

**The options of economic interference
in Natura 2000 areas:
*Recreation in the Wadden Sea***

Master thesis
Environmental Biology - Ecology and Natural Resource Management
Utrecht University

Jürgen Versluis
December 2011 - March 2012

Supervisor: J.N.M. Dekker

Table of contents

Preface.....	5
Introduction.....	6
Chapter 1 Area Description	8
Chapter 2 Economy and ecology relations in conservation regimes regarding the Wadden Sea ...	12
2.1 Natura 2000: The Birds Directive	12
2.2 Natura 2000: The Habitats Directive	13
2.3 UNESCO World Heritage.....	16
2.4 Ramsar Convention on Wetlands.....	18
2.5 Natuurbeschermingswet.....	19
2.6 Economy-ecology problematics within the different conservation regimes	20
Chapter 3 Governmental plans of conservation and recreation in the Wadden Sea	23
3.1 VROM: "Ontwikkeling van de Wadden voor natuur en mens"	23
3.2 Regionaal College Waddenzee (RCW): "Léven in de Wadden"	25
3.3 Trilateral Wadden Sea Plan (TWSP)	25
3.3.1 Salt marshes	26
3.3.2 Tidal area	26
3.3.3 Beaches and dunes.....	27
3.3.4 Offshore areas	27
3.3.5 Birds.....	28
3.3.6 Fish.....	28
3.3.7 Marine mammals.....	29
3.3.8 Conclusions TWSP	29
3.4 Ministerie van ELI: Programma "Naar een rijke Waddenzee"	29
3.5 Development plans for conservation and recreation in the Wadden Sea	30
Chapter 4 Recreation and impacts of recreation in the Wadden Sea	32
4.1 Coastal recreation	33

4.1.1	The impact of hiking and biking	33
4.1.2	The impact of swimming, sunbathing and surfing	35
4.2	Mid sea recreation	36
4.2.1	The impact of jet skiing, waterskiing and other motorized water sports	37
4.2.2	The impact of kite surfing.....	37
4.2.3	The impact of sailing/boating.....	38
4.2.4	The impact of canoeing	38
4.3	Overlapping recreation.....	38
4.3.1	Mudflat walking.....	39
4.3.2	Sport fishing.....	39
4.4	Economic value.....	40
4.5	Conclusion	41
Chapter 5	Options for economic development in the Wadden Sea	43
5.1	Coastal recreation	43
5.1.1	Hiking and biking	43
5.1.2	Swimming, sunbathing and surfing	44
5.2	Mid sea	45
5.2.1	Jet skiing, water skiing and other motorized sports.....	45
5.2.2	Kite surfing.....	47
5.2.3	Sailing and boating	47
5.2.5	Canoeing.....	47
5.3	Overlapping recreation.....	48
5.3.1	Mudflat walking.....	48
5.3.2	Sport fishing.....	48
5.3.3	Civil air traffic.....	49
5.4	Conclusions.....	50
Chapter 6	Discussion	51

Chapter 7	Conclusions.....	54
	Literature.....	55
Annex I	Protected Areas of the Wadden Sea	59
Annex II	Overview of bird species protected by the Birds Directive	62
Annex III:	Recreational zones in the Wadden sea	64
Annex IV:	Kite surfing areas	65

Preface

For my master thesis, I decided to look at the modern day problem of economic activities and their relation to nature conservation. The thesis is an obligatory part of the mastertrack Ecology & Natural Resource Management of the master Environmental Biology in the Graduate School of Life Sciences of the Utrecht University.

I'd like to thank my supervisor for providing information on the European nature conservation legislation, the repeated revisions of the written work and for providing creative inspiration by the use of multiple suggestions.

Introduction

The present day economic crisis presses heavily on nature conservation. With more economic uncertainties, it will be harder to sustain the money flow meant for nature conservation. Therefore it's in the line of expectations that there will be more economic development in nature areas that are protected. Yet, the crisis turns out to be quite positive for nature due to a decrease in the demand for resources (Mongabay, 2009). Another good aspect of the economic crisis is the decrease in greenhouse gas emissions (CBS, 2010). The interesting part here is to identify the possibilities for economic development in the rack and space in the different regimes of nature protection.

The aim of this study is to identify what the options are for intensification of tourism and recreation in the Wadden Sea, within protected nature areas. The options to implement the economic activities in such protected areas in general and more specific the options for economic development in present-day plans for the development and conservation of the Wadden Sea will be investigated. The role of both coastal and mid-sea recreation and (eco) tourism will be investigated to determine the options for an extensive economic development of the Wadden Sea.

One of the conservation regimes in the Wadden Sea is Natura 2000, consisting of the Birds Directive and the Habitats Directive. According to Article 2, paragraph 3 of the Habitats Directive, all measures that are taken to maintain the biological diversity, have to take the requirements of economic, social and cultural development into account (EC, 1992). This shows that there is rack and space in the legislation for economic development. To identify what this rack and space is for the development of recreation in the Wadden Sea area, a separation between coastal and mid-sea regions will be made. This, because the pressure of the different recreation types will differ in those areas and because both coastal regions and mid-sea regions are two quite different types of ecosystems. On top of that the focus will be on the Dutch part of the Wadden Sea only and only recreation will be investigated. This means that other activities like gas extraction, military training activities, windmill parks, agriculture and fisheries will not be taken into account. Only the Wadden Sea itself and the coastal regions are subject of this thesis. The coastal regions are consisting of the coasts of the mainland (Noord-Holland, Friesland and Groningen) and the coastal regions of the different islands that are adjacent to the Wadden Sea. The inland zones and the North Sea coasts of the islands are not part of this investigation. When talking about coastal recreation, all recreation that takes place on the shore and water recreation with a focus close to the shore.

This thesis will be outlined as followed. First an area description will be given (Chapter 1), followed by a thorough explanation of the different nature conservation statuses of the Wadden Sea (Chapter 2). Here the influence of the Habitats and Birds Directive (Natura 2000), UNESCO World Heritage, Ramsar and Natuurmonumenten (Naturemonuments) will be explained. The part of the rules and legislation will be concluded with a comparison of the different regimes and the problems that have arisen with interpretation of the rack and space nature conservation areas will be discussed.

Chapter three will discuss the plans that were already made to determine the future of the Wadden Sea. This chapter will be divided over the Trilateral Wadden Sea plans, a plan by the department of VROM (Housing, Spatial planning and Environment), a plan by the Regionaal College Waddenzee (Regional College Wadden Sea (RCW)) and a plan by the Ministerie van Economische Zaken, Landbouw en Innovatie (Ministry of Economic affairs, Agriculture and Innovation).

Chapter four will follow with an enumeration of the different types of recreation in both the coastal and mid sea regions of the Wadden Sea. With the help of maps provided by a Dutch government institution, the different regions and their corresponding recreation types will be charted.

Also, the impact of those recreation and tourism types will be discussed in the same chapter. An attempt will be made to determine the impact of the recreation on the environment by comparing the impact of similar types of recreation in comparable areas.

This will be finalized in chapter five where options of Natura 2000 economization are discussed by falling back on the result of the previous chapters. The options for economic growth in protected nature areas under the influence of the different legislation will be identified and discussed, followed by the overall discussion and the conclusions.

Chapter 1 Area Description

To understand the importance of the Wadden Sea, an overview of the key characteristics is necessary. Therefore, to show why the Wadden Sea is such an unique area, an overview of the area with its different habitats and animal species will be given.

The Wadden Sea is a natural, dynamic, saltwater tidal area with a complex of deep channels and shallow water with sand and mud banks. Large parts are dry during ebb tide and the sand and mud banks are intersected by a branched system of channels. Scattered along the mainland and the island are salt marshes. These salt marshes have large differences in both salinity and moisture level, leading to a very diverse flora and fauna. Most salt marshes, along the coast of the mainland, are a result of land reclamation and the corresponding human intervention in the salt marsh soils. The soil of these salt marshes on the Wadden islands is mainly sandy, this due to the drifting sand from nearby dunes and the deposition of sand during tidal changes. The gradual transition from the mudflats to the dunes are the cause of the enormous biodiversity in the area (Minister van LNV, 2008).

The hydrodynamics and geomorphology are almost undisturbed, so that natural processes take care of the maintenance and development of characteristic biotopes and habitats. The area is unique due to the natural relationship between the Wadden Sea itself, its coastal zones and the mainland (Minister van LNV, 2008).

Due to its unique aspects, the Wadden Sea is protected by multiple nature conservation statuses. The area of interest here, as stated in the introduction, is only the mid-sea region and the coastal areas, not the islands of the Dutch part of the Wadden Sea. This area is visible in figure 1. This area is about 272.499 ha (Min. ELI, 2012a). The areas of the Wadden Sea that are protected by the Birds Directive and Habitats Directive can be seen in Annex I, figures 1 and 2. The Wadden Sea is a Natura 2000 area since 2009 (Min of ELI, 2012a), yet already in 1981 a large part of the Wadden Sea (110.000 ha) was given the status of Natuurmonument (Naturemonument). In 1993, an additional 150.000 ha became part of the Natuurmonument status (Ecomare, 2012a).



Figure 1: Overview of the Wadden Sea. The yellow area (Natura 2000 and Natura 2000+Natuurmonument) is corresponding to the area of interest in this study. The double lines are showing the area qualified as a Dutch Natuurmonument. The inner lines over the whole area and the Dollard area are showing the areas protected by the Birds Directive, Habitats Directive. These areas are part of the Dutch Natuurmonument. The outer lines are showing the areas that are only protected by the Birds Directive and Habitats Directive. *Image provided by the Ministerie van ELI (2012a).*

The UNESCO World Heritage area (Annex I, figure 3) represents more than 66% of the Wadden Sea, since most parts of the islands are excluded. The area consists of multiple transitional habitats, tidal channels, sandy shoals, sea-grass meadows, sandbars, mudflats, salt marshes, beaches and dunes, estuaries and mussel beds (UNESCO, 2012a).

The Wadden Sea area is the habitat of multiple plant and animal species. The area is considered one of the most important areas for migratory birds, with about 12 million birds per year. The area supports more than 10% of the total worldwide population of 29 different bird species (UNESCO, 2012a). Besides being a key area for multiple migratory bird species, the Wadden Sea is an important feeding and breeding area for millions of fish and shellfish (Waddenvereniging, 2012; Min. ELI, 2012a).

Looking at the Natura 2000 area described in the letter of the Minister of LNV (Minister of Agriculture, Nature and Foodquality) (Minister van LNV, 2008), multiple habitats are subjects of conservation. Besides the habitats, also 6 animal species are subjects of conservation. These groups are characterized with a specific code and nature aims, varying from maintenance and improvement to only maintenance. An overview of these habitats and animal species can be found in table 1. A comparable table for the bird species can be found in Annex II, tables 1a/b and 2.

Table 1a: Overview of the protected habitats in the Wadden Sea determined by use of the Habitats Directive. All habitats are subjected to maintenance. Nat.size shows the amount of ha of a habitat on a national level. WS size shows the amount of ha present in the Wadden Sea. (Minister van LNV, 2008).

Code	Habitattype	Area	Improvement	Nat. size (ha)	WS size	Conservation Status ¹
H1110	Permanently flooded sandbanks (tidal area)	Mid-sea	Yes	130.000	>75%	Unfavorable (inadequate)
H1140	Mud and sand flats (tidal area)	Mid-sea	Yes	109.000	>75%	Unfavorable (inadequate)
H1310	Brackish pioneer vegetation (<i>Salicornia spp.</i> (A) and <i>Sagina maritima</i> (B))	Coast	No	2200 (A)	50-75%	Unfavorable (inadequate)
				300 (B)	6-15%	Favorable
H1320	Mud lawns (<i>Spartinion maritimae</i>)	Coast	No	X	X	Unfavorable (bad)
H1330	Salt marshes and salt meadows (<i>Glauco-Puccinellietalia maritimae</i>)	Coast	Yes	9900	50-75%	Unfavorable (inadequate)
H2110	Embryonic dunes	Coast	No	500	30-50%	Favorable
H2120	White dunes (<i>Ammophila arenaria</i>)	Coast	No	2400	6-15%	Unfavorable (inadequate)
H2130	Grey dunes (calcareous and non-calcareous)	Coast	No	X	X	Unfavorable (bad)
H2160	Sea buckthorn thickets (<i>Hippophaë rhamnoides</i>)	Coast	No	X	X	Favorable
H2190	Humid dune slacks	Coast	No	X	X	Unfavorable (inadequate)

One remark has to be made concerning the different habitat types in the Wadden Sea (Table 1a). The different types of dunes and dune-like habitats, habitat types H21XX, are possibly not all part of the area of interest. The area of interest in this study is limited to the Wadden Sea coasts of the Wadden islands. Yet, the habitat types H21XX can also be found at the North Sea coast of the Wadden islands. This makes interpreting the conservation status of these habitat types in the area of interest harder. Since no additional information could be found, the assumption is made that the conservation status is also correct for the area of interest in this study.

¹ According to Min. ELI (2012b)

While having the conservation status unfavorable, either inadequate or bad, a logical step would be to not only maintain the specific area, but also improve the area. This link is missing when looking at table 1a and 1b and annex I. This might be because the 2008 values are already outdated. The information regarding improvement (Minister van LNV, 2008) can be incorrect due to either improved requirements or a deterioration of the habitats/population. Since the conservation status derived from the ministerie van ELI (2012b), is more up to date, this information will be valued as more important than the improvement aims derived from the minister van LNV (2008).

Looking at the conservation statuses of the different habitats, animal species and birds, the first thing that draws the attention is the bad shape of the different targets of conservation in the Wadden Sea.

Of all ten habitat types, only three have a favorable conservation status of which one habitat type is only partly favorable. This would mean that about 25% of the habitats are favorable, while 75% is unfavorable, of which 20% is even in a very poor condition. Of the six animal species, birds excluded, only the harbor seal has a favorable conservation status, meaning that 83% of the protected animal species in the Wadden Sea has a conservation status of unfavorable. The statuses of the birds species are a little better, with 47% of the bird species with a favorable status. Yet still 29% of all protected bird species in the Wadden Sea are in a very poor condition.

These poor statuses can turn out to be an obstacle for economic development of the Wadden Sea.

Table 1b: Overview of the protected animal species (non avian) in the Wadden Sea determined by use of the Habitats Directive. All species are subjected to maintenance. Nat. pop. shows the size of the population on a national level. WS size shows the size of the population in the Wadden Sea. (Minister van LNV, 2008).

