces economic priorities at sea, and as such can be directly compared to the Barents Sea management plan's regulation of the petroleum industry. Areas of wildlife and habitat protection will co-exist with activities such as dredging, shipping routes and military exercises.

Priority areas are either lineal, in the case of shipping, or set between priority shipping lanes following the "patches" logic explained in the BaltSeaPlan Vision 2030 document. The continuity of habitats is difficult to recognize from the plan, since the extent of the German EEZ outside territorial waters is minimal and territorial waters are under the planning responsibility of the German states. Despite the aim to retain "open areas" where natural habitats are undisturbed by anthropogenic activities, few of these areas remain in the EEZ:

> "The seascape should safeguarded in its natural character and its typical vast open spaces should be preserved."[65]

In this sense the plan is inflexible, apart from the Natura 2000 areas, where the precautionary principle will be applied.

Information about the vulnerable natural areas is minimal, since their management falls outside the responsibility of the planning agency. This can be directly compared to the Barents Sea management plan. Natura 2000 special areas of conservation (SAC) in the German EEZ correspond to habitats for the porpoise, grey seal, little seal and the sturgeon. The habitats of the porpoise, which is listed as vulnerable on the IUCN redlist, often correspond to priority shipping routes. The complete western area bordering Poland is a special protected area under the Birds Directive, and hosts many species of wintering and migrating birds [3]. Studies have shown that birds avoid the heavily-trafficked shipping routes, and rest in the "patches" inbetween.[66]

HOW CAN PLANNING METHODS ADAPT TO ECOSYSTEMS AND THEIR EMERGENT, NON-LINEAR, OPEN-ENDED PROPERTIES?

This management plan does not claim to be based on the "ecosystem approach," however parts that refer to the natural ecosystem do promote this form of management, where monitoring, and analysis of possible impacts are considered case for case and should provide the basis for management decisions. Currently the natural environment in the Baltic must come up to EU standards by 2020 according to EU directives.[67] While

65 BSH:Federal Maritime and Hydrographic Agency, *Marine Spatial Plan for the Exclusive Economic Zone of the Baltic Sea*. p 20

66 Developing a Pilot Maritime Spatial Plan for the Pomeranian Bight and Arkona Basin.

67 The Marine Strategy Framework Directive (Regulation 2008/56/EC of the European Parliament and Council, of 17/06/2008 establishing a framework for community action in the field of marine environmental policy) (Abl. L 164 of 25 June 2008, p. 19) aims to maintain or achieve good environmental status of the EU's marine waters by 2020.

the process has been set in motion with the designation of Natura 2000 areas, these spatial planning aspects have not yet been regulated in the Baltic Sea, whereas sectors based on economic incentives have been quickly established.

4.3.4 INTERPENETRATION AND CONTRACTION

The interpenetration typology is characterized by the co-existence of fixtures and moving systems in the Baltic Sea, located in different spatial layers throughout the water column and airspace. This could be highly relevant for the organization of windparks in relation to, for example "blue corridors" for sea mammals or fish. The Pommerische Bucht/Arkona Basin pilot study mapped the areas used by spawning cod. Such additional information may have an influence on the placement of windpark – clusters, since cod have all but disappeared from the Baltic but represented an important economic factor in the past.

Windpark clusters are required to remain compact in the spatial plan. Interpenetration takes place when spaces between fixtures are wide enough to avoid impeding marine systems, therefore a more dispersed layout may enable greater interpenetration. Currently windpark clusters occupy the few "patches" between marine traffic routes, leaving few areas free of industrial activities. Together with the next phase of wind-power development, it would be worthwhile to reconceptualize this basic spatial layout together with alternative combinations, for example turbines accompanying shipping routes in a linear format.

The contraction typology demonstrates that cables and pipelines on the seabed produce a greater environmental disturbance and occupy more physical space than assumed by their slender profile. In this respect, the concept of collated lineal infrastructure elements as proposed by *Vision 2030* makes sense. Further to this, considering the probable future increase in sub-sea infrastructure, service *channels* could be considered to combine different types of infrastructure. The time-scales of windparks and the Nord-Stream pipeline, demonstrate a high ratio of construction to running lifetime. Flexible infrastructure channels could potentially reduce the disturbance factor of re-powering or new construction.

4.3.5 EXPANSION

The expansive spaces in the Baltic Sea have been recognized as highly valuable and characteristic (see p. 226), however according to the plan, few of these spaces remain within the German EEZ. The expansion typology must be seen within the entire Baltic Sea, and such wide areas coordinated at a pan-Baltic level, as for example the Eastern Gotland Basin which is divided between Lithuania, Latvia, Sweden and Poland. Spaces of expansion could serve a double function as establishing a periodic ecological "rest" period in response to the level of ecological degradation in the Baltic Sea and be defined according to geophysical and environmental properties. Such spaces could be organized on a rotational basis, in order to assess the ecological improvement, thereafter "opening" them again for other activities. In this way, the non-determinate ambition of planning could be realized, and designated spaces passed from one Baltic "steward" to another. A similar proposal concerning fish-stock recovery periods was propsed in the *Vision 2030* document, including compensation for such traditional livelihoods during these periods:

> "Management practices take into account the dynamic nature of the resource and respond flexibly should there be any change. This may include economic trade-offs and offering alternatives

COMPARATIVE TABLE MARINE SPATIAL PLANNING

	BARENTS SEA	BALTIC SEA (German EEZ)
Title:	Integrated Management Plan for the Barents Sea-Lofoton Area (first update)	Spatial Plan for the German EEZ of the Baltic Sea
Date:	2006/2011	10 December 2009
Lead:	Norwegian Ministry of the Environment	Federal Maritime & Hydrographic Agency
Area:	1,400,000 km^2	4,500 km^2
Legal status:	Advisory	Regulatory
Process:	1st integrated management plan 2006 (2002-06 4 years), revised 2010, approved by parliament 2011. Due for revision 2020.	3 years
Stakeholders:	major industries & other ministries: Ministry of Foreign Affairs, Fisheries & Coastal Affairs, Energy, Norwegian Petroleum Directorate 26 directorates and research institutes organised in three groups: the Management Forum (lead Norwegian Polar Institute), the Forum on Environmental Risk Management (lead Norwegian Coastal Administration) and the Advisory Group on Monitoring (lead Institute of Marine Research).	other Federal Agencies
Consultation:	80 responses were received	the bordering states (24/25 September), the German authorities (12 December 2008 and 29 September 2009) and the public (30 September 2008)
Studies:	"fed into" management plan- combined environmental Report Russian/Norwegian	BfN (Naturschutz- establishment of Natura 2000 areas)
Monitoring:	only bio-physical (not the performance of the management plan itself)	project-based (wind-farms, cables etc), plus analysis of results from national & international monitoring programmes: BLMP, MARNET, HELCOM, ICES, habitats (FFH), SPA & environmental monitoring.

[7] Comparative Table: Planning in the Barents and Baltic Seas

for local fishermen who are requested to stop fishing for a certain period due to stock changes."[68]

4.3.6 CONCLUSION MARINE SPATIAL PLANNING

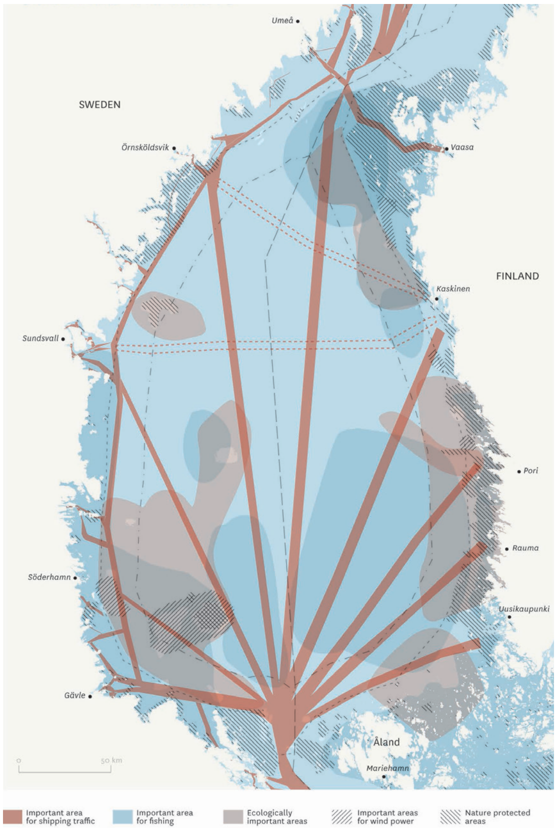
If the exercise of "planning" is primarily concerned with the distribution of activities across a two – dimensional plane, then MSP can be understood as a preliminary "territorializing" set of actions on a newly acquired space; the national EEZ. MSP is then orientated primarily towards the socio-economic and political dimensions of territory. The evaluation of the Barents Sea Management Plan and the Spatial Plan for the German EEZ in the Baltic Sea, shows that both are clearly focused in this direction. The "ecosystem" dimension, which requires an open-ended process, allowance for emergent factors, adapting the *plan* to the *ecosystem,* and not the other way around, is not convincing in these examples since planning and management processes are largely driven by economic objectives. In principle, the anthropogenic components of the ecosystem persist to the threshold limits of the environmental components, which are determined by technological monitoring. In the Baltic Sea, for example, this threshold has already been crossed. Ocean planning is still struggling with the challenge of the ecosystem dimension of its territory. The pilot project, "Planning the Bothnia Sea," articulates the limitations of MSP so far:

> "There is a growing demand for reflection around MSP. The currently available examples of offshore MSP have mainly focused on rational dimensions of planning, such as easily measurable economic benefits. The immediate needs of the wind power industry has also been high on the agenda. The more poetic dimensions, the genius loci, or the very spirit of the seas under discussion, have been largely unexplored… planning at sea should not only be about pure rationality. It should also be about cultural and maritime identity, personal connections to the surrounding marine environment, and our abstract dreams of a better future."[69]

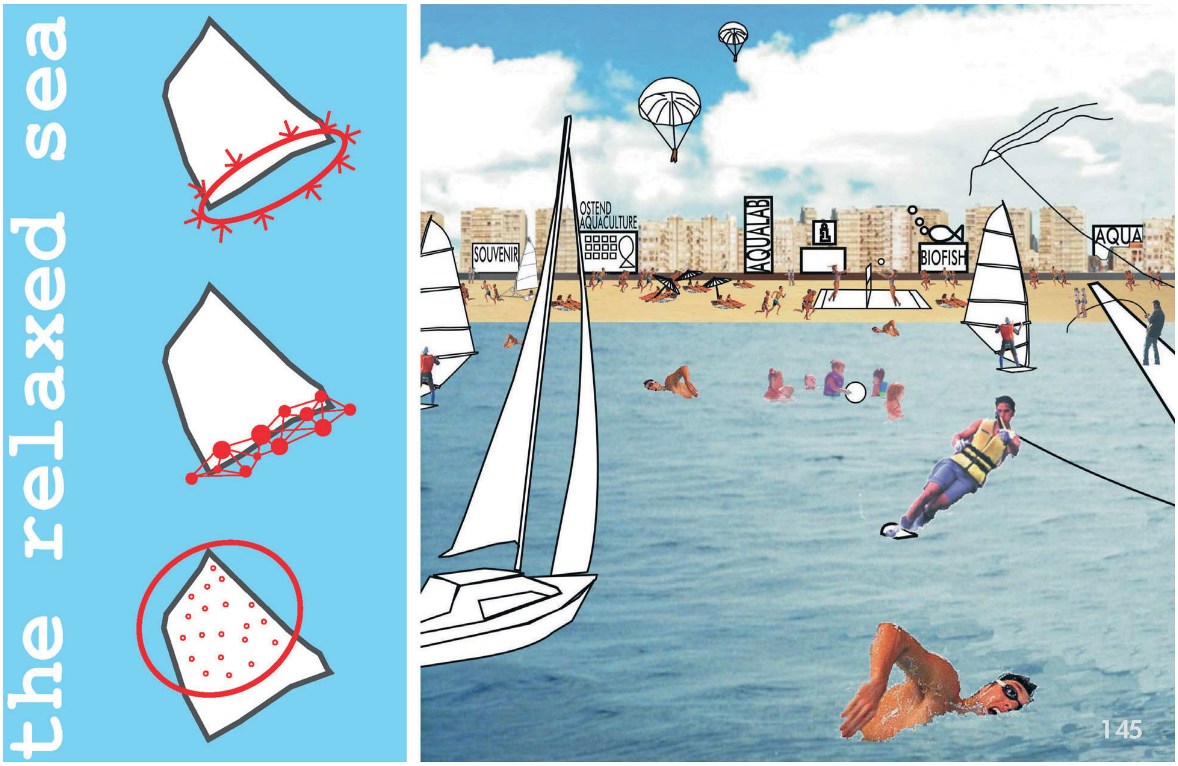
The Bothnian Sea study is trans-boundary, addressing the Finnish and Swedish areas of the sea as one space. It differs from conventional Marine Spatial Plans in that it develops "Interest maps" in the areas of energy, ecology, marine traffic, and fishing, as well as introducing areas of "potentially high natural value" as an additional spatial category alongside existing protected areas [8].

Interest maps are maps of possibilities, and complement "feature maps" which document the state of knowledge about physical features of the sea. Together they serve as an important communication tool to encourage public involvement, since members of the Bothnian Sea communities can identify their particular interests and locate these in relation to other activities. The importance of sea and coastal communities is emphasised as well as the primary importance of maintaining a healthy ecosystem. The maps serve as a basis for discussion about the long-term execution of intentions, in particular their coordination across the national Finnish-Swedish boundary. While the project argues for the importance of the ocean's cultural aspects, cultural heritage and archaeology are two areas regarded as

68 Gee, Heinrichs, and Kannen, Vision 2030. Towards the Sustainable Planning of the Baltic Sea Space. p 30
69 Backer and Frias, Planning the Bothnian Sea- Key Findings of the Plan Bothnia Project.



[8] Map of selected interests, Plan Bothnia.



[9] *The relaxed sea*, scenario for the Belgian North Sea.

"less acute" within the project – since they do not exert development pressure on the area as such.

A second project, and an important inspiration for the Bothnian Sea study, is the ground-breaking work on the Belgian North Sea "A Flood of Space."[70] This document presented the extensive range of uses and spatial claims in the restricted area of 3600 km^2 in the Belgian North Sea, which would together amount to 264% of the available space.[71] It also provided a range of possible strategic scenarios in order to provoke discussion and to serve as a basis for developing a single vision; *the relaxed sea, the playful sea, the natural sea, the mobile sea, the rich sea and the sailing sea* [9]. These scenarios are not only based on economic interests, or on spatial demands, but also on a visionary, imaginative character for the space of the sea itself. They throw open the range of possibilities and call for reflection, participation and the forging of a conscious direction in determining the future of this part of the North Sea.

These projects present descriptive possibilities alongside stocktaking. They do not claim to have resolved conflicts or to have arrived at a solution, therefore they remain fluid in their intentions and call for further input. They exploit the potential of a map to visualize unknown aspects of ocean territory and to "stage the conditions for the emergence of new realities."[72] They largely fulfil the ambitions of an ecosystem-based approach where Marine Spatial Planning as we have seen it, does not.

The methodology followed in this doctoral research has led to valuable insights and a new lens through which the restricted approach of MSP can be expanded. The analysis undertaken in this thesis has paid attention to the ecosystem dimension, which has led to the definition of ocean territory and influenced typological conditions. Each typology represents a particular set of interrelations between anthropogenic and biological materials and processes. I argue that these typologies can inform spatial organization in the ocean, through the principles of *design* as complementary to strategic *planning*.

4.4 THE OCEAN PROJECT

This chapter has introduced and summarized the state of Marine Spatial Planning in general, discussed the origins, possible meanings and potential directions of this type of planning, and presented existing planning and management mechanisms in the Barents and Baltic Seas in relation to typologies extruded from the spatial analysis. The typologies meet ocean planning, not as a solution, but as a conceptual springboard from which to imagine a series of alternative spatial configurations. As they have been extracted from the interrelated dimensions of the geo-physical territory, the biological territory, and the socio-economical territory, the *ecosystem approach* is embedded within them.

Marine Spatial Planning has developed into an area of specialization which builds on qualifications gained in a range of marine or planning disciplines.