Code	Species	Area	Improvement	Nat. pop.	WS pop.	Conservation status ²
H1014	Narrow-mouthed whorl snail (<i>Vertigo angustior</i>)	Coast	No	X	X	Unfavorable (inadequate)
H1095	Sea lamprey (<i>Petromyzon marinus</i>)	Mid-sea	Yes	X	X	Unfavorable (inadequate)
H1099	European river lamprey (<i>Lampetra fluviatilis</i>)	Coast / Mid-sea	Yes	X	X	Unfavorable (inadequate)
H1103	Twait Shad (<i>Alosa fallax</i>)	Mid-sea	Yes	X	X	Unfavorable (bad)
H1364	Grey seal (<i>Halichoerus grypus</i>)	Mid-sea	No	1800-2000	>50%	Unfavorable (inadequate)
H1365	Harbor seal (<i>Phoca vitulina</i>)	Mid-sea	Yes	4200-5500	50-75%	Favorable

² According to Min. ELI, 2012b

Chapter 2 Economy and ecology relations in conservation regimes regarding the Wadden Sea

Multiple different statuses can be given to specific natural areas. All these statuses have their own set of goals and rules. While some are overlapping, some might conflict with the rules provided by another institution. Here the protection provided under the rules and legislation of Natura 2000, UNESCO World Heritage, the Ramsar Convention on Wetlands and the status of Natuurmonument will be discussed. Natura 2000 is the result of two separate directives, namely the Birds Directive (1979) and the Habitats Directive (1992).

2.1 *Natura 2000: The Birds Directive*

The Birds Directive (BD) focuses on the protection of Europe's wild birds (ECE, 2012). The BD was first adopted in 1979 and a revised version was adopted in 2009 by the European Parliament and the Council. The BD works by designating special protection areas, banning activities that directly threaten birds and protecting bird species by drawing up rules for hunting.

The Birds Directive has 20 Articles, but clearly shows the connection with the future HD in Article 1. The European parliament and the council of the European Union divided the first Article into two paragraphs, which clearly state the goal of the whole directive (EC, 2010).

In paragraph 1 it's stated that all species of birds in a wild state that are occurring naturally, in the territory of a Member State of the European Union, should be target of conservation if the Treaty applies. This means that there are rules drawn up for the exploitation of birds; covering the protection, the management and the control of the bird species in a certain Member State.

Paragraph 2 clarifies this further by stating that not only the actual birds are protected, but also their eggs and nests and the habitats that they are living in.

The other main Articles in the BD are Articles 3, 4 and 5, stating what should be done and what definitely shouldn't be done. Article 3, paragraph 2 shows the actions that Member States have to do in relation to habitats. In this paragraph multiple measures are described for Member States to ensure not only the preservation and maintenance, but also the re-establishment of the different biotopes and habitats that the birds are living in. Namely, creating Special Protection Area's (SPAs) and maintaining and managing the ecological needs of habitats that are not only inside the SPAs, but

also outside. Besides that, re-establishment and creation of biotopes are two proposed measurements.

Article 4, paragraph 1 shows the rules that Member States have to live up to in relation to the actual species mentioned in Annex I of the BD. The list of bird species mentioned in Annex I of the BD implies that all birds that are on that list and are present in the SPA, should be a target for conservation. Thus, their habitat must be conserved in such a way that survival and reproduction is ensured. This means that attention has to be given to species that are in danger of extinction and species that are vulnerable to specific changes in their habitat. But also rare species, due to the amount of individuals or restricted distribution. Some habitats are very specific and multiple bird species can only live there due to the specific nature of that habitat. These bird species should also be taken into account.

The prohibiting factors that have to be taken account of, are stated in the last Article of the three major Articles. In Article 5 it is stated that Member States have to take the demanded measures to create a protection system for all bird species that are determined by the use of Article 1, without doing any harm to the 7th and 9th Articles of the BD. This means multiple actions have to be prohibited. Such actions are killing/hunting or capture of birds, destroying or removing the nests or eggs and the taking of eggs, even if they are empty. Especially during the breeding season, the disturbances have to be prohibited. Article 5 cannot do harm to Articles 7 and 9, because these two Articles identify the exceptions on the rules. In these two Articles, it is stated that hunting can still be allowed for species that are not in danger of extinction or are not a rare species in the specific area (Article 7) or if safety or damage to crops, livestock, forests, fisheries and water is caused by a species that is not in danger of extinction or rare in the specific area (Article 9). The list of bird species that may be hunted is drawn up in annex II of the BD.

2.2 *Natura 2000: The Habitats Directive*

The Habitats Directive 92/43/EC (HD) was accepted in May 1992 by the European Council (ECE, 2012). The HD aims to promote the maintenance, the protection and the improvement of biodiversity. This while taking economic, social, cultural and regional requirements into account. Under these legislations, conservation of a wide range of floral and faunal species is ensured and multiple rare and characteristic habitat types are qualified for conservation (EC, 1992). Together with the Birds Directive, the HD establishes the European wide Natura 2000 ecological network of

protected areas. Natura 2000 is now the most important instrument of the EU to achieve the biodiversity goals.

The directive consists of 24 Articles, varying from stating the various definitions to multiple do's and don'ts for members of the European Union. The whole directive can be roughly divided into two major chapters, namely Articles 3 to 11 and 12 to 16. This leads to the division of 'Conservation of natural habitats of species' on the one hand (Articles 3-11) and 'Protection of species' (Articles 12-16) on the other. But perhaps one of the most important articles falls outside of these two chapters. Article 2 paragraph 3 of the HD is already showing the importance of economic development. In paragraph 3, it 's stated that all conservation measures have to take into account the demands for economic, social and cultural development. Also regional and local characteristics are important factors to note. The first chapter 'Conservation of natural habitats of species', shows the full ambition of the whole directive, with a key role for Article 6. Therefore, and since it is important for the evaluation of new activities, Article 6 will be discussed into more detail.

Before Article 6 is applicable to an area, a site has to gain a specific status, which is done in Article 4. By the use of annexes I and II of the HD, Member States can determine certain areas to be Possible Site of Community Importance (pSCI). Annex I shows an extensive list of habitat types that are endangered or limited to a certain area. Multiple large habitat types are divided into subareas where multiple smaller habitat types are listed. All habitat types in this list should be subject of conservation for the area where they occur. Annex II works in a comparable way, yet this annex is to determine the species that have to be subjects for conservation. If an area includes at least one of the habitats that can be found in annex I of the HD or one of the species that can be found in annex II of the HD, that area can be nominated as a pSCI. After gaining the pSCI status from a Member State, the EU determines if a site is worth it to be called a Site of Community Importance (SCI), according to Article 4, paragraph 2. This means that from that moment on, the specific site will be subjected to Article 6, paragraphs 2, 3 and 4. Sites that have gained the SCI label from Article 4 paragraph 2 have to be designated by the Member States as Special Areas of Conservation (SACs) as described in Article 4, paragraph 4. With a label of SACs, the area will also be subjected to Article 6 paragraph 1.

Article 6 can be divided into three provisions. First paragraph 1, with a focus on positive and proactive conservation measures. Paragraph 2 focuses on the avoidance of habitat deterioration and species disturbance and therefore turns out to be preventive. With a general regime formed by proactive measures (Article 6.1) and prevention (Article 6.2), paragraphs 3 and 4 apply to new

projects and outside influences. Paragraphs 3 and 4 define a series of procedural and substantive safeguards with regard to actions that are likely to have a significant effect on a Natura 2000 area.

Article 6, paragraph 1 of the HD states that Member States have to take appropriate conservation measures and establish management plans to sustain the SACs. This in correspondence to the requirements of the habitat types in annex I and species in annex II that are present in the SAC. This means that paragraph 1 provides for positive measures with the goal to achieve the general objective of the HD. The paragraph applies to all SACs of the Natura 2000 network and no exceptions are made for any habitat types or species listed in Annexes I and II of the HD that are present in that specific area.

Article 6, paragraph 2 of the HD states that Member States have to take appropriate measures to avoid the deterioration of both habitat types and species in the SAC and SCI. Hereby clearly stating the prevention role of paragraph 2. The paragraph applies permanently in the SACs and SCI and therefore concerns past, present and future activities and is not limited to only intentional acts, but also covers chance events that could occur and can be predicted. This means that catastrophes cannot be taken into account, but an attempt should be made to decrease the risk of such catastrophes.

With the conservation measures and prevention described, the effects from outside the area and from new projects remain. Firstly Article 6, paragraph 3 states that new plans or projects that have no connection with a SAC or SCI but are likely to have a significant effect on it should be assessed to determine its effect on the conservation of the SAC or SCI. Member States can agree with the plan or project only if the assessment showed that the integrity of the site is not adversely affected. The problem in this paragraph is the meaning of the word significant. This, because the effect of a loss of a few hundred square meters of habitat will probably turn out significant for a small habitat with a few rare species, while a similar loss in size of a larger and more common area may be insignificant. Therefore, the meaning of significant has to be interpreted objectively.

Paragraph 3 works combined with paragraph 4, which states that a negative assessment can be carried out if there is a big public interest, like reasons of economic or social nature, if alternative solutions are not available, but compensations are necessary. Nevertheless, the Member State has to take appropriate measures to maintain the overall coherence of the Natura 2000 area and inform the European Commission of the measures that they adopted. If the SAC or SCI is a host of a priority

natural habitat or species, the only considerations that are allowed are related to human health or public safety.

So, together the final two paragraphs of Article 6 define a step-wise procedure for consideration of different plant and projects. The first step in the procedure is an assessment stage. The second step in the procedure is about the decision of the competent national authorities. The last step in the procedure plays a role when, even though the assessment turned out negative, the plan is not rejected but given further consideration (European Communities, 2000).

Combining this Article, with its four paragraphs, with Article 2 shows the real aim of the HD. Which is easily stated nothing more than using conservation measures, preventing and handling influences from outside the area and new projects in such a way that the different habitat types and species are maintained, protected and improved, while taking into account the demands for economic, social and cultural development.

So, looking at the rules and legislation provided by the BD and HD, it is obvious that not only the habitat itself, but also the species in it are protected by multiple rules. Not only attention should be addressed to the conservation measures against problems that have arisen over the years, but certain rules are also drawn up for the prevention of future cases and for influences from outside. Nevertheless, even though there are a lot of rules drawn up for the maintenance, protection and improvement, there is rack and space in those rules that give rise to economic opportunities.

Yet, Article 2 and 6 are also at odds. Even though Article 2 states that there is a role for economic, social and cultural development, the restrictions provided by Article 6, paragraph 3 and 4 make it hard to determine if new projects have a real chance of implementation. Looking at the conservation statuses in Tables 1a and 1b and Annex II, the current state of the Wadden Sea is not good at all. Due to this, the rack and space that is normally available in the legislation provided by the BD and HD, will turn out smaller in the case of the Wadden Sea.

2.3 UNESCO World Heritage

The World Heritage Convention (1972) was arranged by UNESCO, as a part of the United Nations. After World War I an idea emerged that heritage should be protected internationally after merging the preservation of cultural sites and conservation of nature, the UNESCO World Heritage convention was formed. A unique aspect about the convention is the link that is established between nature conservation and preservation of cultural properties. Up till 2004, sites were selected by the use of

six cultural and four natural criteria. Since 2005, UNESCO uses a set of ten selection criteria to determine if a specific area is special enough to be part of the World Heritage list. A site has to meet at least one criterion in order to get on the Heritage list. (UNESCO, 2012b,c).

These selection criteria are divided into two groups, the cultural and natural criteria. Four of the selection criteria constitute the natural criteria group (criteria 7-10). The 7th selection criterion states that a site should contain either extraordinary natural phenomena or should be of exceptional natural beauty or of a high esthetic value. The 8th criterion states that a site should contain major stages of the earth's history. This criterion focuses on the development of landforms and the significance of both geomorphic and physiographic features of the area. By use of criterion number 9 areas are selected by a focus on both ecological and biological processes that have an effect on the evolution and development of different ecosystems and floral and faunal communities. The 10th and final criterion selects areas that contain natural habitats that are the most important for the conservation of biological diversity. This includes areas containing endangered species with an outstanding universal value (UNESCO, 2011).

The Wadden Sea is protected by UNESCO World Heritage since June 2009. For the Wadden Sea, criteria 8, 9 and 10 are all important (UNESCO, 2012a). With regard to criterion 8, the Wadden Sea is selected because it has a depositional coastline of which both the scale and the diversity are unique. Besides multiple specific properties, the information gained from studying the Wadden Sea provides lessons for scientific importance for wetlands. Also the information gained by coastal management is of international importance.

Both criteria 9 and 10 are focused on the extraordinary species richness of the Wadden Sea. Besides the fact that the Wadden Sea is one of the last remaining largely undisturbed intertidal ecosystems and thus an invaluable record of the dynamic adaptation under influence of global changes, it is also an area with one of the highest productivity of biomass in the world. This species richness, further explained under criterion 10, is unique. Especially in relation to faunal diversity, the Wadden Sea is a unique coastal wetland.

Under influence of the rules and legislation described in paragraph 96-119 of the Operational Guidelines for the Implementation of the World Heritage Convention (UNESCO, 2011), specific management and protection requirements for the Wadden Sea were formed (UNESCO, 2012a).

These requirements state that it is necessary for the protection and integrity of the Wadden Sea to maintain both the hydrological and the ecological processes of the tidal flat system.

It is essential to conserve the marine, coastal and freshwater ecosystems by effective management of the protected areas. This includes special marine no-take zones, where all forms of exploitation are prohibited. According to these requirements it is also necessary to ensure an ecosystem approach that combines the management of already existing protected areas with other key activities in the area, like fisheries, shipping and tourism. Continuous monitoring and assessment of the area should take place and development projects, like wind farms should be subjected to Environmental Impacts Assessments. Also oil and gas exploitation should not be allowed in the specific area.

Thus, looking at the rules and legislation from UNESCO World Heritage provided for the protection of the Wadden Sea, economic activities are not excluded. Yet, instead of focus on economic development, we can see a focus not only on the conservation of the habitat, but also of the species richness. The management and protection requirements show the aim to intervene in the existing problems and to prevent future problems from arising. In comparison to Natura 2000, no special rules are set up for new projects. But, just as with Natura 2000, UNESCO World Heritage aims to a situation where economic opportunities work well together with the proposed conservation methods.

2.4 *Ramsar Convention on Wetlands*

The Ramsar Convention on Wetlands is a global environmental treaty that deals only with wetland ecosystems. This convention (1971 in Ramsar) aims to achieve sustainable development throughout the world through conservation and "wise use" of wetlands. Ramsar is part of the UN system of Multilateral Environmental Agreements (Ramsar, 2012a).

The Wadden Sea is designated as a Ramsar Wetland since 1984 and is divided into two different Ramsar areas. First an area of 135.000 ha consisting of the Wadden islands, the North Sea coastal zone and Breehaart. The second area, the actual Wadden Sea, is an area of almost 250.000 ha. A full view of the Ramsar Wadden Sea area is provided in Annex I, figure 4. Ramsar defines their concept of "wise use" as the maintenance of the ecological character of a specific Ramsar area, gained by the implementation of ecosystem approaches. This has to happen within the context of sustainable development. This means that Ramsars concept of "wise use" aims for conservation of the ecology, botany, zoology, limnology and hydrology (Article 2, paragraph 2 of the Ramsar Convention), but also for the sustainable use of wetlands and their resources.