70 Maes, A Flood of Space. Towards a Spatial Structure Plan of the Sustainable Managemet of the North Sea. Study 2003-05 funded by the Belgian Science Policy: GAUFRE (Towards a Spatial Structure Plan for Sustainable Management of the Sea)

71 See 1.6 THESIS INTRODUCTION – PLANNING [6]

72 Corner, *The Agency of Mapping: Speculation, Critique and Invention.*

WHAT CAN ARCHITECTURE CONTRIBUTE TO THIS FIELD?

In this thesis, the urbanization of the sea has been approached from an analytical architectural perspective encompassing both theory and empirical studies. Both channels lead to an urbanized sea, where land-based urban systems stretch across and through the ocean, partly carried by the ocean's own embodied energies and partly embedded in its deep, concealed spaces. The typologies expose these relationships and reveal the specific ways with which the ocean interacts with urban processes. Firmly interwoven partnerships are formed through silent contracts. This liaison has both historical roots and startling new dimensions. I argue that there are three reasons why the urbanization of the sea is an architectural domain:

ECOLOGY

> "Ecology means inevitable responsibility, forced intimacy, utter hospitality and coexistence. It means that there can be no 'away,' no 'over there,' no 'yonder' – everything 'stands' awkwardly close. But between 'right here' and 'over there,' there is architecture, guarding the limits between inside (controlled environment) and outside (framed spectacle)."[73]

The *new nature* formed by the metonyms *urban* and *nature* in the Anthropocene provides a new challenge for architects. The man-made has penetrated all dimensions of the planet, including the sea, and forms an integral part of its ecology. Therefore spatial disciplines are faced with dispersed spatial typologies driven by natural forces, and environmental disciplines are faced with planning. In its Manifest, laba defines *urban-nature* as "the condition of living on industrial earth" for which a new aesthetic – in the sense of a design concept – needs to be explored.

GEOGRAPHY

Extended urbanization in the sea is driven by long-ranging trans-national connections and forges links with disciplines such as geology, wind engineering and oceanography. Seascapes of energy are established as a new spatial typology for urbanized societies. Territorialization describes the formation of territory, not only through establishing legal boundaries, but also through trans-national dynamics which cross these boundaries. These are urban phenomena which intersect geography and therefore demand new dimensions to the architectural project.

CONCEPT

Architecture and urban design are conceptual disciplines. The changing status of the oceans as an urbanized realm requires above all an enriched conceptual basis which embraces the idea of the periodic, differentiated spatial reality of the ocean in addition to its (quantitative) economic contribution. From such a basis, the process of articulating identities and desired spatial characteristics, can be launched. Ocean space is a commons. Therefore the development of a rich conceptual basis is crucial to a democratic, heterogeneous construction of ocean futures. Urban design as a discipline is already faced with the challenge of addressing the "dissolution" of modern urban theory, demanding what Paola Viganò describes as

73 Gugger and Costa, *Urban-Nature: The Ecology of Planetary Artifice.*

a "new and immense effort of imagination and of conception."[74] Not only a technical, scientific dimension, but an *interpretive dimension* is required to release the inherent creative potential of ocean space. Viganò also argues that through *conceptualization*, *description* and *conjectures* about the future, the territorial *project* can produce knowledge.[75]

The planning of ocean space demands a holistic, coherent yet fluid approach. I propose that an added design dimension is a necessary and crucial compliment to the established spatial planning frameworks, in order to establish ocean space as a territorial *project*. The ocean project is comprehensive and geographical. It links previously disconnected materials, actors, scales and disciplines ranging from energy to ecology and from fishermen to migrating seabirds. It also seeks to reestablish the public character of ocean space. As a project, spatial configurations for the ocean can be varied, open-ended, participatory, local, visionary and as such can respond to the *ecosystem* dimension in a way that planning cannot. First experiences in the BaltSeaPlan project have made it clear that tools and methods to deal with trans-national contexts, which are however, intrinsically interrelated in the ocean, are lacking. The spatial scale of the oceans is global, but the governance of global commons is marked by an absence of a superordinate authority. However, according to Vogler, a global commons specialist, "technological change and pressure on limited common pool resources will exert pressure for collective regulation."[76]

74 Paola Viganò, *Les territoires de l'urbanisme*. Own translation
75 Ibid.
76 Vogler, *The Global Commons.* p 16

5 CONCLUSION

5.1 FOUNDATIONS

The primary aims of this research relate to establishing the ocean as a valid subject of territorial and urban studies. The ambition is to take a holistic view while giving specific thematic areas the attention they merit, and to communicate the potentially complex reality of the oceans in a simple, understandable way. I argue that the research represents *groundwork* and should provide a foundation for discussing ocean space in relation to urbanization processes. This groundwork joins important studies by Boeri and Topalovic mentioned in the thesis introduction and has taken a geographical approach by nominating two European seas as the main objects of study.

Other work which has developed the concept of the oceans as a specific spatial site with urban properties include;

Adriatico la città dopo la crisi,[1] Antonio di Campli's work on the Adriatic region, including both the Italian and Croatian coastal areas . Existing structures and systems, characterised by fragmentation, mutation, instability and seasonal transformation, are analysed. Di Campli claims that the Adriatic condition is made up of elements which behave as a "relational device", whose fundamental character is an unbalanced confluence, not necessarily in harmony or equilibrium, and therefore comparable to a city. He refers to the idea of a „reflexive space", in which it is easier to change a system of relationships, of references or to remodel your personal identity.

The Dispersed Urbanity of the Aegean Archipelago, Constantopoulos and Papadopoulos, commissioners to the Greek pavilion, 10th International Architectural Biennale Venice.[2]
In this contribution, the Aegean Archipelago is presented as a particular dispersed urbanity, within which individual elements (islands) share similar characteristics yet maintain their distinct identity. This makes up a complex network, a system of differences. The constellation of the archipelago establishes a certain condition of freedom - it is both flexible and resilient. The ocean is the spatial connector, hosting public spaces in the form of the inter-island ferry system.

Sites Pacific.[3] Hoete and Refiti's essay identifies five conditions particular to the Pacific spatial identity based on the some 4000 islands which share the largest geographical feature on earth; identity refers to the ocean, rather than to land, it is defined by points (islands) rather than by lines (borders), networks arise to form an archipelago in order to ensure survival, the metaphor is the dominant bridge to connect the archipelago and new forms of urban identity emerge in the polynation of the cross-cultural city of Auckland.

During the development of this thesis, the Urban Theory Lab at Harvard GSD led by Neil Brenner undertook the *Extreme Territories of Urba-*

1 di Campli, Adriatico- la città dopo la crisi
2 Burdett, Cities
3 Hoete and Refiti, Sites Pacific

nization project,[4] which aimed to test the theory of extended urbanization and the chose the Pacific Ocean as one of nine zones commonly thought to lie outside the urban condition. Also at Harvard, *The Oceanic Turn*[5] was a project led by Pierre Bélanger, Assoc. Professor of Landscape Architecture, which examined the ocean as part of a wider investigation of 21st century landscape infrastructure.

Parallel to these spatial investigations, world attention is being drawn to the oceans from both economic and environmental poles of interest. This year, the Economist and National Geographic host the third World Ocean Summit,[6] which aims to unite these poles, focusing on a "blue economy" where economic opportunity is balanced by responsible investment in a sustainable ocean economy. The relevance of the oceans, which cover 71% of the planet and provide 95% of all space available for life, is unquestioned. Increased economic and environmental investment in the oceans will have spatial implications which also demand attention.

Therefore I argue that this research resonates with the other studies mentioned above in establishing ocean space as a necessary field of urban enquiry. Further to this, the increased attention being focused on oceanic development increases the spatial complexity. Theoretical and practical reflections as well as design expertise in this field, will also be increasingly in demand.

5.2 TERRITORY

In order to pursue and explore this field, the first objective of the research was to propose a definition of ocean territory distinct from land. An understanding of the ocean as territory assists in structuring a dialogue between its inherent spatial properties and urbanization processes. It provides a conceptual link to the territory as palimpsest, as described by Corboz [7], and also to the territory as a "double agent", shaped and shaping, active and reactive as described by Marc Angélil and Carey Siress; "Territory is not a stable entity, but rather a dynamic forcefield engendering spaces of change."[8] Both of these aspects of territory are equally if not more prominent in ocean space than on land. The recognition of the oceans as distinct territories has wide-ranging implications. While I refute the purely political definition of territory, the ocean is no longer a "wilderness" and therefore the motivation to reconceptualize territory in the case of the oceans, is intrinsically linked to urbanization.

The proposed definition is based on dynamic relationships between organic and inorganic forces, acted out in a physical space defined by geographical rather than political thresholds. Stuart Elden's research on the concept of "territory" results in a definition closely aligned to bounded, political space and the technological means of representing this space. Offshore, I argue that an understanding of territorial dynamics is highly dependent on biological and geo-physical dimensions. Borders are open, dilating and contracting with the seasons, relations are inter-scalar and commu-

4 http://urbantheorylab.net/projects/ Extreme Territories of Urbanization, spring 2013/ spring 2014
5 Spring semester 2014
6 http://www.economistinsights.com/sustainability-resources/event/world-ocean-summit-2015. Accessed 1.05.15
7 André Corboz, *Le territoire comme palimpseste et autres essais.*
8 Angélil and Siress, "Wilderness of Mirrors."

nities migrate over large distances. The socio-economic relations are then superimposed onto this biological and geo-physical reality.

The demarcation of socio-economic space in the ocean is not a new phenomenon, but since the period after the second United Nations Convention Law of the Sea in 1982 – the culmination of fifteen years of preparatory studies- it has taken on new dimensions. The Convention is a direct result of urbanization processes which caused spatial conflicts at sea. It is the single-most influential document regarding ocean space since the Papal Bull of 1493 allocating half of the world seas to Portugal, the other half to Spain. Extending political land boundaries into ocean space has also led to the acceleration of spatial repartitioning which is manifest through the definition of production, extraction and protection zones within this realm.

The establishment of territorial claims in the ocean takes diverse forms; parallel to the formal spatialization described above, other mechanisms interact with the ocean in unofficial, discreet and more subtle ways. Ocean space is wide and deep and has the potential to harbour a range of activities and practices in a way which would be impossible on land. The outer limits of an exclusive economic zone come under surveillance only in the most extreme cases and the borders are highly abstract. This means spatial practice effectively follows its own logic – a logic rooted in centuries of ocean travel, exploration and exploitation, shipping, deep-sea fishing and warfare. Hence the high seas represent the largest periphery on earth. Far from being home to only pirates and renegades, many activities taking place here are firmly within the grip of multi-national corporations and unofficial political alliances. Keller Easterling vividly describes this zone as the ”slushy seas”.[9]

Furthermore, this thesis builds up the argument that territory in the ocean is more usefully defined through the cycles and bathymetry which comprise the biological and geo-physical territory. The research shows how distinct spaces are formed in the ocean as a result of a combination of periodic factors. In the case of the Barents Sea, these oscillating thresholds serve a thriving fishing industry. Efforts to establish meaningful fixed coordinates in the ocean meet with a differentiated spatial mass in constant movement. Tensions and contradictions therefore arise which are characteristic of western society’s relationship with the sea. The socio-economic territory is attempting to supersede the bio/physical territory. I argue that the investigation into current ocean planning systems validates this proposed model of ocean territory. Initiatives such as an “ecosystem approach” to management of the seas have arisen out of the recognised failure of “closed”, sectorial planning models to deal with cumulative anthropogenic impacts and which are focused solely on the socio-economic sea. A hydrodynamic and thermodynamic rescaling of oceanic space is required to integrate temporality and fluidity within a new conceptual framework.

5.3 URBAN THEORY

The second aim of the research was to test the relevance of urban theory as applied to ocean space in two ways;
firstly the developing theory of planetary urbanization, which pointedly expands the realm of the urban to include dynamics outside concentrated

9 Easterling, *Enduring Innocence.*

urban agglomerations and addresses service areas, hinterlands and "operational landscapes" including the ocean, and
- secondly in the four related areas of Networks, Seascape, Technology and Ecology, which are not exclusive to ocean space per se, but which I argue permeate predominant maritime relations.

5.3.1 EXTENDED URBANIZATION:

Within Brenner and Schmid's developing theory, this investigation aligns itself to one of the three "mutually constitutive moments" of planetary urbanization; extended urbanization. Extended urbanization refers to the extension of inherently urban systems into territories and landscapes specifically for the purposes of resource extraction, the production and circulation of energy (including fossil fuels), and water and waste management.[10] This process reorganizes territory, displaces existing inhabitants and activities and links these places back to urban populations who depend on the services provided by such an extension. The relevance of the oceans to processes of extended urbanization is tested on the Barents and Baltic Seas, including a closer analysis of five typologies. The following conclusions have been drawn;

Seas are distinguished from land in that they are not inhabited territories, rather they are habitats. The pattern of displacement associated with extended urbanization is evident in the sea not for human communities, but for other living species. Resource extraction and the circulation of energy consistently have priority over these existing populations.

Infrastructural networks play a critical role in the connection of extended sites of extraction to centres of distribution. In the sea, linear infrastructural elements are stretched through ocean space to particular destinations, producing isolated "intensities". However these intensities do not provide the basis for further secondary development and diversification, as is potentially the case on land; "Settlement has often been a byproduct of infrastructure."[11] Therefore extended urbanization is in a sense frozen and limited to specific trajectories for specific purposes. While offshore infrastructure is installed with a given "expiry" date, for example of 25 years in the case of windfarms, and 20 years for the Nord Stream pipeline, the problem of such frozen trajectories lies in their subsequent removal or reuse. This has largely remained unresolved, since the environmental disturbance associated with their removal may be greater than leaving them in place.

Oceans frequently represent environmental and territorial frontiers, the penetration of which demand heavy investment and state-of-the-art technologies. Both of these requirements firmly link ocean exploitation to multi-national companies and capitalist development. This has been verified through research on ocean technologies, in particular the incremental move to *deeper and colder* waters.[12] Maritime transport networks also become extended as they penetrate further into previously unpassable straits, such as the Northern Sea Route across the northern coast of Russia. In this case, extended urbanization occurs through the linkage of technology with climate change; ships of a more powerful ice-class are being constructed to

10 Brenner and Schmid, "Towards a New Epistemology of the Urban?"
11 Gugger, Couling, and Blanchard, *Barents Lessons. Teaching and Research in Architecture*. p 26
12 Martin, "Deeper and Colder."

cut through ice year-round, while the arctic ice-cover is both receding and becoming thinner.

Within the two seas, forms of urban extension are more and less extreme. Already urban infrastructure has become a kind of “second nature” in the city context[13] - a phenomenon beginning to emerge in the Baltic Sea and exemplified by the Nord Stream pipeline and Nysted wind-park. Productive and infrastructural seascapes are considered a necessary and accepted way of maintaining or creating flows of energy. Across this relatively narrow sea, the urban gap has closed. The case of the Barents Sea represents water depths and climatic constraints to a greater extreme. But here extended urbanization is reinforced by the substantial wealth and offshore experience of the Norwegian oil and gas industry, to the point of installing Snøhvit gas-field extraction equipment on the seafloor. Here the extreme site conditions and remoteness are overcome by highly developed systems of access and control.

Important preliminary phases of extended urbanization occur “under-the-radar” in the sea. These phases involve scanning using specialized technology to develop knowledge about the sub-surface sea. This is a form of pre-urbanization which prepares the ground for targeted development and which requires greater investment than on land. The urge to exploit precedes the knowledge base, hence the sea can virtually be unknown in its properties until the knowledge can be quantified. Its layers are therefore full of undisclosed history, hidden relics and new biological information. The undetonated mines in the Baltic Sea, first documented and quantified through the laying of the Nord Stream pipeline, are an example of this aspect of extended urbanization.

Extended urbanization in the Barents and Baltic Seas is not immune to, or independent of, the forces and spaces of the sea itself. The typological studies reveal that the interactions at sea have been fundamentally reshaped due to extended urbanization. The extent of this research does not allow for further testing of these conclusions in other land- or sea-based, contexts. However, the five detailed typological cases have made links to comparable land-based references. Parallel “pipeline” studies, for example, the video and photographic work of Ursula Biemann, and contributions made by Rania Ghosn, reveal similar phenomena; linear “narratives” distort the real scale of transformation and dishevel involved in the construction of a trans-national pipeline[14] and oil infrastructures externalize their true social and spatial requirements- their “crude geographies” - by sliding them to the periphery.[15]

5.3.2 FOUR TOPICS

Through the testing of Networks, Seascape, Technology and Ecology on the two case study seas, I argue that the study has been able to identify and articulate aspects of ocean space in relation to these four topics which have not been previously presented. An understanding of four possible seas is transferred; a networked sea, a cultivated sea, a technical sea and an ecological sea. The five typologies then describe how each of

13 Hård, Urban Machinery.
14 Biemann and Pendakis, “This Is Not a Pipeline. Thoughts on the Politico-Aesthetics of Oil.”
15 Ghosn, “Where Are the Missing Spaces- the Geography of Some Uncommon Interests.”

these identities competes, co-operates or merges to form a particular spatial configuration.