Multiple criteria for identifying wetlands of international importance are drawn up by Ramsar. These criteria include a set of three criteria about species and ecological communities and two specially focused on waterbirds. Also fish have two specific criteria and other taxa are combined into one specific criterion (Ramsar, 2012b). Using these criteria, a wetland is considered as internationally important if it either supports species or ecological communities that are threatened, endangered, vulnerable or critically endangered or if there are populations of floral or faunal species that are important for the maintenance of the biological diversity in a certain area. A wetland is also considered internationally important if there is support of floral and faunal species during a critical stage in their life cycles. Specially for waterbirds, the international importance is depending on the fact that the wetland supports at least 20.000 waterbirds regularly or on the fact that the wetland supports 1% of the individuals of the world wide population of a waterbird species regularly.

The importance of a wetland in relation to fish is valid if either the wetland contributes to the global biological diversity of fish or if the wetland is an important place for fish in terms of food, nursery or spawning ground. Concerning other taxa, a wetland is considered important if it supports 1% of the individuals of the world wide population of a (sub) species that is wetland dependent, but non-avian, regularly.

In comparison to Natura 2000 and UNESCO World Heritage, no clear rules are stated if and how conservation and prevention should take place, nor are there specific rules for new projects. Although there is the aim to conserve not only the habitat but also the species in it, no real specification is given by Ramsar. But, in line with both Natura 2000 and UNESCO World Heritage, Ramsar aims for a better sustainable development of the area and therefore is open to economic opportunities.

2.5 *Natuurbeschermingswet*

Besides the global and European protection, the Wadden Sea is also protected by the Dutch Natuurbeschermingswet (Nature protection law) since 1998 and therefore gained the label "Staatsnatuurmonument" (State Naturemonument). An overview of this area can be seen in Annex I, figure 5. The Natuurbeschermingswet is a law that makes it possible to forbid or limit the activities in a certain area. For the Wadden Sea, Articles 16 and 17 are important (Waddenzee, 2012e). In Article 16, a large set of restrictions are drawn up and the role of permits is described. In Article 17, the rules concerning management plans are shown. By the use of this Article, areas are designated that are closed off for public entry part of a year or the whole year. Thus, Article 17 focuses more on important breeding areas of birds and marine mammals, while Article 16 focuses more on permits

and restrictions for recreationists (Natuurbeschermingswet, 1998). A major short-coming of this law is the lack of attention towards avian and non-avian species. Since the Natuurbeschermingswet only focuses on habitats, use of the Dutch Flora en Fauna Wet (Flora and Fauna Law) is necessary to gain a complete protection of the area. Nevertheless, since all areas of the Wadden Sea that are protected by the Natuurbeschermingswet are part of the Natura 2000 Wadden Sea area, the Dutch government decided to drop the status of Natuurmonument (Min. ELI, 2012c).

In comparison to the other regimes, the Natuurbeschermingswet shows very few possibilities for economic development. Although it's not excluded, the restrictions shown in Articles 16 and 17 gives rise to the presumption that the focus lies more on conservation and prevention, than on the possibility for economic development.

2.6 Economy-ecology problematics within the different conservation regimes

According to the Ministerie van ELI (2012d), the conservation of nature is standing in the way of economic and social development. Looking at the different protection regimes discussed in paragraphs 1-5, this is something that can be discussed.

With help of a multi criteria analysis (MCA), an overview can be given about the important aspects of the economy-ecology relationship in the different regimes (Table 2). To determine the most strict regime and the most important in terms of recreation, different values were given for the different aspects of the regimes.

The role of habitat, animals, birds, conservation and prevention is all equal and therefore gains the value 1. Since the next chapters will be focused on economic opportunities, this subject got a value of 2. But, since the filling in of the economic opportunities requires new projects, the legislation concerning new projects is regarded as essential. The different protection regimes can score a 2 (clearly present), a 1 (present, but not well defined) and a 0 (missing). In the overview given by the MCA table, it's clear that even though the ecology aspect is very important for every protection authority, they all show the aim to improve economic opportunities on a certain level.

Table 2: MCA of the different protection authorities.

Protection regimes	Habitat	Animals	Birds	Conservation	Prevention	New projects	Economic opportunities	Total Score
Value	1	1	1	1	1	essential	2	
Natura 2000	2	2	2	2	2	2	2	16
UNESCO World Heritage	2	2	2	2	2	0	2	0 (14)
Ramsar Wetland Convention	2	2	2	1	1	0	2	0 (12)
Natuurbeschermings wet	2	0	0	1	1	0	1	0 (6)

Throughout the remainder of this study, only one regime will be followed. The role of new projects is very important and was therefore rated as 'essential' in the MCA. Thus, regimes with a high score but a zero value on new projects will be cast aside. As a result of this requirement, Natura 2000 is the only remaining protection regime. Thus from now on, since the Natura 2000 regime was the only regime where separate rules for new projects were stated (HD Article 6, paragraphs 3 and 4), the rules and legislation provided by the BD and HD will be used.

The problem of economy and ecology interaction, was already discussed in a letter correspondence between former Prime Minister of the Netherlands, Jan Peter Balkenende, and President of the European Commission, José Manuel Barroso, in 2009. In this correspondence Jan Peter Balkenende stated that "Natura 2000 fails to strike a balance between ecological value, economic interests and other uses. This is due mainly to the wording of the precautionary principle" (Balkenende, 2009). Barroso stated that the precautionary principle in the context of the Habitats directive does not oppose a balance between ecological value, economic interest and other uses at all. He literally underscribed that by saying: "it should not represent an obstacle to sustainable economic development since plans or projects can be authorized when there is no evidence of significant adverse effects on Natura 2000 conservation objectives"(Barroso, 2009).

In 2011, the State Secretary for Economic Affairs, Agriculture and Innovation, Dr. Henk Bleker, proposed a ten point plan to the Dutch House of Commons to bring more balance to nature conservation (Bleker, 2011). By one of the points of this plan, it is indicated that if the conservation of a certain habitat type in the whole country is at an appropriate level, then it is allowed to have an impairment in certain areas of the same habitat type. This way, a better interconnection between economy and ecology is tried to be realized.

Looking at the different viewpoints of the Ministerie van ELI, the former prime minister of the Netherlands and the current State Secretary for Economic Affairs, Agriculture and Innovation, the main concern is the lack of economic opportunities. Nevertheless, as can be seen in table 2, all protection regimes show possibilities for economic development while keeping in mind the conservation and prevention. Thus, by filling in the rack and space that is existing in the legislation provided by the different regimes, the economic development is possible.

The next part of this study will focus on the existing plans and how those plans look at recreation as a form of economic development. Also, a continuous comparison to the conservation statuses stated in Tables 1a and 1b and annex II will be made.

Chapter 3 Governmental plans of conservation and recreation in the Wadden Sea

Multiple plans are made concerning the future of the Wadden Sea. Not only on national level, but even internationally, in cooperation with Germany and Denmark, plans were made for the conservation of this unique ecosystem. This chapter will describe four of those plans made for the Wadden Sea. Firstly the oldest plan by the Dutch ministerie van VROM (Ministry of Housing, Spatial Planning and the Environment), followed by a plan from the Regionaal College Waddenzee (Regional College Wadden Sea). After those two plans, the Trilateral Wadden Sea Plan, originated from the agreements made between The Netherlands, Germany and Denmark, will be discussed. The part of the plans will be finished with a future view drawn up in cooperation with Natuurmonumenten. A description of the most important aspects of the plans are given and compared to the options for economic development of recreation and (eco)tourism stated in each of the different plans.

3.1 VROM: "Ontwikkeling van de Wadden voor natuur en mens"

In 2007, the former ministerie van Volkshuisvesting, Ruimte Ordening en Milieubeheer (VROM) created a plan called "Ontwikkeling van de Wadden voor natuur en mens" ("Development of the Wadden for nature and people"). This plan is also known under the name: 'De derde nota Waddenzee' ('The third note Wadden Sea') (VROM, 2007a). The plan is a political approach to the conservation and the economic development of the Wadden Sea area. In figure 2 the area of interest in this plan, very comparable to the area of interest in figure 1, can be found, identified by the red lines.

This plan is a very rough sketch of what should be done and what should be prohibited, thereby giving a frame for further planning. It can be seen more as a guide for making plans than an actual plan of conservation and economic development. In this plan a few goals for the Wadden Sea are described. The main goal, as described by VROM, is a sustainable protection and development of the Wadden Sea as a natural area and the conservation of the unique open landscape. This means that policies aim for sustainable protection and a development that is as natural as possible of the following subjects: Water movements and corresponding geomorphic and soil processes; Quality of air, soil and water; Flora and fauna.

Besides that, the conservation of landscape qualities is very important and archeological and cultural historic aspects of the Wadden Sea have to be protected. This all, while maintaining the safety of the inhabitants.



Figure 2: Area of interest (pkb-gebied) for the plan drawn up by VROM (VROM, 2007a).

This main goal and its sub goals lead to two different policy choices. On one hand there are policies that focus on the space for nature and landscape, while on the other hand the policies focus on human activities.

For nature and landscape, it's necessary that the ecosystem develops in a natural way. This does not exclude human interference in the restoration of the area, but this interference should be done very selective. This means that human interferences should occur in such a way that the natural processes are being enhanced. The pollution of the Wadden Sea will be reduced to minimal amounts.

Policies for the space for human activities go a lot further. This varies from the creation of closed-off areas to recreation, fisheries, transport and reclamation.

Civil air traffic is allowed, but not on an altitude lower than 450 meters. Also no new civil airports are allowed to be built and no advertisement flights are allowed. Recreation should be promoted, but on a very sustainable way. This means that certain areas are prohibited. No yacht harbors can be established and rapid cruising areas will be adjusted. Fast cruising and motorized forms of recreation are only allowed around Oudeschild. The fast cruising area at Den Helder will be closed off (VROM, 2007a).

Thus it can be concluded that this plan is quite unspecific, but it is clear that even though conservation is very important, economic interference in the form of recreation should be allowed and promoted in a sustainable way.

3.2 *Regionaal College Waddenzee (RCW): "Léven in de Wadden"*

In 2008, the Regionaal College Waddenzee (Regional College Wadden Sea(RCW)) created the plan "Léven in de Wadden" ("Living in the Wadden"). This plan is partly based on the previously discussed plan by VROM. The ultimate goal of the plan proposed by the RWC is to protect and develop a robust and resilient natural area. In this area it should be possible to live, work and enjoy recreation in a healthy way (RCW, 2008). The plan focuses not so much on animals, but gives an idea about the habitats value and the unique aspects in term of recreation and tourism.

The conservation of ecosystems, habitats and species is divided into multiple areas. Yet, even though the whole area is divided into subareas, all subareas are demanding more or less the same conservation methods. Both the trenches and the dunes are requiring a lot of attention. This attention should be pointed at maintaining and recovering the natural processes. The RCW plan also states that the natural development of the morphology should be promoted. For recreation and tourism, the RCW sees multiple possibilities. An increase in the amount of shops should increase the livelihood of the area and thereby increase the tourism. Promotion of recreational activities could lead to an increase in this sector. This is especially the case for sustainable activities as mudflat walking. Infrastructure should be improved to obtain better routes for bicycles, boats and hikers. Also it is proposed to improve existing harbors instead of creating new ones (RCW, 2008).

3.3 *Trilateral Wadden Sea Plan (TWSP)*

The Trilateral Wadden Sea Plan (TWSP) was adopted in March 2010 and drawn up by the governments of The Netherlands, Germany and Denmark (Trilateral Wadden Sea Plan, 2010). The aim is to identify the targets of conservation and set up a detailed plan of conservation for each target of the Wadden Sea. The plan is drawn up for the whole Wadden Sea. The Dutch part of the Wadden Sea that is used in the plan, is the same as the area that is called 'pkb-gebied' (area of interest) in the plan of VROM (figure 2). While making the plan, attention was payed to the rules and legislation provided by the Habitats and Birds Directives and UNESCO World Heritage.

The TWSP separates the Wadden Sea environment into eleven groups with all their specific plan of conservation. These groups vary from broad subjects like Landscape and culture to small, specific areas like the tidal areas, offshore areas. Animals, namely birds, marine mammals and fish, are separate targets of conservation.

A more detailed explanation will be given here for the following groups. Firstly the different habitats that will be discussed are salt marshes, the tidal area, beaches and dunes and offshore areas. After the habitats the plan will be specified for birds, fish and marine mammals. By discussing these groups, all habitat types, fish and marine mammal species (Table 1) and birds (Annex II, tables 1 and

2) that are protected in the Wadden Sea will be discussed. The four remaining target groups (Landscape and Culture, Water and Sediment, Estuaries and Rural Area) are not discussed since the content of those 4 groups is not relevant to the subject in this study.

3.3.1 Salt marshes

The salt marshes area includes all salt marshes that can be found on the coasts of the mainland and islands. This includes the zone with the pioneer vegetation. Habitat types that can be found in the salt marsh area are H1310, H1320 and H1330 (Table 1). The salt marshes are strongly affected by biological and geomorphological processes and form the upper parts of the intertidal zone and the supralittoral.

Multiple conservation goals were set for the salt marshes as a habitat. Besides increasing the area of salt marshes with natural dynamics, the goal is also to maintain a full range of variety of salt marshes. This, because they are so typical for the Wadden Sea. On top of that it's necessary to strive for natural dynamics and natural morphology. This includes natural drainage of mainland salt marshes, but a reduction of the present surface area is not allowed. Also a variation in vegetation structure and favorable conditions for typical species should be achieved. No details are drawn up for recreation, but to reduce the damage caused by recreation, an information system and zoning is necessary.

3.3.2 Tidal area

The concept of tidal area includes all tidal flats and subtidal areas. Most of these areas are a part of the Natura 2000 area. The tidal area is build up from multiple habitat types, for example H1110 and H1140 (Table 1). The tidal area is the most characteristic habitat of the Wadden Sea and the tidal flats form the largest continuous stretch of mudflats (H1140) worldwide.

Three conservation goals were set for the tidal area as a habitat. Firstly the natural dynamic situation of the tidal area has to be preserved. Secondly the area with the tidal flats and subtidal areas that are both geomorphically and biologically undisturbed should be increased. The third and final goal for the tidal area concerns the natural mussel beds, *Sabellaria* reefs and *Zostera* fields (present on both H1110 and H1140). The aim here is to maintain their natural size, distribution and development.