The networked sea is, along with airspace, distinct in its continuous surface potential. As opposed to the topological compression of time and space achieved by rapid networks, physical network activity carried out by shipping vessels in the ocean is slow, but multi-directional. The interaction of the "open sea", a phenomena regulated by the horizon, and multidirectional movement, results in a distinct spatial field which is continuously transforming and charged with latent possibilities.

The cultivated sea – the seascape- is undergoing transformation in this century as "wild" biological harvesting gives way to offshore energy harvesting. The FAO and other organizations report both an alarming reduction of fish stocks and a steady rise in aquaculture- one of the fastest-growing food industries. New seascapes for the production of renewable energy are erected, which although in themselves "renewable" after 20-25 years, emit an air of technological permanence through which our "productive" relationship with the sea becomes clearly visible.

The technical sea is ubiquitous. Technology enables specific long-distance interactions such as electronic vessel-monitoring, automated gas-extraction and pipeline surveillance. This contributes to the extreme character of extended urbanization, elongating connections through virtual circuits. Technology is primarily employed by exploitive industries, and while specialized technology is still closely linked to costs, detailed knowledge about ocean ecosystems is dependent on a close alliance with these industries.

The ecological sea is an active agent in all development questions, collaborating with technology and is itself the subject of technological monitoring. The ecological sea is adaptive, emergent and partly unpredictable. Its well-being is also the prerequisite for all future visions, yet has been neglected in the case of the Baltic Sea. However, the "land-locked" view of oceans is slowly shifting towards systems-based ideas more in tune with the ecological sea. It is the ecological sea from which planning initiatives are now attempting to learn.

5.4 OCEAN URBANIZATION

A third aim of the thesis was to investigate the relationship between forces of urbanization and the sea as an environmental force with its own spatial traditions. The proposed definition of territory provided the basis for the analysis of the Barents and the Baltic Seas. The results of this investigation show that distinct forms of urbanization take place in different seas, building a local identity comparable to specific regional patterns on land. This verifies the argument that seas are geographic, cultural and historical entities where forces are played out and interactions reinforced.

- The Barents and the Baltic Seas strongly influence urban dynamics and act as agents of connection. I argue that both seas are a referential, identity-building space. They are both *conceived* and *lived* spaces as described by Lefebvre.[16] Particularly in the case of the Baltic Sea, cross-sea interaction and collaboration is strong. This is manifest in the dense network of shipping activities. In the case of the Barents Sea, dispersed communities

16 Lefebvre, *The Production of Space*.

are linked into a loosely distributed urban web through the coastal shipping route- a connection less related to physical distance than to the single, persistent connecting element of the sea itself.

Operations at sea reflect the geographical context. The Barents Sea is a large, fluid, open, ecologically-intact system which contributes directly to the region's wealth and well-being. The Baltic Sea is fragmented by many overlaying structures, which restrict the already limited spatial configuration and also the sea's ecological recovery. The density of crossings, topography of islands, archipelagos and shallow shores, mean that urban systems step offshore with ease, but are then required to share space with existing marine life-forms.

Tenuous links emerge through, and are reinforced by the sea, building a tentative form of urbanity based on seasonal relationships. I have called the north of Norway and Russia a double periphery- both to central Oslo Moscow and to the Barents Sea. Relationships are stretched across the whole sea, and hence the urban entity can only be conceived of at the territorial scale. These are primarily habitual, material relationships, established through ocean-based activities such as fishing and are not "organizational" in the political sense. These relationships largely successfully negotiate and overrule the Russian-Norwegian political boundary. This is an oceanic "spatial tradition" which I argue is *unfamiliar* and *radical*. Exploitation of oil and gas in the Barents region is a variant of the temporary, extractive, infrastructural urbanism which contributes to this radical configuration.

The radical urbanity of dispersed, singular, independent urban units which prevails in the Baltic Sea, has historical roots in the trading networks of both the Vikings and the Hanseatic League. This has laid the ground for a dense network of connections which has formed the referential sea space described above and called the "sea common" by previous researchers.[17] The sea common, argues Lundgren, is again less formed by formal agreements, than habitual interaction, in particular as a common space of leisure. Both forms of urbanity are specific to the sea, and radical in their porosity, resilience, accommodation of individual difference and incorporation of ocean distance within their morphologies. They are structured by the biological and geo-physical properties of the territory, which confirms my argument that *inherent* conditions support specific urbanization processes.

An additional radical space inherent to the sea is its *non-spatialized* realm. If spatialization is a combination of all interactions which produce, demarcate and transform space, can we conceive of a non-metricized space? The sea can visually conceal traces of urbanization and although we are clear that the sea is no longer a wilderness, I argue that parts of the sea, even if still in use, are *non-spatialized* and non-determined. They do not issue from a Euclidian tradition. Some zones of the sea are still "open". This is an important quality unique to the sea and possibly to other wide, abstract spaces and has been identified through the *expansion* typology. Expansion echoes the persistent history of the freedom of the seas and the ocean commons. Within the context of planetary urbanization, this is a quality to endorse, even if we do not yet possess the legal or conceptual means.

17 Lundgren, *The Transformation of a Geopolitical Space into a Tourist Space*.

5.5 TYPOLOGIES

The fourth objective was to *propose spatial typologies* which describe specific instances of urbanization within the Barents and Baltic seas. In order to promote their typological potential, these instances have been named according to *conditions* which should be possible to identify in other examples; Interpenetration, Contraction, Expansion, Assemblage and Confluence. All of the typologies are involved in material kinetics.

At this more detailed scale, the typologies show that ocean space is thickly layered, and that distinct "habitats" are colonized by specific activities which cover the full range of its depth; currently hydrocarbon exploitation and extraction in the Barents Sea operates on the seafloor, but establishes connections to depths of between 2500 and 5000 m deeper, the "neutral", submerged seafloor supports horizontal energy infrastructure such as the Nord Stream pipeline, the uppermost layer of the water-column is the site of spring primary production, the continuous surface is exploited by shipping and the air-space is activated to produce energy. These typologies have deepened the understanding of the nine principles of extended urbanization in the Barents and Baltic Seas by addressing the HOW of interactions; how they are structured and how they operate. At the same time the approach has been to link them to larger, more global tendencies. As typologies they remain at the level of a proposition. Further research would be required to verify, refine and refute their definitions and formats.

5.6 PLANNING

The final objective was to evaluate the relevance of these typologies for strategic ocean planning. As a territory, seas are subject to management and planning. The scale of interventions corresponds to the scale of the sea and is reaching geographic proportions. Marine Spatial Planning is currently taking hold of the organisation of ocean space and this practice has been evaluated and compared to my research results.

The two case study seas are both located in Europe. While Norway is relatively sparsely populated, its economy and national wealth is inextricably embedded in offshore oil and gas, which it exports in large quantities to the European market. Russia is a similar case. Both seas are heavily implicated in questions of economy and shipping has priority status. Therefore ocean planning also has a clear agenda. The example of Australia is taken in comparison- the government is in the process of setting up vast "bioregions" which cover their entire oceanic EEZ. In this case planning is less steered towards production, rather ocean heritage including Australia's coral reefs and manifold offshore nature reserves.

I argue that Marine Spatial Planning has not been able to reconcile the ocean's dynamic spatial dimensions with requirements of production and maritime transport and that its methods are inherited from land. A public dimension has not been invested into the organization of these commons by planning authorities acting for the public good. This recalls Bruno Latour's conclusion that politics and ecology by definition cannot be combined, largely because of the misunderstandings about "nature".[18]

In the section on planning, the typologies are juxtaposed and serve to construct an outlook. They can be understood as a conceptual springboard

18 Latour, "To Modernize or to Ecologize? That Is the Question."

to enrich the discussion and to suggest alternative spatial and temporal configurations.

The results of my research do not claim to resolve the inherent tensions between fixing limits and open, emergent systems in ocean space. The research does not conclude with a “plan”. Rather it has taken its own path and through a combination of theory and practice, has identified five typological *conditions* which give clues to the reconciliation of tensions and the loosening of edges in ocean space;

Interpenetration concludes that under certain conditions, the contrasting systems of fixtures and ocean flows can be overlaid and be mutually beneficial. *Confluence* demonstrates how resource exploitation and ecological monitoring streamline knowledge systems and *Expansion* reinforces the qualities of the edge-less ocean surface spaces. *Assemblage* suggests a stripping away of “land-based” geometric systems in favour of the periodic, oscillating, organic intensities, which adhere more to a contingent “navigational” way of understanding territory as described by November and Latour in the Thesis Introduction.[19] Then *Contraction* critically exposes the spatial “externalities” of an undersea pipeline.

In conclusion, I argue for a multiplicity of alternative approaches and for the reclaiming of ocean space back into the public realm. This territory should not be conceptualized as underwater *land*. Materials, maps and methods which can construct temporary descriptions of oceanic relationships and which have the resilience and flexibility to oscillate across broad thresholds rather than borderlines, are required. These elements have a *project* character- limited, possibly incomplete, collaborative, “becoming” and interpretive.

The economic and ecological merger occurring within ocean space calls for a comprehensive ocean *project* which is capable of registering and acting with dynamics. The four urban literary topics, two case-study seas and five typologies presented here each offer new insights and contribute to preliminary theory of ocean space. Through these perspectives, the modulating, participative role of ocean space within contemporary urbanization processes has been firmly established.

“The oceanic project…challenges the dry, closed, terrestrial frameworks that shape today’s industrial, corporate, and economic patterns. As contemporary civilization takes the oceanic turn, its future clearly lies beyond the purview of any head of state or space of a nation.”[20]

5.7 DISCUSSION

The approach taken in this research touched many cornerstones on the path to developing a referential framework for spatial relationships offshore. Many of these have high investigative potential in their own right and indicate directions for further discussion.

5.7.1. BORDERS

The urbanizing mechanisms and dynamics I describe cross the land/sea border. This border itself is made up of different littoral zones and thresholds and is not physically fixed, although a “base-line” is defined for

19 November, Camacho-Hübner, and Latour, “Entering a Risky Territory.”
20 Bélanger, “Harvard Design Magazine.”

planning purposes. In some cases, as in the Baltic Sea, the land/sea border is gradual and urban systems cross with ease. In other cases, as we are reminded by Appadurai, "cultural dealings between socially and spatially separated groups have been bridged at great cost and sustained over time only with great effort."[21] I argue that this principle also applies to urban systems. Most offshore technology is not yet "free" of the link to land or to the ground and the land/sea border can demand an expensive and challenging "bridge".

My focus has been the offshore space itself and the transformations taking place there, rather than the border to land. However, relevant literary references used in connection to ocean space, refer to the dissolution of traditional borders; Barry's *technological zones* and Appadurai's five *scapes* dissolve national borders and Appadurai refers to a "post-national order". Floridi investigates the fluid border between analogue and digital "space" which he claims is also dissolved. Ocean space is capable of dissolving political borders at sea, and in fact my definition of territory provokes the understanding of a unified biological and geo-physical space irrespective of political borders. Radical systems of urbanization facilitated by the oceans existed previous to the rise of the nation state and globalization has further implications for both the erasure of traditional borders and the establishment of other types of selective boundaries. Hence further work on the relationship between oceans and borders can make a valuable contribution to research on post-national space.

5.7.2 TERRITORY

"As the ocean reveals itself to be a highly urbanized entity, could the reverse be true – can an understanding of complex ocean systems enrich and inform our understanding of urban systems?"[22]

The geographic extent of this thesis remains within the ocean. The relevance of the findings relating to urbanization processes have not been tested on land-based territories. Can the conditions of contraction, confluence or assemblage be identified outside ocean space, ie. in landspace, and if so, do they contribute to the development of new knowledge about urban processes? The relevance of the proposed definition of territory is an question for other realms of investigation. Can bio- and geo-physical regions be useful entities for urban studies on land and how would these then be defined? Which histories would be better represented by such entities? Would a "cultural territory" which describes shifting cultures and connections in relation to the geo-physical landscape, as proposed by Carl Sauer be the result? This territory would also produce its own variegated maps, traces and thresholds potentially independent of, but in interaction with, established political borders.

5.7.3. FOUR TOPICS, TWO SEAS

The choice of the four topics Networks, Seascape, Technology and Ecology have been influential in steering this investigation and, together with the choice of two seas, have led to particular conclusions. Each of these topics could alone be the subject of a doctoral thesis. Further to

21 Appadurai, Modernity at Large.p 28
22 See THESIS INTRODUCTION, SUMMARY

this, the use of this methodology with alternative topics would arrive at new results, for example the military space of the sea, the recreational and leisure space, the navigational space and the literary space (as opposed to the visual space). The four chosen topics have exposed certain extreme forms of urbanization. In the larger picture, this position would ideally be balanced by studies venturing into the more philosophical and aesthetic aspects of ocean space which connect the ocean commons to the population at large.

The two chosen seas are geographic neighbours. Further case studies would identify the spatial properties and conceptions of oceans in more diverse political, climatic and socio-political regions. Such investigations could provide a basis for a true comparative study of a range of seas, and the relationships between their local and global influences - a hugely important field which is already being approached in different institutions around the world.

5.7.4 THE OCEAN PROJECT

The potentials of the Ocean Project are boundless and exciting. Using the findings of this thesis as a basis, prototype projects could be developed as further research exploring forms of spatial and temporal organization in detail and in diverse contexts. Such projects demand high levels of interdisciplinarity, collaboration and new forms of representation (s. 5.7.6).

5.7.5 SPATIAL SYSTEMS

Conclusions drawn in this thesis point to the lack of tools and methods to comprehend, govern and represent ocean space; a re-conceptualization of ocean space is called for. Certain spatial configurations inherent to the ocean have been defined, such as the reversal of the territorializing effect of lines between points. The ocean offers radical possibilities to rethink the very definition of negotiating space, and to experience such progressive, non-linear spatialities. The idea of "navigating" dynamic coordinates has been put forward by Hillier[23] and Latour and November[24] and deserves further research attention.

5.7.6 REPRESENTATION

A spatial study of the ocean space quickly reaches the limits of land-based methods of representation. This thesis has aimed to balance representation and mapping with theoretical research, and therefore leaves many avenues of representing ocean space unexplored. The question of scale and "true" measure poses extreme challenges in ocean space. While I argue that we have reached the threshold of physical spatial limits at many "nodes", and that specific layers of ocean space have been habitually modified and *scaped*, further research and experimentation is required in order to visually communicate new knowledge about the ocean to its global stewards.

I wish those pursuing any of these avenues much success in this rewarding and fascinating field.

23 Hillier, "Strategic Navigation in an Ocean of Theoretical and Practice Complexity."
24 November, Camacho-Hübner, and Latour, "Entering a Risky Territory."