The recreational and touristic activities in the tidal area are mainly boating and mudflat-walking. Hunting is mainly prohibited, but hunting for wildlife management and pest control are possible throughout the whole tidal area. Conservation of the tidal area is performed while taking in account the following rules for recreation: Zones where no recreation is allowed at all will be or are already established; Use of motorized equipment like jet skis and water skis are prohibited or very limited;

Water sports have to be balanced with the needs for conservation and bathing; Kitesurfing is prohibited or only allowed in special zones; There are speed limits for ships; Hovercrafts and hydrofoil crafts are forbidden; Information systems will further reduce disturbances and damage caused by recreation.

This will all be done, but experiencing nature and landscape should still be made possible, but by use of appropriate measures like spatial zoning and field guidance.

3.3.3 Beaches and dunes

The concept of beaches and dunes include all beaches, sandbars, beach plains and different types of dunes. This includes habitat types like H2110, H2120, H2130, H2160 and H2190 (Table 1).

The beaches and dunes provide habitats for many species and are important for both coastal defense and recreation. Therefore the conservation goals for these habitat types are firstly to increase the natural dynamics of beaches and dunes and all other corresponding habitat types in connection with the offshore zone. The second goal is to increase the presence of a complete natural vegetation succession.

In the beaches and dunes area, no clear rules about recreation are drawn up. Part of the management takes the demands of recreation and tourism into account. Nevertheless, 'hands-off management' should increase the natural situation in some areas. The disturbance and damages caused by recreation and tourism, same for the tidal area, should be reduced by the use of information systems and spatial zoning. This spatial zoning is an example of the 'hands-off management' where some zones are prohibited and some zones are open for recreation.

3.3.4 Offshore areas

The concept of offshore areas includes the range from the border of the tidal area to the seaward border of the Nature Conservation Area. This includes habitat types like H1110 and H1140 (Table 1). The water depth in the offshore area is mainly 10 meters, but there is a close connection between the tidal area and the offshore area. This is also reflected in the corresponding habitat types.. The conservation goal in this area is only to increase the natural morphology. This includes the outer deltas between the different island in the Wadden Sea. No rules are set up for recreation in these areas.

3.3.5 Birds

As described in chapter 1, chapter 2.1 and as can be seen in Annex II tables 1 and 2, there are a lot of bird species protected in the Wadden Sea area due to the BD. Of 5 different species, even more than 25% of the Northwestern European population is breeding in the Wadden Sea (Trilateral Wadden Sea Plan, 2010). These large numbers and the fact that the Wadden Sea is a very important area for bird species (Chapter 1, Chapter 2.1) are a reason for the large amount of conservational goals described in the Trilateral Wadden Sea plan.

These goals are mainly showing a demand towards more natural situations, leading to: Breeding success and survival determined by natural processes; A natural population supported by an undisturbed connectivity between breeding, feeding, moulting and roosting sites; Natural processes should determine the fluctuations in food stocks. This all while there is a stable or increasing number and distribution of the species.

Due to the fact that especially roosting areas are affected by recreation during the summer, multiple rules are set up. Also restrictions for hunting and civil air traffic are addressed. For recreation this means that clear temporal and spatial zoning should lead to a reduction in disturbance for the different bird species. Also, it's forbidden to drive with a car in breeding areas. Hunting of both migratory and non-migratory bird species is prohibited. The impact of civil air traffic will be further limited and no new civil airports will be constructed. Expansion of the civil airports is prohibited unless expansion is needed to maintain the safety. Minimum flight altitudes will be established and advertisement flights are forbidden. For helicopter flights, specific routes will be set up to reduce the effect to wildlife. Use of motorized water sports, kitesurfing and wind surfing are subjected to the same restriction as described in chapter 3.3.2.

3.3.6 Fish

The Wadden Sea is an area that supports functions like reproduction, breeding and feeding for many different fish species and works as an acclimation space for diadromous fish. The fish fauna in the Wadden Sea consists of approximately 150 species of which 13 are freshwater species.

The conservation goals in relation to fish focus on the population size and natural production. Living conditions for endangered species have to be improved and natural dynamics have to be maintained for the occurrence and abundance of the fish species. The diversity of natural habitats must be maintained for spawning and nursery functions. Besides that, it's also a goal of conservation to maintain and restore the passages for migrating fish from salt to fresh water. No goals or rules concerning recreation are drawn up in relation to fish. Yet, since fishery rules apply on this subject, also the sport fishing will be affected by those rules.

3.3.7 Marine mammals

For the marine mammals the focus lies mainly with the grey seal (H1364) and the harbor seal (H1365) (Table 1). The conservation goals for these species are to maintain viable stocks and a natural reproduction capacity of the marine mammal. This includes juvenile survival. Besides the viable stock of the marine mammals, also the quality of the habitats where the marine mammals live in should be conserved. No rules are set up for recreation in relation to these two marine mammals.

3.3.8 Conclusions TWSP

Looking at the most important aspects of the TWSP, described in paragraphs one to seven, it's clear that conservation is very important for the different habitat types, birds species and marine mammals. The measures described in this plan are also a lot more in line with the conservation statuses of the habitats, non-avian and avian species described in tables 1a and 2b and annex II. For most, if not all, of the unfavorable conservation statuses for the habitats and species, the plan is not only pointing out the necessary maintenance, but also improvements.

Large restrictions are placed on different types of recreation and tourism, for example on hunting, motorized water sports and civil air traffic. Nevertheless, there are multiple options for recreation in these areas that are not conflicting with the conservation of the specific habitat types or animal species. Although some types of recreation are completely prohibited, the rules apply in such a way that especially under supervision of tour guides, multiple ways of experiencing nature are still an option under influence of these plans.

3.4 Ministerie van ELI: Programma "Naar een rijke Waddenzee"

In 2010, the minister van ELI (ministry of economic affairs, agriculture and innovation) developed the plan Programma "Naar een rijke Waddenzee" (Program "Towards a rich Wadden Sea". This plan was created with help of the Dutch Natuurmonumenten (Naturemonuments) and the RCW. This plan is unique, since it shows a target scenario for in 2030 instead of a detailed plan of action (Ministerie van ELI, 2010).

The idea for 2030 is a Wadden Sea which is ecologically healthy, with clean water and very high species richness, while it's still a place where people can live, work and enjoy recreation. This demands conservation in multiple aspects of the Wadden Sea, especially the conservation of the trenches, mud flats and beaches and dunes. Recreation is mainly found in forms of hiking and cycling and multiple bird watching areas. Also the shape of the Wadden Sea and the dikes should change in such a way that multiple new areas for bird species are formed. Thus this plan, in contrast to the

other discussed plans, shows no real actions that have to be taken, but imply to a future scenario where recreation is mainly hiking, cycling and bird watching, while nature is developed in such a way that the different habitat types are maintained and improved.

3.5 Development plans for conservation and recreation in the Wadden Sea

Comparing the plans, multiple similarities can be found (Table 3). For conservation, all plans show the aim to maintain or increase the natural development of the Wadden Sea and the aim to maintain the natural dynamics and morphology.

On the level of recreation a real clear view is lacking in most plans. Only a short explanation of what takes place or should not take place is given, without a scenario how this will change in the future. Nevertheless, restrictions for civil air traffic (f.e. minimal altitude and no increase in the number of airports), renovation of yacht harbors, instead of additional ones, and improvements in the field of hiking and biking are common ideas for the development and restriction of recreation in the Wadden Sea.

Table 3: Overview of the conservation goals and plans/restrictions for recreation for each plan.

Plan	Conservation goal	Recreation plans/restrictions
VROM (2007)	Natural Development	Altitude of civil air traffic at least 450m
	Selective Human interferences	No new civil airports
	Minimal pollution	No advertisement flights
		Sustainable recreation promotion
		No new yacht harbors
		Adjusting rapid cruising areas
		Motorized water sports only available at Oudeschild
RCW (2008)	Maintenance and recovery of natural processes	More shops to lure tourists and recreationists
	Natural development of morphology	Promotion of recreation (f.e. mudflat walking)
		Better infrastructure (biking, hiking and boats)
		Improve existing harbors
TWSP (2010)	Increase area of most habitats	Information systems and zoning
	Maintain/increase natural dynamics and morphology	Maintaining recreation (boating, mudflat walking)
	Maintain/improve flora and fauna	Hunting restricted (unless wildlife management/pest control)
	Increase natural vegetation succession	Limit motorized water sports
	Viable stocks (maintenance and improvements) and reproduction of fish and marine mammals	Maximum speed limit for boats
		No cars in the breeding areas of birds
		Adjusting civil air traffic (see VROM)
	Special helicopter routes	
Min van ELI ("2030")	Ecologically healthy Wadden Sea	Improved hiking
	Clean water	Improved biking
	High species richness	Bird watching

Looking at the different plans for conservation and recreation in the Wadden Sea, the Trilateral Wadden Sea plan shows the most complete overview of the different targets for conservation and the most detailed overview of the restrictions and possibilities in the field of recreation. The details of conservation are more elaborated and more in line with the conservation statuses as described in tables 1a, 1b and annex II. Therefore, mainly the TWSP will be used as a comparison for the increase and adjustments of recreation in the Wadden Sea.

Now, with the different plans and their vision on recreation discussed, the following chapters will discuss recreation and economic development in this area in more detail.

Chapter 4 Recreation and impacts of recreation in the Wadden Sea

After discussing both the rules and legislation and the plans for the Wadden Sea, it is not excluded that there are possibilities for economic development in the area. Although there are many restrictions, the rack and space in both the legislation and the existing plans can perhaps be filled with recreation. Before filling in the rack and space in the Natura 2000 regime, an overview of the recreation that is taking place in the Wadden Sea right now is necessary. When the different forms of recreation that take place are discussed, an idea of the financial value of the Wadden Sea will be given.

Before a description of multiple forms of recreation is given, first a few comments have to be made. All recreation is influenced by spatial zoning. Some closed off areas are created and there is only 1 area remaining where fast cruising water sports can take place. An overview of the area can be seen in Annex III. Also, a lot of information is available on the number of tourists in the German and Danish part of the Wadden Sea. Yet, the amounts of tourists and recreationists in the Dutch part of the Wadden Sea are not well known. Information about these numbers vary from thousands of tourists (Waddenzee, 2012a) to millions of people (Ecomare, 2012b). Where possible, exact amounts are provided.

All recreation types that will be discussed have a certain impact on the environment, including flora and fauna. Yet, the impact can differ in space (small/large scale) and time (short/long term). Another possibility with the impact of recreation is that the effect is not direct, but indirect like for example pollution occurring due to throwing away garbage while hiking or biking.

Since there are many possible forms of impact, like impacts on flora, fauna, soil, air and water quality, the aim of this chapter is to describe the impact on either the flora, soil, air or water quality and the impact on the fauna in the area, with an indication of the space and time effects of the impact. A problem occurring while looking at the impact of recreation is the possibility of cumulative impact effects. Impacts that are not harmful by itself, can turn harmful when they are affecting the same area. There is not enough available to cover this subject and only a line of reasoning can be given on this point. Therefore, the impacts of recreation might be more problematic than can be discussed here.

Table 4: Overview of the different recreation types in the Wadden Sea.

Coastal recreation	Mid sea recreation
Swimming	Jet skiing
Sunbathing	Waterskiing
Biking	Kite surfing
Hiking	Sailing/boating
Surfing	Canoeing
Mudflat walking	
Sport fishing	
Civil air traffic	

Different forms of recreation can take place in the different areas of the Wadden Sea. Therefore, a distinction is made between recreation that is taking place in the coastal regions and in the mid sea regions. Nevertheless, some forms of recreation take place in both regions (Table 4). These form of recreation will be discussed separately.

4.1 Coastal recreation

In the coastal areas, meaning the area with the beaches, dunes and the start of the actual sea of both the mainland and the islands, multiple forms of recreation can be found (Table 4). Off course the basic types of recreation are taking place in these areas, namely swimming, sunbathing, biking and hiking. Although these types of recreation mostly take place on the different islands, a subject that is not part of the investigation, multiple bicycle roads can also be found on the shore of the mainland. Swimming and sunbathing can take place along multiple small beaches in Friesland and Groningen. Hiking can take place on multiple areas along the coastline (Waddenzee, 2012a).

Another important type of recreation is surfing. Surfing happens mainly along the coastline and only few surfers are starting from boats. There are multiple designated areas for surfing, with simple facilities like parking spots and dressing rooms.

4.1.1 The impact of hiking and biking

The impact of hiking and biking on an ecosystem can be pretty severe. A study in a Chinese protected area of the impact of hiking showed significant decreases in vegetation on the different trails in the reserve. Trails were made and the type of trail, namely pristine, flagstone and wooden trails, resulted in different effects on the vegetation. Although flagstone trails and wooden trails reduced the

damage to the roots of multiple plant species in comparison to pristine trails, damage still occurred (Li *et al.*, 2005). This result is comparable to a Finnish study that investigated different types of recreation on trails in a forest. Their result showed impacts so severely that on the trails for hikers, no vegetation cover could be found anymore. In comparison, horse riding, a recreation type that might be well implementable in a region like the coastal areas of the Wadden Sea, damaged the vegetation cover of the trail severely, yet it also created an opportunity for invasive species that might be harmful to the natural environment (Törn *et al.*, 2009). A sort like impact can also be found when looking at biking. A study about recreational mountain biking in America showed that about one third of the investigated areas a degradation of the environment could be seen. Yet, this is not the only impact taking of biking. In more than fifty percent of the areas, conflicts were reported between bikers and other recreationists (Chavez *et al.*, 1993).

Another problem of hiking, and in a certain degree biking too, is that the trampling can affect not only the vegetation, but also the soil. The trampling can make the soil more compact, reducing the porosity. Due to the reduced porosity, the water intake of the soil can decrease. This can lead to more soil erosion (Cole, 2004). The layer that is eroding is a source of nutrients for the vegetation, thus erosion of this layer under influence of trampling by recreation, can decrease plant growth by eroding of both the nutrient layer and the mineral layer (Cole, 1993). These effects of trampling occur rapidly, yet the regrowth in the trails is very slow, possibly due to erosion effect, unless human assistance takes place (Cole, 2004). This means that the effect of hiking and biking is both a short term as a long term effect. The scale of the impacts are small and are found mainly on the trail itself. Yet, due to the chance of indirect and cumulative effects, the impact can be large scale.

According to Edwards (1987), effects of trampling can mainly be found in areas with sand dunes and salt marshes. Those regions show the same effects on path erosion and horse riding.

But, not only negative effects can be found from trampling. Just like the study from Törn *et al.* (2009), a study in Australia showed that even though the existing species in the trail disappeared or were reduced, this gave rise to other floral species (Pickering *et al.*, 2011). This could indicate that a reduction of existing species and an increase of new species in the trail area, could lead to a higher species richness in the whole area.

Besides vegetation, hiking and biking also causes a risk to the different bird colonies. It is shown that fewer human contacts, so less disturbance, leads to more surviving offspring. Another problem with human disturbances is that general bird species, who are perhaps more used to human disturbances, can displace area-sensitive bird species (Cole, 1993).

The problem of cumulative impact effects can be explained by the impact of hiking on birds. On the one hand there is the effect of stress on birds due to hikers. On the other hand you can have trampling effects on the trail. This trampling can reduce the porosity of the soil in such a way that the vegetation cover will reduce. Due to the reduced vegetation cover, birds have less places to hide or find their food. This can also negatively affect the survival rate of the different birds in the Wadden Sea area. Due to the cumulative effect of these two impacts, the actual impact of hiking and biking on birds can turn out more severe than first thought.

So, multiple forms of impacts can be found when investigating hiking and biking. Most effects can be found on vegetation, but also the effects on soil and bird species are clear. Yet, the impacts are not always by recreationists on nature, but also by recreationist on other recreationists. Hikers and bikers can be a really bad combination if they use the same trails, since speed differences can lead to considerable inconvenience. Another impact that is not well investigated but could cause multiple environmental problems, is the fact that both hikers and bikers can pollute the area by the dumping of trash.

4.1.2 The impact of swimming, sunbathing and surfing

Swimming is a very common activity, but can have some disadvantages. Especially on the area of contamination, swimming, partly in relation to sunbathing, can turn out to be a problem. According to Priskin (2003), swimming can contaminate the water with materials like oils, soaps and feces. Liddle (1997) points out another problem that can be compared to the problematics with hiking. Due to the walking towards the water and walking in the undep parts of the sea, coastal plants get trampled.

The same counts for surfing, that is commonly done on the same areas. Keeping in mind the trampling of the plants, also the contaminations described by Priskin (2003) can be found for surfing. What makes surfing more harmful in comparison to swimming is the use of equipment, which can disturb the wildlife. Both swimming and surfing can be harmful to the vegetation and dunes when enough parking space and roads are not at hand (Priskin, 2003).

Another harmful impact can be found in relation to the birds. Especially waders can be heavily influenced by crowdedness along the coastline. A study in a wetland in Argentina showed that bird species that are waders and thus need the coastline as a source of food, were not present in the area during days with high disturbance (high crowdedness). These bird species could only be found in the area during days with low disturbance (Cardoni *et al.*, 2008).

The scale of the impact of swimming, sunbathing and surfing can vary from small scale (trampling of the vegetation) to large scale (contamination of the sea). The regrowth of the trampled coastal plants will be a long term effect. Other impacts (contamination, chasing away birds) are mainly short term. The same cumulative impact as with hiking and biking might be present where the trampling can lead to reduced vegetation, possibly leading to increased bird mortality.

4.2 Mid sea recreation

Other major forms of recreation can be found in the open water or mid sea areas (Table 4). Here multiple forms of motorized water sports, non-motorized water sports and other recreation types take place.

Most of these water sports are taking place in specifically designated areas or at least are prohibited in some others. As can be seen in Annex III, multiple regions are closed off (the yellow areas) for every type of recreation. Oudeschild, a region around the southeastern shore of Texel, is the only area that is designated as a fast cruising area. Thus, extreme water sports, like jet skiing, waterskiing and other sort like motorized sports are only allowed in that specific area (VROM, 2007b).

For kite surfing, a few other rules are applying. This type of sport was forbidden until 2006, but since 2009 four different areas are designated specially for kite surfing (Rijkswaterstaat, 2012).

These areas are:

- Westzijde veerdam Nes (Ameland)
- Groene Strand (Terschelling)
- Westerzeedijk (Harlingen)
- Hoek van de Bant (Dongeradeel)

The maps of these areas (Waddenzee, 2012d) can be seen in annex IV.

Other types of water sports that can be found in the Wadden Sea are sailing/boating and canoeing. Sailing/boating takes place in specific zones and channels with a maximum speed of twenty km per hour. In concreted channels and the routes taken by the different ferries, sailing is allowed without a maximum speed. About 100.000 lock passages were counted in 2000 (Stuurgroep Waddenprovincies, 2001). This is a growth of 44% in comparison to 1982. This indicates that the recreational fleet has increased over the years. The size of the recreational fleet is estimated at 2500-3500 boats during the weeks that sailing is most common (mid July-mid August).

Canoeing is done on specific routes far from the flood refuges. Almost all canoeists are part of a canoe union. These unions are willing to participate to create a code of conduct for their members.

4.2.1 The impact of jet skiing, waterskiing and other motorized water sports

As can probably be expected, the impacts of motorized water sports can be enormous. This also explains why there are very few fast cruising areas and extreme water sport areas in the Wadden Sea. When talking about the impact of motorized water sports, the noise, the fumes and the vibrations are three very common negative impacts. But also oil spills and paint leakages are part of the problem (Priskin, 2003). Especially shallow environments and both wildlife and whole food webs can be disturbed by the impact of motorized water sports. As described by Davenport and Davenport (2006), these types of sports can do excessive harm to both marine mammals and birds. Accidents by jet skis, water skis or power boats with marine mammals are quite common, with their death as a result. Accidents like these are decapitations by propellers or blunt trauma by a power boat or jet ski. Besides the severe risk towards marine mammals, the birds suffer from visual and acoustic disturbances. Especially during breeding season the impact of motorized water sports can be harmful to bird colonies. On the other hand, exploratory research done by Henkens *et al.* (2007) indicated a chance of tolerance towards noise by different bird species. Power boating can also cause small damage in sand dune areas, salt marshes and mudflats (Edwards, 1987). The effects will mainly be short term, but their scale can vary.

4.2.2 The impact of kite surfing

Although kite surfing might not seem so harmful to the environment since it's not motorized, multiple negative impacts can be seen in relation to the bird populations present in the specific area. For example a study in the Dee Estuary (West Kirby shore, England) showed multiple impacts of kite surfing for the neighboring bird colonies. First of all the size of the kite is about 5 square meters and flying around 30 meters in the sky. Although the actual bird perception is unknown, it can't be excluded that the bird species can identify the kite as a huge predator. Another cause of stress in the bird colony can be the location of the kite. The kite surfer himself may be far away from the nesting birds, the kite on the other hand, since it's on an altitude of 20-40 meters, can be blown much further towards the colony, causing stress to the nesting birds. Besides these perception impacts, also noise can turn out stressful for the birds in the area. Losing control of the kite causes the kite to tumble down, sometimes crashing in the water. Such crashes go hand in hand with considerable noise. Thus, although there are uncertainties, the impacts of kite surfing can turn out quite harmful (Smith, 2004). Besides that, kite surfing has the potential to cause small damage in salt marshes and mudflats are moderately sensitive for damage (Edwards, 1987). The impacts will probably be short

term and only small scale. Stress will be reduced once the kite is gone again and the kite will only affect a small area.

4.2.3 The impact of sailing/boating

Multiple examples of the impact of sailing/boating on birds and marine mammals can be found. For example an area in England, where sailing was previously forbidden, became almost deserted by some bird species, after sailing was allowed (Priskin, 2003). Slower marine mammals, like the dugongs in the Great Barrier Reef, are not able to dodge fast cruising boats. Even with moderate speeds reached by boats like catamarans, collisions can't be ruled out. In for example turbid water, species like the dugong cannot take evasive actions in time to dodge a high speed sailing craft. Nevertheless, other reasons like weather conditions cannot be excluded to play a role in these collisions (Preen, 2000). There is a small chance that mudflats and salt marshes experience damage due to sailing (Edwards, 1987). Just like the paint leakages from the boats used by motorized water sports, paint leakages cannot be excluded here (Priskin, 2003). The effects can be short term, since birds that are scared away can come back, yet according to the example given by Priskin (2003), long term effects are also possible. The scale, since sailing and boating can happen in many areas, will be large.

4.2.4 The impact of canoeing

There are little to no problems caused by canoeing. This is mainly due to the work of unions who arrange tours that are far away from areas that are protected (waddenzee, 2012a).

Nevertheless, there is a small possibility for damage to salt marches and mudflats (Edwards, 1987)

4.3 *Overlapping recreation*

Some forms of recreation are happening both in the coastal areas as the mid sea areas (Table 4). Such recreation types are mudflat walking, sport fishing and civil air traffic.

As could be seen in the different plans discussed in chapter 3, civil air traffic is limited by a few rules. Such as an altitude of 450 meters and no new civil airports are allowed to be build. Nevertheless, some sources even state that all civil air traffic is forbidden (waddenzee, 2012a). Therefore the impact will not be discussed.

Mudflat walking, where you walk on the mudflats during ebb, happens only on specifically designated routes. These tours are often towards one of the different islands, but there are also options for stray tours and educational excursions. These happen in the vicinity of an island or the coast of the mainland. Due to the risks of these excursions, a guide is required (Waddenzee, 2012b).

Every season, about 50.000-75.000 people are participating in a mudflat walking tour. This is the maximum amount that is allowed as a result of agreements made by the multiple mudflat walking organizations and the provinces of Friesland, Groningen and Noord-Holland (Waddenzee, 2012a; Waddenzee, 2012c).

Sport fishing mostly takes place around the coastline, but some fishermen are taking their boat to mid sea regions. Fishing happens in the whole region and often close to channels and wreckages (Waddenzee, 2012a). The sport fishing fleet in 2000 counted approximately 25 open motorboats and about 60-65 commercially exploited ships that accommodates 12 to 75 fishermen.

4.3.1 Mudflat walking

The impact of mudflat walking is very small. Trampling and path erosion, the two main impacts of hiking in a terrain, are showing little or no impact on mudflats (Edwards, 1987).

The effect of mudflat walking on the presence of birds is a short-term effect. A study to identify this effect showed that the bird population is scared away at the time of disturbance, but is getting back towards it's normal size after 30-120 minutes (Pouwels and Vos, 2001) Besides that, mudflat walking organizations decided that no more than 75.000 people can walk upon the mudflats as described in more detail in chapter 4.1 (Waddenzee, 2012b).

4.3.2 Sport fishing

The impacts of sport fishing can partly be compared to boating and sailing. Besides those impacts, results of sport fishing are also the decline of fish stocks and pollution by discarding fishing equipment like fishing lines and plastics. These lines and plastics are a cause of animal entrapment, leading to increased starvation, predation and disabled animals (Priskin, 2003). Another negative aspect of sport fishing is the digging for bait in the area, possibly causing damage to salt marshes and mudflats (Edwards, 1987). These impacts will be long term, since plastics can drift in the sea for a long time. The scale, since plastics can drift far away will be large. There can be a cumulative impact if the pollution of the water turns out to be a death cause of different fish species, leading to even further declining fish stocks.

4.4 Economic value

Determining the actual value on the other hand is tough. For example the intrinsic value of the Wadden Sea as a natural area can't be defined in financial profits. Yet what easily can be defined are the financial benefits that can be gained by tourism and recreation.

In a study done by Kuik *et al.* (2006), the benefits of the Wadden Sea and the Delta area are calculated. They estimated that the value of these areas, by estimating the value of environmental functions and the value of the safety and recreation, is around €3.228 per hectare per year. This means that in the Wadden Sea, the Natura 2000 area of 272.449 ha can generate a profit of approximately €879.5 million per year. What should be pointed out is that this €879.5 million per year is a value obtained by estimating the values of resources, recreation, environment, environmental functions and non-use values. This means that the actual value for recreation and tourism in the Wadden Sea will be a lot lower. In the same study, Kuik *et al.*, estimate the actual value of recreation in the Natura 2000 area of the Wadden Sea on only €647 per hectare per year, leading to a total value for recreation of €176.3 million per year.

A study by the Ministerie van Verkeer en Waterstaat (Ministry of Transport, Public Works and Water management) that calculated the profits gained from recreation and tourism in the Netherlands showed that 24% of all money spend on recreation is water related, leading to €3.9 billion per year. About €12.5 billion was earned from non-water related recreation (Ministerie van Verkeer en Waterstaat, 2002). They showed that only the water related recreation in the Wadden Sea already accounted for €218 million per year, this excludes all terrestrial types of recreation that can take place in the Wadden Sea area, thus profits have the potential to exceed €218 million per year in the Wadden Sea.

The difference in total value between Kuik *et al.* and the Ministerie van Verkeer en Waterstaat can perhaps be explained by the definition of the area. In the study of Kuik *et al.*, it's said that only the Natura 2000 area was investigated. The study done by the Ministerie van Verkeer en Waterstaat does not explain what the actual area of interest has been. This makes it possible that water recreation in a part of the Wadden Sea that is not part of the Natura 2000 area causes the potential total value to be a lot higher. Yet, this is uncertain.

4.5 Conclusion

Table 5: Overview of the impacts of the different forms of recreation

	Hiking and biking	Swimming, sunbathing and surfing	Jet skiing, waterskiing and other	Kite surfing	Sailing / boating	Canoeing	Mudflat walking	Sport fishing
Direct impact	Reduced soil porosity	Contamination of water	Contamination of air/water	Predator misconception	Contamination of water		Disturbance of birds	Pollution with fish lines
	Reduced vegetation cover	Trampling of vegetation	Vibration effects	Stress due to kite presence	Scaring away birds			Pollution with plastics
	Increased bird mortality	Wild life disturbance	Collision chance	Noise stress	Collision chance			Digging in soil for bait
			Visual/acoustic disturbance					Decline of fish stocks
Indirect impact	Soil erosion							Decline of fish stocks
	Vegetation change							Entrapment of fish/marine mammals
	Species displacement							
	New species							
Time (term)	Varying	Varying	Short	Short	Varying		Short	Long
Scale	Small (indirectly large)	Varying	Varying	Small	Large		Small	Large
Cumulative impact	Porosity can reduce the vegetation cover, leading to increased bird mortality	Reduced vegetation might lead to increased bird mortality						Pollution might enhance declining fish stocks
References	Li <i>et al.</i> (2005), Törn <i>et al.</i> (2009), Chavez <i>et al.</i> (1993), Cole (1993), Cole (2004), Edwards (1987), Pickering <i>et al.</i> (2011)	Priskin (2003), Liddle (1997), Cardoni <i>et al.</i> (2008)	Priskin (2003), Davenport and Davenport (2006), Edwards (1987), Herkens <i>et al.</i> (2007)	Smith (2004), Edwards (1987)	Priskin (2003), Preen (2000), Edwards (1987)	Waddenzee (2012a), Edwards (1987)	Edwards (1987), Pouwels en Vos (2001), Waddenzee (2012b)	Priskin (2003), Edwards (1987)

Looking at the overview of the impacts of the different forms of recreation (Table 5), what can be seen is that there are mainly direct impacts to be found. A common impact is the contamination of either water or air. The effects of these contaminations could turn out more severe, due to the cumulative possibilities.

Now with the information about the legislations present, knowing what the plans are and what types of recreation are taking place and their corresponding impacts on the environment, the marine mammals and the birds, an overview can be made to determine the possibilities for improved economization on the level of recreation.