APPENDIX

Appendix 1 – Windparks in the Baltic Sea

Appendix 2 – Facts, Nysted Windpark

Appendix 3 – Facts, Nord Stream Pipeline

Appendix 4 – Future Pipelines, Baltic Sea

APPENDIX 1– Windparks in the Baltic Sea

Country	status	year	capacity MW	turbine	nr	depth	distance	area	height tot.	developer	owner
Denmark											
Middelgrunden	operating			2 MW	20		2 km				
Rodsand 2(Nysted II)	operating		207	2.3	90	6-12m	8.8km	34 km2	115	Wind Sverige AB	E ON Climate & renewables GmbR
Nysted I	operating	2003	165.6	2.3	72	6-9m	10.8km	26km2	110	Dong Energie	PensionDanmark 50%
											DONG energy 47.25%
											Stadtwerke Lübeck 7.25%
Vindeby (1st offsh w/f)	operating	1991	4.95	0.45	11	2-4m	1.8 km		52.5	SEAS-NVE energy group	Dong Energy
Poseidon	test- wind/wave										
Anholt	operating	2013	399.6	3.6	111	14-17m	15km	145 km2	141.6	Dong Energy	Dong Energy 50%
											PensionDanmark 20%
											pensionskasse Admin 30%
Germany											
EnBW Baltic I	operating		48.3	2.3	21	16-19m	17km	7km2	113.5	EnBW Baltic I GmbH	EnBW Energie Baden Württenburg 50.31%
											19 municipalities 49.69%
EnBW Baltic II	under construction		288	3.6	80	20-40m	32km	30km2	138.2	EnBW baltic II GmbH	EnBW Energie Baden Württenburg
Baltic Power	consent application submitted		500	6	80	43-47m	33 km	38 km2		FC Windenergie GmbH	FC Windenergie GmbH
Arcadis Ost I	consent authorized		348	6	58	43-45	21	29 km2	180	KNK Wind GmbH	VW Energie AG 43%
											iKB Innsbrucker Kommunalbetriebe 11.1%
											Stadtwerke Bad Vilbel GmbH 6.94%
											Nordex Ebergie AG 38.89%
Arkona -Becken Sud-Ost	consent authorized		385	06. Jul	60	21-28m	35km	39 km2		dpark Entwicklungs-Beteiligungsges. mbH	
											E.ON Energy projects GmbH 98%
											AWE-Beteiligungsges. mbH 2 %
Poland											
Lithuania											
Latvia											
Estonia											
Kihnu Sth Offfshore	consent application submitted		560MW			12-23m		60km2		Esti Energia	Esti Energia
Kihnu Sthwst	consent application submitted		245MW			6-22m		41 km2		Esti Energia	Esti Energia
neugrund	consent application submitted		100-190	5 MW	38	3-20m		13km2		OU Neugrund	OU Neugrund
Hiiummaa offshore windpark	EIA. Waiting approval & MSP		700-1000	not known	100-160		12km			Nulja energia	
Finland											
Kemin Ajoksen I	operating	2007	15 MW	3 MW	5	6m	5 km	2 km2	128	Innopower Oy	Innopower Oy
Kemin Ajoksen II	operating		16 MW	3 MW	5	6m	5 km			Innopower Oy	Innopower Oy
Sweden											
Lillgrund	operating			2.3 MW	48	4-13m	11.3km	6 km2	114.5		Vattenfall Europe Windkraft GmbH
Utgrunden1	operating		10.5MW	1.5	7	6-15m	4km	row	100	Dong Energy	Vattenfall Europe Windkraft GmbH
Karehamn	operating	2013	48 MW	3 mW	16	6-20m	4-7 km		136	e.on wind sweden	e.on climate & renewables
Yttre Stengrund	operating (1 turbine)	2001-15	10 MW	2 MW	5	6-7.5m	4 km	row			Vattenfall 100%decomm. in su 15
Bokstiegen	operating		2.75	0.55 MW	5	6			60m	OM O2	

APPENDIX 2 – Facts, Nysted Windpark

Nysted Windfarm FACTS

Capacity:	72 turbines x 2.3 MW = maximial output 165.6 MW
Area:	24km^2 + 200m exclusion zone = ca. 28km^2
Water Depth:	6-9.5m
Distance:	10 km offshore
Wind:	prevailing south-westerly. Windspeed 263 km/hr in “brisk wind”.
Turbines:	Manufacturer Bonus Energy (now Siemens since 2004) Weight 250 tonnes. Height: total 110 m / Nacelle 70 m above sea surface Rotor diameter = 82.4 m Transported 12 hrs by ship from Newbourg (Denmark). 4 turbines/trip Colour = airforce grey
Layout:	8 rows- separated by 850m (10.5 x rotor diam) / 9 turbines/row separated by 480m (5.8D) = 5950 x 3840 m
Substation:	33000-132,000 volts. 25m high (4 stories) x 15m wide x 20 m long Located 200 m from northern turbine row
Masts:	4 meterological masts provide information on impact of windfarm on windspeeds/turbulence etc.
Cable:	total length = 48 km. 10 km to land, at Vantore Strandhuse. Land-based cable located 150 m from coast Diameter = 20 cm (largest & heaviest marine cable) Manufactured in London, delivered by ship.
Grid:	Connected to high-voltage Eastern Danish power grid at Radsted 132kV switching station, Sakskobing
Foundations:	cylindrical shaft = 4.2 m diameter, hexagonal basement: h=3 m x 16 m. 6 chambers filled with gravel and stones. outer diameter, scour protection (large stones) = ca. 25 m. base = 0 to 5 m below the natural seabed. Surface, stone fill in the basement chambers = 4.5 m to 7.5 m below sea surface (max = up to 10 m below the surface at a few turbines) 514m^3 / concrete for each base + 91 tonnes reinforcement.
.	construction in Swinoujscie, Poland (new concrete factory close to waterfront) Transported in 24 trips Swinoujscie-Nysted Built to resist ice-pressure
Construction:	Excavation started 2002. Started operation 1.12.2003
Owner:	Dong energy since 2003
.	

APPENDIX 3– Facts, Nord Stream Pipeline

Total length:	1220 km
Diameter:	1.2 m
Start:	Portovaya Bay, Russia
Finish:	Lubmin, Germany
Sections:	3 – different wall thickness according to gas pressure
Pipes	202,000
Single length	12 m
Single weight	24 tonnes
Pipe manufacture	Germany, Russia, Japan- Sumitomo
Steel needed	2 million tonnes
Concrete coating	2 new pkants: Mukran, Germany / Kotka, Finland (70,000 pipes, 300 jobs @EUPEC pipe coatings SA) Mukran (130,000 pipes- port expansion, 300 employees
Pipe Storage:	Hanko (F), Kotka (F), Karlskrona (S)- 90,000 m2 storage area (9 hectares), Slite (S)- vessel to vessel transfer, port facilities expanded, Mukran
Construction phase:	
Ships on the sea	30 at any given time
max transport distance pipe	100 n m
laying barges	Mukran, Karlskrona
Start of pipe manufacture	Aug. 2009
Transport to marshalling Yards Slite & Hanko	Feb 2010
Start of laying pipe 1	April 2010 off Gotland
End pipe 1 Germany	July 3 2010
End pipe 1 Russia	July 28 2010
End pipe 2 germany	July 17 2010
End pipe 2 Russia	4 Aug 2010
Last pipe in line 1 laid	April 2011
Ploughing trenches line1	Feb – March 2011
Pressure testing line 1	April – May 2011-
Line 1- 2 sections connected	June 2011
Line 1- drying completed	July 23- August 9 2011
Line 1- last welds	Aug 2011
Line 1 operational	Nov 2011
Line 2- ploughing trenches	Feb-March 2012
Line 2 last pipe laid	April 2012
Pressure testing line 2	April-May 2012
Logistics structures	July 2012 (Demolished)
Official opening line 2	October 2012

APPENDIX 4 – Future Pipelines, Baltic Sea

NAME OF PROJECT	CABLE TYPE	LOCATION	IN OPERATION	LENGTH OFFSHORE
Balticconnector	Gas pipeline	Finland – Estonia	2010	120 km
Great Belt	Electricity cable	Denmark	2010	30 km
Fenno-Skan 2	Electricity cable	Finland – Sweden	2011	200 km
Nord Stream	Gas pipeline	Russia – Germany	2012	1,200 km
Baltic Pipe	Gas pipeline	Denmark – Poland	2013	230 km
Estlink 2	Electricity cable	Estonia – Finland	2013/2014	140 km
Gotlandskabeln	Electricity cable	Sweden	2015 (earliest)	100 km
Nordbalt	Electricity cable	Sweden – Lithuania	2016/2017	350 km
Ekolänken	Electricity cable	Sweden	2015–2030	700 km
Ambergate	Electricity cable	Sweden – Latvia	2015–2030	390 km
(No name)	Electricity cable	Estonia – Sweden	2015–2030	350 km
TOTAL				3,810 km

New cables and pipelines in the Baltic Sea that are either under construction, have been approved or are under consideration during the next 20 years (electricity cables from projected wind farms not included).
Source: WWF. Future trends in the Baltic Sea 2010.