Chapter 5 Options for economic development in the Wadden Sea

Now, knowing the impact of the multiple forms of recreation that are already taking place, a reconnaissance of the options can be made to determine if it is possible to fill in the rack and space in the Natura 2000 legislation. In this chapter, the focus will lie on the possibilities to maintain, expand or replace the recreation type. In the end, a small overview will be given of the options for recreation in the Wadden Sea.

5.1 Coastal recreation

Table 6: Overview of the impacts of coastal recreation and possible alternatives, with (D) as direct and (I) as indirect impacts. The arrows indicate possible relationships that can increase the effect of the impact.

Activity	Effect medium	Effect vegetation	Effect animals	Remaining effects	Alternatives
Hiking/biking	Reduced porosity of soil (D)	Reduced vegetation cover (D)	Increase mortality rate of birds (D)	Mainly effects Sand dunes and salt marshes	None, additions possible with good zonal management
	Soil erosion (I)	Vegetation changes (I)	Species displacement (I)		
		Slow regrowth (D)			
Swimming, sunbathing and surfing	Contamination of the water with oils, soaps etc. (D)	Trampling of vegetation in the waterline (D)	Wildlife disturbance (by use of equipment) (D)		Pedaling
		Trampling of vegetation due to parking (D)	Disturbance for waders (D)		

5.1.1 Hiking and biking

Looking at the impacts of hiking and biking, reduced vegetation cover and soil adjustments are the biggest problems occurring in relation to the medium and the vegetation (Table 6). But, the reduced vegetation cover also gives the opportunity for other flora species to grow in the area. This change in species composition could perhaps be more interesting than the vegetation that you lose in the process. To reduce the effect of trampling in areas that are not desirable, fences could be applied as a method of zoning. By doing this, not only the trampling effects in the whole area can be reduced, but it can also make the protection of rare bird species (Annex II) easier. Yet, it will reduce the

attractiveness of the area. To improve the attractiveness, natural fences can be a solution. Yet if you introduce new species to form the natural fences, other problems could arise that can nullify the profits gained by natural fences. Since the influences of this type of recreation can be kept in line, by the use of zoning, no reduction in this recreation type might be necessary.

It is even possible to suggest an expansion of this form of recreation. Horseback riding has sort-like influences on the vegetation on the trails as hiking and biking, but going off-road is more unlikely. This would mean that by the use of the same trails as for hiking, another subform of recreation is possible. Yet, the influence of horses on birds and also the possible effects of feces should be investigated in more detail before setting up special horse riding routes.

If there are possibilities to pave some trails without doing much harm to the surroundings of the trail, you will lose the positive effect of the new vegetation on the trail, yet new options are implementable. Due to the construction of paved trails, recreation types like skating become more freely available in the region. The same trails can be used by bikers and for horse riding and perhaps for hiking. Yet, skating is not recommended on the existing hiking trails. By the adjustments to the trails recommended for skating, multiple age groups can enjoy nature by the use of inline-skates, rollerblades or skateboards.

To make the trails for hiking and biking and possible other forms of recreation more interesting and at the same time raise awareness and understanding of the closed-off areas, bird watching points with information signs can be placed at certain points. By raising awareness of this kind, off-road hiking might be reduced. Besides that advantage, by providing special areas where birdwatchers can enjoy themselves while reading what they are actually looking at, the areas with the endangered species can be left in more peace, solving part of the problems with birds that are caused by recreation types like hiking and biking.

5.1.2 Swimming, sunbathing and surfing

As can be seen in table 6, recreation types like swimming, sunbathing and surfing can cause multiple problems. Yet, there is hardly any method to prevent contamination of the water or trampling the vegetation in the waterline. But, some adjustments to these recreation types can be made.

To keep the trampling of vegetation as small as possible, at least at every large place where people can go swimming and sunbathing, an acceptable amount of set parking area should be made. This, so that trampling of the area can be hold inside a certain limit. The need for parking spaces is highest for areas where surfing takes place. Small beaches where people can only swim and sunbath, parking

can be situated further from the actual beach, since these people can easily walk towards the coastline. Exceptions have to be made for disabled people. This can be done by creating a small parking space for disabled people, closer to the shore. But for surfing, heavy equipment is necessary and often these types of recreationists will not want to walk a long way before reaching the shore. Thus, to reduce the trampling of the area due to illegal parking for surfing equipment, areas have to be designed where trampling of the vegetation is not as big of a problem, close to the shore.

To reduce the impact on bird types, it is possible that the amount of areas where swimming, sunbathing and surfing can take place has to be reduced. Especially areas with rare bird species should be closed off for the public. Such areas include the areas where waders are very common and are affected by the recreationists.

An additional form of recreation that can take place in the coastal regions is perhaps pedaling. At a few beaches, the rental of pedal boats could be possible. Pedal boats are an easy form of water recreation without a motor. Due to the fact that there is no noise, this might be a good form of recreation in relation to the different birds.

Although the options for intensification are sounding very promising when looking only at the impacts, a few problems still remain in regard to these coastal regions. First of all for recreation forms of hiking and biking, there are multiple relationships between the possible results of trampling. This risk of cumulative impacts is not investigated, yet it can put a large strain on the environment. Another problem concerning the coastal forms of recreation are the different conservation statuses of the habitat types. Multiple dune habitats (H21XX, Table 1a) have an unfavorable conservation status and therefore should be improved. This problem can also be found when looking at the birds (Annex II). Assessments of the different forms of recreation may reduce the options for further recreational development.

5.2 *Mid sea*

5.2.1 Jet skiing, water skiing and other motorized sports

Due to negative impacts (Table 7) like the contamination of air and water and many possible problems concerning the animals in the area, all types of motorized sports are very limited. The effect of vibrations, the risks of collisions and the visual and acoustic disturbances are forming such a large risk, that adjustments for economic development might not be an option. Yet, as long as these

types of recreation stay away from endangered bird species (Annex II) and the H11XX habitat types (Table 1a), a reduction in recreational activity might not be necessary.

Table 7: Overview of the impacts of mid sea recreation and possible alternatives, with (D) as direct and (I) as indirect impacts. The arrows indicate possible relationships that can increase the effect of the impact.

Activity	Effect medium	Effect vegetation	Effect animals	Remaining effects	Alternatives
Jet skiing, water skiing and other motorized sports	Contamination of air (fumes) (D)		Effect of vibrations in the water on the fish and marine mammals (D)	Possible small damage to sand dunes, salt marshes and mudflats	No motorized water sports can replace the present types
	Contamination of water (oils, paint) (D)		Collisions with marine mammals (D)		
			Visual and acoustic disturbance birds (D)		
Kite Surfing			Predator misconception (D)	Potential to cause damage to salt marshes and mudflats	Skimboarding
			Stress due to kite presence (D)		
			Noise stress (D)		
Sailing and boating	Contamination of water (paint) (D)		Scaring away birds (D)	Small chance on damage to mudflats and salt marshes	Not necessary with good zoning
			Collision chance with marine mammals (D)		
Canoeing				Possible damage to salt marshes and mudflats	No need

5.2.2 Kite surfing

Looking at kite surfing, the actual impact is not well known (Chapter 4.2.2). Yet, since there are enough possibilities for negative effects (Table 7), the accessibility is limited by law. This accessibility should not be adjusted, as long as the effect of kite surfing is not well known.

Another possibility for recreation, a little comparable to kite surfing, is skimboarding. Although skimboarding is not as exciting as kite surfing in terms of speed, the problems with skimboarding are possibly less severe. Without a kite, misconception for a predator is not an issue anymore. Also the noise will disappear in comparison to kite surfing. Due to the shallow depth of the boat, the risk towards mudflats can possibly decrease too. But, more research has to be done on this point.

5.2.3 Sailing and boating

Looking at the negative impacts of sailing (Table 7), the problems are mainly with animals. Also contamination of the water due to paint leakages (or oil) can be a big problem. According to the study done at the UK heritage coast (Edwards, 1987) sailing and boating could scare the birds away. The scenario described in that study is quite harsh, since they claim that all birds disappeared in the area. More information should be gathered about this phenomenon, but as long as the sailing and boating takes place in areas where there is no problem with the present bird species, sailing and boating can turn out less problematic for birds.

For the collision chance with the marine mammals that are living in the Wadden Sea, more information should be gathered. Improving the sailing and boating as a recreation type is not possible, since large parts of the Wadden Sea are already available, but with a little more research on the specific area and the corresponding species, there will not be a problem if the recreational boating stays as it is.

5.2.5 Canoeing

Canoeing is by far the least damaging form of mid-sea recreation (Table 7). The only possible damage is small damage to salt marshes and mudflats. Yet, still there are very few canoes on the Wadden Sea. So, more advertising with this recreation type can be an easy way to create economic development.

Another way, to ensure that the damage to the environment stays slow, is to arrange more guided tours. By the use of guided tours, the canoeing becomes safer, since people are not alone and damage to the environment can be reduced since the guide knows where to and where not to go.

5.3 Overlapping recreation

Table 8: Overview of the impacts of overlapping recreation and possible alternatives, with (D) as direct and (I) as indirect impacts. The arrows indicate possible relationships that can increase the effect of the impact.

Activity	Effect Medium	Effect Vegetation	Effect animals	Remaining effects	Alternatives
Sport fishing	Pollution water with fish lines (D)		Decline of the fish stock (D/I)	Possible damage to salt marshes and mudflats	Seal Spotting Sightseeing tours. But not really necessary, since sport fishing is not common enough to pose a real threat
	Pollution water with plastics (D)		Entrapment fish and marine mammals (I)		
	Digging in the coastal soil for bait (D)				
Mudflat walking			Short-term disturbance effect on birds (D)		No need

5.3.1 Mudflat walking

Mudflat walking is a pretty harmless form of recreation (Table 8). The only effect of mudflat walking can be found in relation to birds and this is only a short term effect. Yet there are arrangements between different mudflat walking organizations, making adjustments to this type of recreation difficult. Nevertheless, the advice can be given to the different organizations to adjust their arrangements and let more people enjoy the Wadden Sea by increasing the maximum amount of individuals per season who can go mudflat walking.

But, the possibility of increasing negative effects should be investigated in more detail before real statements can be made about adjusting this recreation type. For example the unfavorable conservation status of the tidal area may cause an assessment of mudflat walking to turn out negatively.

5.3.2 Sport fishing

Multiple big problems are arising with sport fishing (Table 8). The pollution of the water with fish lines and plastics can cause unnecessary deaths to the fish and marine mammals, due to entrapments in the plastic and fishing lines. Besides a possible decline of the fish stocks, some fisherman will dig for bait in the areas.

Looking at these impacts, it would be recommendable to ban digging in the salt marshes and mudflats for bait. Since the amount of fisherman is pretty small (Chapter 4.3) and decreasing over the years, an adjustment in the maximum amount of sport fisherman might not be necessary. Yet, with better restrictions on the pollution of the water, multiple problems can be solved. By doing this, an intensification of sport fishing is certainly possible in the rack and space of the Natura 2000 legislation. A side note here is that of course attention have to be paid to the fishing stocks.

A possible additions in the field of sport fishing can be marine mammal spotting. With the larger fishingships, for 12-75 fisherman, tours can be made. Either combinations can be made, where the fishing gets combined with for example seal spotting, or the fishing boats can be used as tour boats for seal spotting when they are not used for fishing. This does not have to be limited by seal spotting only. Sightseeing tours across the Wadden Sea is also an option. This is already done, but an expansion of this recreation type is certainly an option. This way the ships that are no longer in use due to the reduced interest in fishing can be used for other properties and more people can enjoy a trip on the Wadden Sea.

5.3.3 Civil air traffic

There are many uncertainties with regard to recreational flying. Where some sources are speaking over an embargo on civil air traffic (waddenzee, 2012a), other sources, like for example the plans from chapter 3 are only talking about restrictions. Assuming that these plans work with the most up to date rules and legislation, civil air traffic would be possible.

Yet, zoning is essential to keep the impact on birds as small as possible. The altitude should, as the development plans indicated (chapter 3), always be above a specific line to keep the disturbances to the bird colonies as small as possible. This has to be investigated into more detail before final conclusion can be drawn.

Table 9: Overview of the adjustments, replacements and additions of the different recreation types.

Zone	Recreation type	Adjustments	Replacements	Additions
Coastal	Hiking and biking	More zoning by use of fences		Horseback riding
		Paving of some roads		Skating
		Bird watching areas with information signs		Bird watching + information of the area/birds
	Swimming, sunbathing and surfing	More set parking areas		Pedaling
		Reducing the amount of areas		
Mudflat walking	Increase limit			
Mid sea	Jet skiing, water skiing and other motorized sports			
	Kite surfing		Skimboarding	
	Sailing and boating	None if zoning is done properly		
	Sport fishing	Ban on digging for bait		More seal spotting/ sightseeing tours
		Better rules against pollution		
		Increased limits		
Canoeing	Intensification			
	Advertizing			
All	Civil air traffic			

5.4 Conclusions

So, as can also be seen in the overview provided in table 9, intensification of multiple forms of recreation can take place, as long as certain adjustments are provided. Besides adjusting the present recreation so that their intensity can increase, there are also options available for additional recreation. Given these possible adjustments for intensification and additional recreation types, it can be concluded that the rack and space in the Natura 2000 legislation can be filled in by increased recreation to achieve economic development in the Wadden Sea.

Recreation can be improved by replacing skimboarding for kite surfing in good areas where kite surfing is not possible due to the impact on bird species, by increasing hiking and biking, swimming, sunbathing and surfing and canoeing. Also, if it falls within the possible limits, sport fishing can be increased. Recreation in the Wadden Sea can also be improved by the addition of horseback riding, skating, bird watching, information signs about the area, pedaling, seal spotting and sightseeing tours. Nevertheless, all forms of recreation have to be further investigated by use of a nature assessment, to get better insights in the effects of cumulative impacts and the effects on the different habitat types and both avian and non-avian species. In line with Article 6 of the HD, multiple options may turn out as impossible, due to not thoroughly investigated impacts.

Chapter 6 Discussion

A first note that should be made is that recreation is not the only option for economic development in the Wadden Sea. Many other options are taking place or can perhaps take place, like military training activities, gas extractions, wind mill parks, agriculture and fisheries. The impacts and gains of for example gas extractions and wind mill parks are very different from recreation and therefore can't be compared to the conclusions that are drawn in this study.

The conclusions that are drawn in relation to recreation are only focused on the Dutch part of the Wadden Sea. Conclusions about the options for increased recreation in the Dutch part of the Wadden Sea can't be used for adjustments to recreation in the German and Danish Wadden Sea. On top of that, by excluding the inner regions of all the islands, possibly multiple forms of recreation are excluded. When talking about recreation types at the inner regions of the island, options are for example hunting and a large area where hiking, biking, horse riding, skating and whatever more can be possible. When talking about hunting, possible targets are the roe deer, rabbits and perhaps birds (waddenacademie, 2011).

A problem with the impacts on the environment is that for each recreation type their own impacts are investigated. This means that the cumulative impact of recreation stays unknown. The impacts can accumulate in a way that two different types of recreation are affecting the same region, thereby causing a larger impact than that they do by themselves. But the impacts can also accumulate with other activities besides recreation. Since the focus is on recreation only, the possible cumulative impacts formed by recreation and other activities is not investigated. This can severely influence the outcome of this study.

Another problem is the lack of knowledge on some subjects. Overall there is a lack of Wadden Sea specific information. The impact of only a very few forms of recreation are really investigated in the Wadden Sea area. For other types of recreation, comparisons have to be made with other ecosystems. Although an attempt was made to search for sort-like ecosystems, the Wadden Sea is a unique area, thus comparing this area with other ecosystems can lead to misconceptions towards the impact of recreation. This is aggravated by the lack of knowledge on the impact level. Mainly direct impacts are discussed, with their effects on the flora and fauna. Indirect impacts, causal relationships and the time and space of the actual impact are rarely described.

For multiple types of recreation, specific zoning is important to reduce the impact on the different habitats and multiple bird species. Although roughly all habitats are known, the major problem with zoning occurs with the different bird species.

As can be seen in Annex II, of multiple species of birds only a few dozens of birds or a few hundreds of pairs are populating the Wadden Sea area. Some species have even less than 10 pairs in the Wadden Sea. In comparison, some species go over even 10.000 pairs in the Wadden Sea area. Impacts on a bird species with only 200 pairs are probably a lot more problematic than the impacts on a bird species that is very common with over 10.000 pairs. Impacts on very rare species like the northern harrier are likely to be disastrous for the survival of that species of birds in the Wadden Sea area. The importance of such zonal restrictions are shown by a study of the human disturbance in Florida (Rodgers and Smith, 1995). In this study, they created a model that could calculate the distance that a source of human disturbance should be in relation to a colony of breeding waterbirds. Due to their high-density nesting habits, the effect of disturbance is immediately effecting a large amount of birds. The model showed that the waterbirds were more disturbed by hikers than by approaching motor boats. This supports the claim that zoning is crucial to improve multiple recreation types .

With the use of detailed maps that show where different bird species are situated the most, zoning becomes more easy to do. Only after the creation of such detailed maps, real plans can be made to determine the increase and adjustments on recreation in the Dutch Wadden Sea.

A problem coinciding with the detailed maps is civil air traffic. There is very few information available on the impacts of civil air traffic on different bird species. Impacts like air pollution and noise are possibly two problems concerning the survival chances of different bird species. Environmental noise can influence the singing, and thus the communication, of the birds in a colony (Brumm, 2004). This study showed that the singing of birds is affected by environmental noise in a way that birds in an area with higher noise levels are singing with a higher amplitude than birds in an environment with less noise. This study suggested that the level of environmental noise contributes to the quality of the territory, thereby affecting the behavioural ecology of the bird species.

Although the noise provided by airplanes are only short-term, this could possibly still play a role for the bird colonies in the Wadden Sea. Therefore, more research should be done on this subject. The results of such studies then can be used, together with detailed bird maps, to determine if civil air traffic and helicopter tours can be allowed and if so where it is allowed. Specific flying regions will have to be implemented to make sure that even if the impact is small, the impact is not affecting the most crucial bird species.

A problem concerning the options for economic development is that, to make sure that a new activity is allowed under the legislation of Article 6 of the HD, an assessment has to be performed to fully determine the impact of that activity to the area. Since that was not possible in this study, the information about the options for economic development is just a reconnaissance of which changes possibly could be made to adjust and improve the recreation in the Wadden Sea. Therefore that section of this study can't be seen as an actual analysis and has to be handled with a lot of uncertainties.

Chapter 7 Conclusions

Even though there are many uncertainties, multiple conclusions can be drawn in regard to the options of intensification of tourism and recreation as economic activities in the Dutch Wadden Sea. The rack and space in the Natura 2000 legislation provides options for recreational improvement and the economic development (Article 2, paragraph 3). Also the already made plans for the Wadden Sea do not oppose options for adjusting the recreation intensity of existing forms of recreation nor for the implementation of new forms of recreation.

For coastal recreation, the intensity of hiking, biking may increase. The intensity of swimming, sunbathing and surfing should be reduced in important areas for waders. Multiple additions can be made for coastal recreation, namely horseback riding, skating, bird watching with addition of information panels and pedaling.

No changes can be made on motorized water sports or sailing/boating without compromising the environment and the different birds and marine mammals in the Wadden Sea. Improvements can be made on canoeing. Especially on canoeing a lot of development can be gained without negative impacts on the environment. Skimboarding can be a good substitution for kite surfing in areas where kite surfing cannot be permitted. Additional forms of recreation in mid sea regions are seal spotting and sightseeing tours.

Options for recreation that takes place in all areas, mudflat walking, sport fishing and civil air traffic, are also not excluded. Both mudflat walking and sport fishing might be able to be increased. Civil air traffic might take place if this activity stays limited and well zoned.

Besides the options for implementation and alteration of different recreation types, a few conclusions can be drawn regarding to knowledge gaps, namely: More information has to be gained about the impacts of civil air traffic; Detailed maps have to be made of the living areas of the different bird species of the Wadden Sea; More information has to be gathered on cumulative impacts of recreation and recreation has to be investigated specifically in the Wadden Sea area.

For every type of recreation, a nature assessment should be done before adjustments can be made to the recreation in the Wadden Sea.

Literature

- Balkenende 2009. Dutch position paper on Natura 2000. *Letter to José Manuel Barroso*.
- Barroso 2009. European Commission response to the Dutch position paper on Natura 2000. *Reply on the letter from Jan Peter Balkenende*.
- Bleker, H., 2011. Letter to the Dutch House of Commons. *Aanpak Natura2000*.
September 2011, Ref: 230499
- Brumm, H., 2004. The impact of environmental noise on song amplitude in a territorial bird. *Journal of Animal Ecology*, 73, p. 434-440.
- Cardoni, D.A., Favero, M. and Isacch, J.P., 2008. Recreational activities affecting the habitat use by birds in Pampa's wetlands, Argentina: Implications for waterbird conservation. *Biological conservation*, 141, p. 797-806.
- CBS, 2010. Minder broeikasgassen door economische crisis. <http://www.cbs.nl/nl-NL/menu/themas/natuur-milieu/publicaties/artikelen/archief/2010/2010-3199-wm.htm>
(last visited on 10-2-2012)
- Chavez, D.J., Winter, P.L. and Baas, J.M., 1993. Recreational mountain biking: a management perspective. *Journal of Park and Recreation Administration*, 11-3, p. 29-36.
- Cole, D.N., 1993. Minimizing conflict between recreation and nature conservation. *Ecology of greenways: Design and function of linear conservation areas*, Univ. of Minnesota Press, Minneapolis, MN, US, p. 105-122.
- Cole, D.N., 2004. Impacts of hiking and camping on soils and vegetation: a review. *Environmental impacts of ecotourism*, chapter 4. CABI Publishing, Wallingford, Oxfordshire, UK.
- Davenport, J. and Davenport, J.L., 2006. The impact of tourism and personal leisure transport on coastal environments: *A review*. *Estuarine, Coastal and Shelf Science*, 67, p. 280-292.
- EC, 1992. Habitats Directive 92/43/EC
- EC, 2010. Directive 2009/147/EC
- Ecomare, 2012a. De geschiedenis van natuurbescherming. <http://www.ecomare.nl/nl/ecomare-encyclopedie/mens-en-milieu/natuurbeheer/geschiedenis-natuurbescherming/>
(last visited on 17-03-2012)
- Ecomare, 2012b. Recreatie aan zee. <http://www.ecomare.nl/ecomare-encyclopedie/mens-en-milieu/recreatie-en-toerisme/recreatie-kust-wadden/> (last visited on 29-2-2012)
- Edwards, J.R., 1987. The UK heritage coasts: An assessment of the ecological impacts of tourism. *Annals of tourism research*, 14, p. 71-87

European Commission Environment, 2012. EU nature legislation:

<http://ec.europa.eu/environment/nature/legislation/> (last visited on 25-2-2012)

European Communities, 2000. Managing Natura 2000 Sites. *The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC.*

Henkens, R.J.H.G., de Molenaar, J.G., Reijnen, M.J.S.M. and Kistenkas, F.H., 2007. Champ Car evenement TT-circuit Assen. *Voortoets betreffende de effecten van extra geluidsbelasting op de natuurwaarden van het Witterveld.* Wageningen, Alterra, Alterra-rapport 1482.

Kuik, O., Brander, L. and Schaafsma, M., 2006. Globale batenraming van Natura 2000 gebieden. Instituut voor Milieuvraagstukken.

Li, W., Ge, X. and Liu, C., 2004. Hiking trails and tourism impact assessment in protected area: Jiuzhaigou biosphere reserve, China. *Environmental Monitoring and Assessment*, 108, p. 279-293.

Liddle, M.J., 1997. *Recreation ecology: the ecological impact of outdoor recreation and ecotourism.* Chapman and Hall, London, UK

Minister van LNV, 2008. Natura 2000-gebied Waddenzee.

Ministerie van Economische Zaken, Landbouw en Innovatie (Min. ELI), 2010.

Programma 'Naar een rijke Waddenzee' 14 januari 2010. *Vastgesteld door de Stuurgroep d.d. 22 januari, na instemming RCW d.d. 14 januari.*

Ministerie van Economische Zaken, Landbouw en Innovatie (Min. ELI), 2012a.

Gebiedendatabase: Natura 2000 "Waddenzee". (last visited on 14-2-2012)

<http://www.synbiosys.alterra.nl/natura2000/gebiedendatabase.aspx?subj=n2k&groep=1&id=n2k1>

Ministerie van Economische Zaken, Landbouw en Innovatie (Min. ELI), 2012b.

Gebiedendatabase: Waddenzee - doelstelling en staat van instandhouding van soorten en habitattypen. (last visited 23-2-2012).

<http://www.synbiosys.alterra.nl/natura2000/gebiedendatabase.aspx?subj=n2k&groep=1&id=n2k1&topic=doelstelling>

Ministerie van Economische Zaken, Landbouw en Innovatie (Min. ELI), 2012c.

Gebiedendatabase: Bescherm natuurmonument 'Waddenzee I'. (last visited 27-2-2012)

<http://www.synbiosys.alterra.nl/natura2000/gebiedendatabase.aspx?subj=gebnbwet&groep=1&id=SN170>

Ministerie van Economische Zaken, Landbouw en Innovatie (Min. ELI), 2012d. Waddenzee:

<http://www.rijksoverheid.nl/onderwerpen/natuur/waddenzee> (last visited on 27-2-2012)

- Ministerie van Verkeer en Waterstaat, 2002. De betekenis van water voor recreatie en toerisme in Nederland.
- Mongabay, 2009.: http://news.mongabay.com/2009/0127-economy_deforestation.html
(last visited 31-1-2012)
- Natuurbeschermingswet (Nature protectionlaw), 1998.
http://wetten.overheid.nl/BWBR0009641/geldigheidsdatum_18-03-2012
(last visited on 18-3-2012)
- Pickering, C.M., Rossi, S. and Barros, A., 2011. Assessing the impacts of mountain biking and hiking on subalpine grasslands in Australia using an experimental protocol. *Journal of Environmental Management*, 92, p. 3049-3057.
- Pouwels, R. and Vos, C.C., 2001. Recreatie en biodiversiteit in balans: een ruimtelijke benadering van functiecombinaties. Wageningen, Alterra, research instituut voor de groene ruimte. Alterra-rapport 227.
- Priskin, J., 2003. Tourist perceptions of degradation caused by coastal nature-based recreation. *Environmental Management*, 32-2, p. 189-204.
- Preen, T., 2000. Dugongs, boats, dolphins and turtles in the Townsville-Cardwell region and recommendations for a boat traffic management plan for the Hinchinbrook Dugong Protection Area.
http://www.gbrmpa.gov.au/__data/assets/pdf_file/0006/5568/gbrmpa_RP67_Dugongs_Boats,_Dolphins_And_Turtles_2000.pdf (last visited on 18-2-2012)
- Ramsar, 2012a. About the Ramsar convention: <http://www.ramsar.org> (last visited on 9-2-2012)
- Ramsar, 2012b. What are the criteria for identifying wetlands of international importance?
http://www.ramsar.org/cda/en/ramsar-about-faqs-what-are-criteria/main/ramsar/1-36-37%5E7726_4000_0__ (last visited on 26-2-2012)
- Regionaal College Waddenzee (RCW), 2008. Léven in de Wadden. *Beheer- en ontwikkelingsplan Waddengebied. Deel A*.
- Rijkswaterstaat, 2012. Aanwijzen van een aantal locaties op de Waddenzee waar kitesurfen is toegestaan.
- Rodgers jr, J.A. and Smith, H.T., 1995. Set-back distances to protect nesting bird colonies from human disturbance in Florida. *Conservation Biology*, 9, p.89-99.
- Smith, R., 2004. The effect of kite surfing on wader roosts at West Kirby, Dee Estuary.
<http://www.deeestuary.co.uk/decgks.htm> (last visited on 18-2-2012).
- Stuurgroep Waddenprovincies, 2011. Monitoring Watersport op de Waddenzee. Resultaten 1998-2000