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CURRICULUM VITAE
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TEACHING – RESEARCH

Research/doctoral assistant 2010 – 15	EPFL, lapa/ laba Prof Harry Gugger, Architecture and Urban Design
Semester contract 2009	TU Berlin, Department Prof K. Zillich, Architecture und Urban D esign
Replacement 2008 – 9	TU Berlin, Department Prof K. Zillich, Architecture und Urban D esign
Research semester 2001 Apr – Okt	4th year Tutor for course coordinator urban design, Steve Whitford, University of Melbourne, Australia
Assistant professor 1999 – 2005	Department Prof. Klaus Zillich, TU Berlin Architecture und Urban Design
Semester contract 1994	Prof. Heike Büttner, Fachhochschule München

INDEPENDANT PRACTICE

cet-01 2005 – 2010 Berlin	Couling | schnorbusch GbR with Dipl. Ing. M. Arch Susanne Schnorbusch
cet-0 1995 – 2005 Berlin	Interdisciplinary practice with Gerald Eberhard & Susanne Schnorbusch, Architects and Klaus Overmeyer Landscape Architect

INTERNATIONAL COLLABORATION

2001	LAB Architecture Studio Melbourne, Australia
1997	Architecture & Planning LPT Hong Kong
1991-97	independant projects and architectural practices and Germany Steidle & Partner / Peter Lanz Architekt / Beringer & Wawrik, Munich Atelier Christoph Langhof, Berlin
1989-90	Architectural practices Italy Prof. G. Polesello / Prof R. Sordina / Ugo Camerino Architetto, Venice Massimiliano Fuksas, Rome
Employed 1983-88	Architectural practices New Zealand Rewi Thompson Architect, Auckland Dave Launder Architect, Wellington

EDUCATION

can Doc 2011-15, EPFL	Thesis Title: "The Role of Ocean Space in Contemporary urbanization" Supervisor: Prof Harry Gugger.
Postgraduate Scholarship 1988-89	One-year Arts Scholarship awarded by the Italian Government. Study completed at Università per Stranieri, Perugia and at the Istituto Universitario di Architettura di Venezia (I.U.A.V)
Architectural Registration 1987	Examination, New Zealand Architect's Registration Board
Graduation 1983	with "Honours" (equivalent to Master of Architecture)
Bachelor of Architecture 1978-1983	University of Auckland, New Zealand, Faculty of Architecture

SELECTED PROJECTS CET-01

Research Management LURI.watersystems GmbH	Preliminary research, urban feasibility study, design and permit drawings 2006- for an off-shore holding tank, "SPREE2011" Osthafen, Berlin with König Architekten. Applied research funding: BM
Immobilie Facility Management GmbH 2009	Urban block with six low-energy apartments according to the *Passivhaus* standard in Leipzig-Lindenau (Developed Design)
Federal Ministry of Transport, Building & Urban Development with Leipzig City 2005-09	Prototype "Colonnades on the old salt route" - post-demolition communal garden and colonnade, Leipzig-Grünau. Applied research funding: ExWoSt programme Urban quarters for young and old
Siemens Real Estate 2003-06	"Siemens Strukturkonzept" Strategy for reorganisation of the central administration building in Berlin, 4 phases realised /"Siemens Spreegelände"- redevelopment of an industrial site. 4 phases realised
Senat for Urban development, Berlin 2004	"Urban Pioneers" temporary use as development catalyst, with studio urban catalyst.
ASW, Leipzig City 2001-04	Sportfield 5.1, Leipzig Grünau. Design & realisation Highly commended Architecture Prize Leipzig 2005
The Kingdom of Bahrain	invited urban design competition "Durrat Al Bahrain Crescent", with WS Atkins & Partners, Middle East

SELECTED TEACHING PROJECTS

laba,EPFL 2013-14 teaching support	Deep Urban Land- An Underground Constitution for Switzerland / Inversion- from Object to Space
laba,EPFL 2012-13 teaching support	CH2048- An Urban Portrait revisited / CH2048- Charging Territory
laba,EPFL 2011-12 content management	Sea of Opportunities- A territorial Constitution for the Barents Sea / Exploring Infrastructure- Living & Working in the Barents Sea
Prof K. Zillich, TU Berlin 2009 teaching	Wasserschaft Spree. Urban Design und research paper, Spree river Berlin with Paola Alfaro d'Alençon.
Prof K. Zillich, TU Berlin 2008 teaching	urban zero plus. Urban design strategies für urban ecology und zero-emission development, Berlin.
Prof K. Zillich, TU Berlin 2004-5 teaching	Quantum Shift. Pacific urbanism and double density. Summer School at Auckland University, NZ.
Prof K. Zillich, TU Berlin 2003-4 teaching	Maximal Change vs. Local Identity. Collaboration with BICEA Beijing. Fayuan-Si district, Beijing
Prof K. Zillich, TU Berlin 2003 teaching	Hochwasser^2. Flood protection competition, Regensburg, with Landscape Planning (Prof. Loidl), Water Management (Stückrath) und Arch. Design (Popp)

SELECTED PRESENTATIONS

Presentation: Architecture in the Expanded Field, with H. Gugger & B. Costa	*urban lab +* Symposium "Urban Teaching Global Learning", laba, Basel 10-14 November 2014 coordination: N. Couling
Paper: The Intercultural Dimensions of Ocean Territory	*urban lab +* PhD colloquium "Research Methods for the Intercultural Dimensions of Territory", EPFL 14.11.14 coordination: N. Couling
Presentation: The Cultural Territory, with P. Cannavò, S. Sundararajan & R Gupte	*urban lab +* Symposium "Shaping the City- an ethical committment?", University of Calabria, June 2014
Presentation: Imagining the Region	*urban lab +* Workshop "Intercultural Approaches" KRVIA, Mumbai Feb 2014
Paper: The Urbanization of the Sea	International PhD Seminar "Urbanism & Urbanization ›Urbanism after Urbanism" Ecole Nationale Supérieure d'Architecture Paris-Malaquais, October 2013
Paper: The Military Space of the Ocean	International Conference, urban and landscape days "Between Architecture of War and Military Urbanism" Estonian Academy of Arts, Tallinn, 2013 http://architectureofwar.artun.ee/documentation/
Paper: Scarcity within a context of abundance- case-study Barents Sea, Norway	PhD conference, "Within the Limits of Scarcity- Rethinking Space, City and Practices", University of Westminster 2013. Organisers: SCIBE research project; Scarcity & Creativity in the Built Environment http://www.scibe.eu/category/conference/
Lecture: Strategies for urban ecology / How can less (city) be more (urban)?	University of Applied Science (FH), Lausitz 2009
Lecture: New implants for deconstructed territories. Projects cet-01 in the sth-Leipzig region	Symposium & Exhibition "Berlin: Nomad Architects" Lebanese American University, Beirut 2009 Dept. of Architecture and Design
Lecture: urban zero plus	Forum & Exhibition "Spreeforum Wasserschaft Spree - future Scenarios between Schilling and Elsenbridges" Faculty Forum TU Berlin, 2009. Organisation N. Couling, P. Alfaro d'Alençon, D. Konrad.

SELECTED PUBLICATIONS

Couling, N., 2014.	Scarcity and Ocean Space- case-study Barents Sea, Norway. Archidoct Vol 1, issue 2. ENHSA http://www.enhsa.net/archidoct/Issues/ArchiDoct_vol1_iss2/main.html
Couling, N., 2014.	Planning for Flow in Ocean Space. A Barents Sea Case Study, in "Spaces and Flows: An International Journal of Urban & ExtraUrban Studies" Vol 4, issue 1. Champaign: Common Ground Publishing
Couling, N., 2013.	The Urbanization of the Sea in "Urbanism after Urbanism". Paris: LIAT/ENSA Paris Malaquais
Gugger, H., Couling, N., Blanchard, A., 2012.	Barents Lessons. Teaching and Research in Architecture. Zurich: Park Books
Fibich, P (ed). 2008.	Park 5.1 in "Leipzig, Begleiter für neue Landschaftsarchitektur" Editionen Garten + Landschaft. München:Callwey
Chamber of Architects Berlin (eds). 2005.	Project Park 5.1, Leipzig, cet-01 in Architektur Berlin 05. Salenstein: Braun Publishing
Couling, N. & Overmeyer, K. 2004.	New from Suburbia - Agro City, in "The Challenge of Suburbia". Ilke & Andreas Ruby (eds) AD Architectural Design, 05/ 2004. London: Wiley Academy
Couling, N., Overmeyer, K. & Schnorbusch, S. 2001.	Urbane Reste - offene Systeme. Park 5.1 in Leipzig-Grünau in "Zeit", anthos:Zeitschrift für Landscahftsarchitektur Nr. 2 2001. La Chaux-de-Fonds: BSLA