- Törn, A., Tolvanen, A., Norokorpi, Y., Tervo, R. and Siikamäki, P., 2009. Comparing the impacts of hiking, skiing and horse riding on trail and vegetation in different types of forest. *Journal of Environmental Management*, 90, p. 1427-1434.
- Trilateral Wadden Sea Plan (2010)
- UNESCO World Heritage, 2011. Operational Guidelines for the Implementation of the World Heritage Convention. World Heritage Centre, November 2011
- UNESCO World Heritage, 2012a. The Wadden Sea: <http://whc.unesco.org/en/list/1314>
(last visited on 26-2-2012)
- UNESCO World Heritage, 2012b. Criteria for Selection: <http://whc.unesco.org/en/criteria/>
(last visited on 26-2-2012)
- UNESCO World Heritage, 2012c. The World Heritage convention:
<http://whc.unesco.org/en/convention> (last visited on 26-2-2012)
- VROM (2007a). Ontwikkeling van de Wadden voor natuur en mens: *Deel 4 van de planologische kernbeslissing Derde Nota Waddenzee, tekst na parlementaire instemming.*
- VROM (2007b). Nota van Toelichting: *Bij deel4 van de planologische kernbeslissing Derde Nota Waddenzee*
- Waddenacademie, 2011. Jacht. http://www.waddenacademie.nl/fileadmin/inhoud/pdf/06-wadweten/WisWad/Archieven_28-06-2011/Economie_Jacht.pdf (last visited on 3-3-2012)
- Waddensea worldheritage, 2012. Explore the Wadden Sea World Heritage.
<http://www.waddensea-worldheritage.org/cwssmap/popup.html?wms=wmsb3>
(last visited 23-2-2012)
- Waddenvereniging, 2012. Het Waddengebied: <http://www.waddenvereniging.nl/>
- Waddenzee.nl, 2012a. Recreatie en toerisme.
http://www.waddenzee.nl/Recreatie_en_toerisme.464.0.html (last visited on 18-2-2012)
- Waddenzee.nl, 2012b. Wadlopen. <http://www.waddenzee.nl/Wadlopen.1431.0.html>
(last visited on 14-2-2012)
- Waddenzee.nl, 2012c. Regelgeving: Wadloopverordening.
<http://www.waddenzee.nl/Regelgeving.2182.0.html> (last visited on 14-2-2012)
- Waddenzee.nl, 2012d. Kitesurfen. <http://www.waddenzee.nl/Kitesurfen.1986.0.html>
(last visited on 15-2-2012)
- Waddenzee.nl, 2012e. Wetten voor de Waddenzee.
http://www.waddenzee.nl/Wetten_voor_de_Waddenzee.467.0.html
(last visited on 27-2-2012)

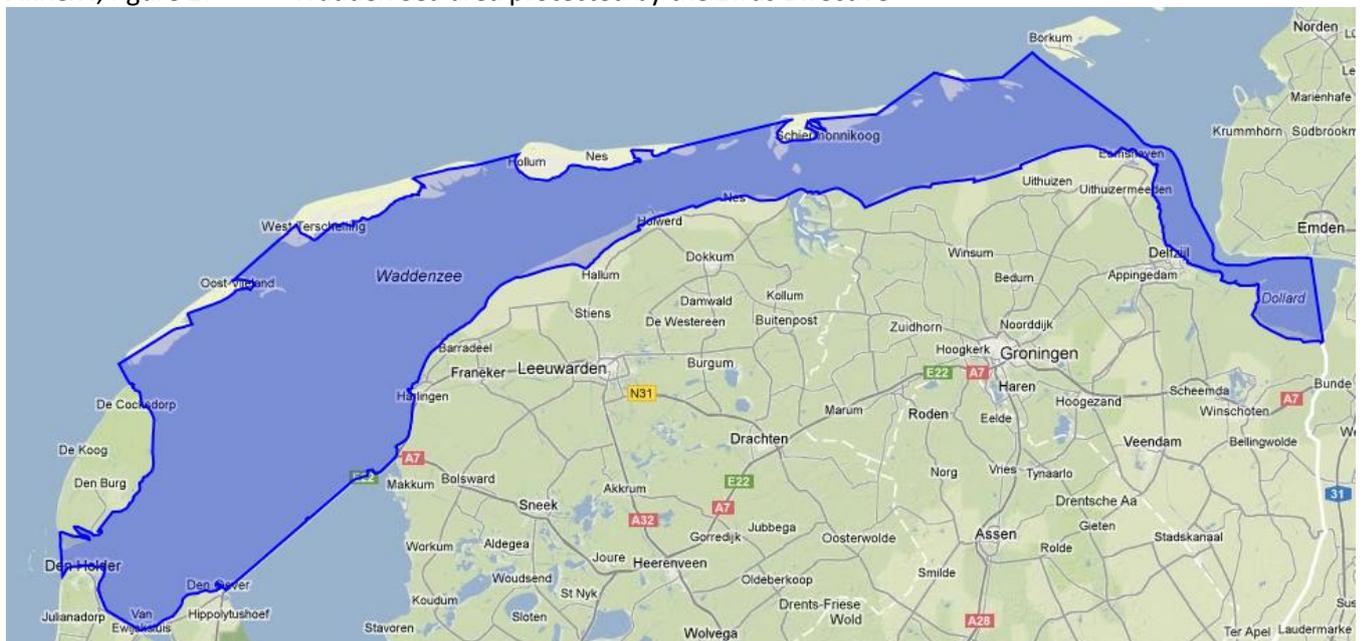
Annex I Protected Areas of the Wadden Sea

Annex I, figure 1: Wadden Sea area protected by the Habitats Directive



The protected area is highlighted in green (Min van ELI, 2012a).

Annex I, figure 2: Wadden Sea area protected by the Birds Directive



The protected area is highlighted in blue (Min van ELI, 2012a).

Annex I, figure3: Wadden Sea area protected by UNESCO World Heritage



The protected area is highlighted in green. The highlighted part in the upper right is the beginning of the German part of the Wadden Sea that is protected by UNESCO (waddensea worldheritage, 2012).

Annex I, figure 4: Wadden Sea area protected by Ramsar Convention on Wetlands



The protected area is highlighted in orange. The highlighted part in the upper right is the beginning of the German part of the Wadden Sea that is protected by Ramsar (waddensea worldheritage, 2012).

Annex I, figure 5: Wadden Sea area protected by the Natuurbeschermingswet



The protected area is highlighted in orange (Min van ELI, 2012a).

Annex II Overview of bird species protected by the Birds Directive

Annex II, table 1: Overview of protected bird species determined by the Birds Directive (Minister van LNV, 2008) Conservation status according to Min. van ELI (2012b).

Code	Bird species	Improvement	Population (pairs)	Conservation status
A034	Eurasian spoonbill (<i>Platalea leucorodia</i>)	No	430	Favorable
A037	Tundra swan (<i>Cygnus columbianus</i>)	No	1600	Unfavorable (inadequate)
A045	Barnacle goose (<i>Branta leucopsis</i>)	No	36.800	Favorable
A081	Western marsh harrier (<i>Circus aeruginosus</i>)	No	30	Favorable
A082	Northern harrier (<i>Circus cyaneus</i>)	No	3	Unfavorable (bad)
A103	Peregrine falcon (<i>Falco peregrinus</i>)	No	40	Favorable
A132	Pied avocet (<i>Recurvirostra avosetta</i>)	No	3800	Unfavorable (inadequate)
A138	Kentish plover (<i>Charadrius alexandrinus</i>)	Yes	50	Unfavorable (bad)
A140	European golden plover (<i>Pluvialis apricaria</i>)	No	19.200	Unfavorable (bad)
A157	Bar-tailed godwit (<i>Limosa lapponica</i>)	No	54.400	Favorable
A191	Sandwich tern (<i>Sterna sandvicensis</i>)	No	16.000	Unfavorable (bad)
A193	Common tern (<i>Sterna hirundo</i>)	No	5300	Unfavorable (inadequate)
A194	Arctic tern (<i>Sterna paradisaea</i>)	No	1500	Favorable
A195	Little tern (<i>Sterna albifrons</i>)	Yes	200	Unfavorable (bad)
A197	Black tern (<i>Chlidonias niger</i>)	No	23.000	Unfavorable (bad)
A222	Short-eared owl (<i>Asio flammeus</i>)	No	5	Unfavorable (bad)

Annex II, table 2: Overview of the protected migratory bird species determined by the Birds Directive (Minister van LNV, 2008). Conservation status according to Min. van ELI (2012b).

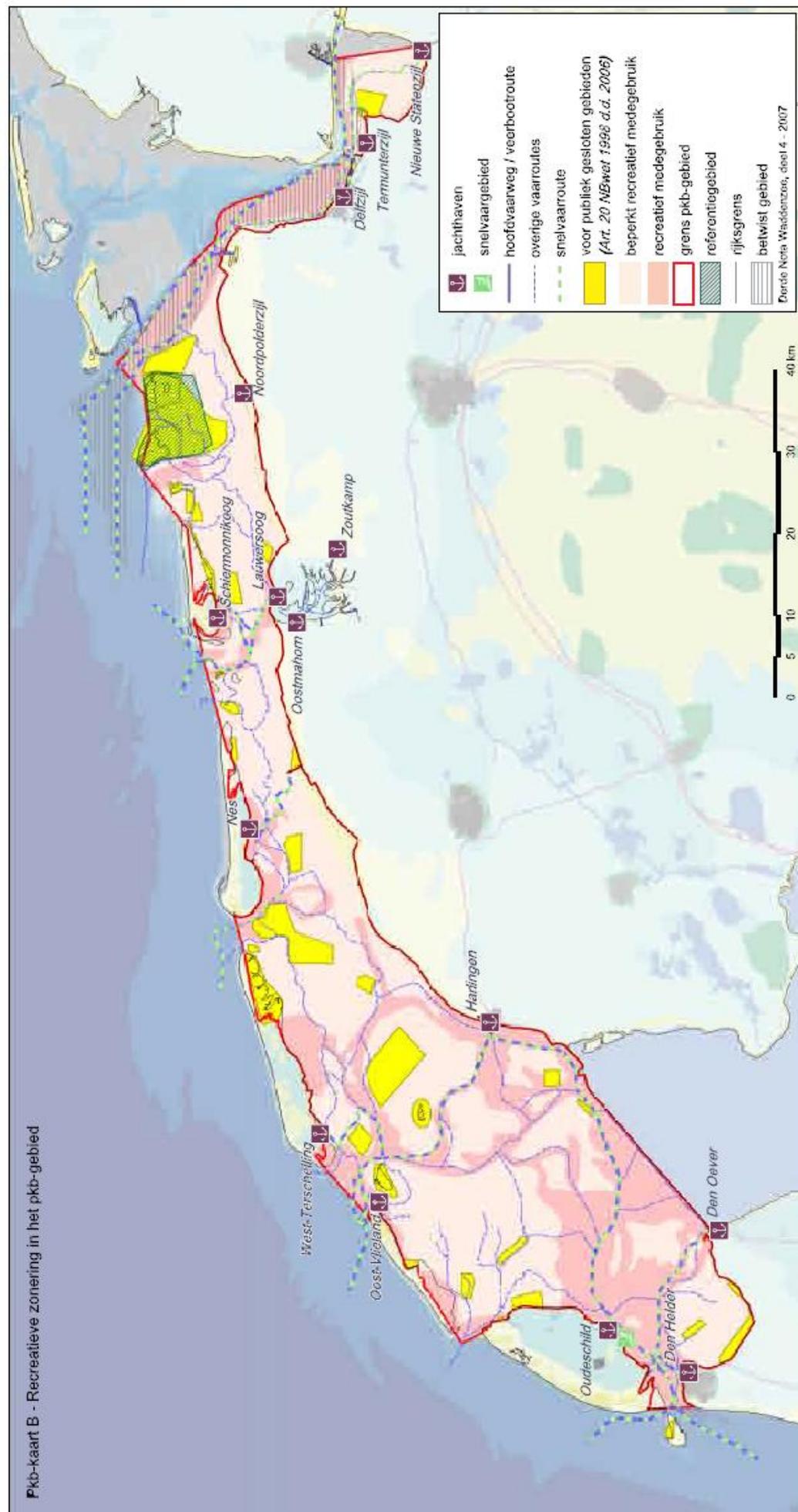
Code	Bird Species	Improvement	Population (pairs)	Conservation status
A005	Great crested grebe (<i>Podiceps cristatus</i>)	No	310	Unfavorable (inadequate)
A017	Great cormorant (<i>Phalacrocorax carbo</i>)	No	4200	Favorable
A039	Tundra bean goose (<i>Anser fabalis ssp. rossicus</i>)	No	None	Favorable
A043	Greylag goose (<i>Anser anser</i>)	No	7000	Favorable
A046	Brant goose (<i>Branta bernicla</i>)	No	26.400	Unfavorable (inadequate)
A048	Common shelduck (<i>Tadorna tadorna</i>)	No	38.400	Favorable
A050	Eurasian wigeon (<i>Anas penelope</i>)	No	33.100	Favorable

Annex II, table 2 continued.

Code	Bird Species	Improvement	Population (pairs)	Conservation status
A051	Gadwall (<i>Anas strepera</i>)	No	320	Favorable
A052	Eurasian teal (<i>Anas crecca</i>)	No	5000	Unfavorable (inadequate)
A053	Mallard (<i>Anas platyrhynchos</i>)	No	25.400	Favorable
A054	Northern pintail (<i>Anas acuta</i>)	No	5900	Unfavorable (inadequate)
A056	Northern shoveler (<i>Anas clypeata</i>)	No	750	Favorable
A062	Greater scaup (<i>Aythya marila</i>)	Yes	3100	Unfavorable (bad)
A063	Common eider (<i>Somateria mollissima</i>) (breeding)	Yes	5000	Unfavorable (bad)
	Common eider (non-breeding)		90.000-115.000	Unfavorable (bad)
A067	Common goldeneye (<i>Bucephala clangula</i>)	No	100	Favorable
A069	Red-breasted merganser (<i>Mergus serrator</i>)	No	150	Favorable
A070	Common merganser (<i>Mergus merganser</i>)	No	70	Unfavorable (bad)
A130	Eurasian Oystercatcher (<i>Haematopus ostralegus</i>)	Yes	140.000-160.000	Unfavorable (bad)
A137	Common ringed plover (<i>Charadrius hiaticula</i>)	No	60	Unfavorable (inadequate)
A141	Grey plover (<i>Pluvialis squatarola</i>)	No	22.300	Favorable
A142	Northern lapwing (<i>Vanellus vanellus</i>)	No	10.800	Unfavorable (inadequate)
A143	Red knot (<i>Calidris canutus</i>)	Yes	44.400	Unfavorable (inadequate)
A144	Sanderling (<i>Calidris alba</i>)	No	3700	Unfavorable (inadequate)
A147	Curlew sandpiper (<i>Calidris ferruginea</i>)	No	2000	Favorable
A149	Dunlin (<i>Calidris alpina</i>)	No	206.000	Favorable
A156	Black-tailed godwit (<i>Limosa limosa</i>)	No	1100	Unfavorable (bad)
A160	Eurasian curlew (<i>Numenius arquata</i>)	No	96.200	Favorable
A161	Spotted redshank (<i>Tringa erythropus</i>)	No	1200	Favorable
A162	Common redshank (<i>Tringa totanus</i>)	No	16.500	Unfavorable (inadequate)
A164	Common greenshank (<i>Tringa nebularia</i>)	No	1900	Favorable
A169	Ruddy turnstone (<i>Arenaria interpres</i>)	Yes	2300-3000	Unfavorable (bad)
A183	Lesser black-backed gull (<i>Larus fuscus</i>)	No	19.000	Favorable

Annex III: Recreational zones in the Wadden sea

Map derived from VROM (2007a). A complete view of the area is given. Also indicated are the yacht harbors (purple blocks) and the areas that are closed of for visitors (yellow areas). The Oudeschild area is the only remaining spot for fast cruising.



Annex IV: Kite surfing areas

Derived from Waddenzee (2012d).

